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ABSTRACTS

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GEOLOGICAL HERITAGE : OUR ENVIRONMENT AND THE ROLE OF UNESCO

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The 1992 "United Nations Conference on Environment and Development" (UNCED), the so-called Earth Summit in Rio de Janeiro, called for the integration of enhanced socio-economic development with conserving a healthy environment. Development must become sustainable to ensure that it meets the needs of the present generation without jeopardizing the ability of future generations to meet their own. Agenda 21 provides the international programme of action for taking this new course of sustainable development. It requires a change in national policies and a redefinition of priorities in international co-operation, including the implementation of recent international conventions, like the "Convention on Biological Diversity" or the UN "Convention to Combat Desertification and Drought", and collaborative activities connected with "Global Observing Systems" or in the area of natural hazards reduction in support of the International Decade for Natural Disaster Reduction (IDNDR).

The first prerequisite of sustainable development is education for all, followed by the advancement, sharing and application of scientific knowledge. Only an informed public and a trained workforce can introduce the new sustainable production and consumption patterns required.

Environment and development issues are by definition complex and multidisciplinary and require responses built on similar lines. UNESCO's unique broad mandate and expertise in the sciences, education, culture and communication, enable the Organization to respond to the requirements of sustainable development, to enhance interdisciplinary scientific work and to increase cooperation between all areas of its competence. One should like to recall that UNESCO has been focussing on environment and development issues for the past 50 years.

Milestones include the launching of the Arid Zone Programme in 1951, the creation of the "Intergovernmental Oceanographic Commission" (IOC) in 1960 and the International Hydrological Decade in 1965, succeeded by the

"International Hydrological Programme" (IHP), the creation of the "Man and Biosphere" (MAB) Programme and of the "International Geological Correlation Programme" (IGCP) one year later. Especially over the past 25 years, UNESCO has made a substantial contribution to improved understanding of climate change through a diverse set of programmes within these scientific undertakings.

Since the Earth Summit, UNESCO has reoriented its programmes and priorities further to address and promote sustainable development and, therefore, contributed to the needs of society

The winds of change have also reached the earth sciences, at UNESCO and elsewhere. The traditional roles and "cultures" of geology have been obliged to change in order to accomodate new demands for services and products directed at current societal needs. The challenges of geoscientific sciences have tended to evolve from small units concerned with geological mapping and documentation of mineral resources, to complex programmes in order to provide fundamental geoscience information for the public and for political decision-makers. Areas of concern include sustainable resource development, natural hazards monitoring and prediction (if and whenever possible!), environmental assessment and protection, and public safety and security In other words, the basic mission of any modern geosciences is to ensure the availability of the geoscience information and expertise that are required for the wise use of the earth's mineral, energy and water resources, for the health and safety of people, and for the protection of our environment (R. Price, 1992).

This is, more or less, identical with the objectives of UNESCO's Division of Earth Sciences. Parts of UNESCO's Science Programme is called "Environmental Sciences in the Service of Society", and that includes also the Earth Sciences Subprogramme which is targeting at Earth System Management and Natural Hazards.

The latter consists out of 4 main objectives:

(1) International and regional co-operation in fundamental and applied aspects of geosciences and their role in protecting and developing (in a sustainable manner) our cultural and natural heritage.

The main line of actions include the implementation of individual projects, regional or global in scope, the framework of the International Geological

Correlation Programme (IGCP), which is run jointly with IUGS, the Improvement of the endogenous scientific capacity of Member States, including the participation of developing countries in the International Continental Drilling Programme (ICDP), contributions to the World Heritage Convention and the promotion of a global programme of "Geoparks" due to their unique geological features.

(2) **Capacity building in earth sciences through training and education, exchange of scientists and preparation of geological maps for selected purposes.**

This includes the enhancement of existing capacity in geological aspects of the environment through the support to universities and research centres, UNESCO chairs, fellowship-grants, and production of geological maps.

(3) **Improvement of the management of paleo-and-modern geodata, stimulation of the use of modern technologies to enhance socio-economic and environmentally sustainable development.**

This is being done by the promotion of geodata handling in developing countries through GIS and Remote Sensing methodologies for sustainable resource development and environmental protection (secure waste disposal) as well as the strengthening of geoinformation networking activities in Africa and Asia.

(4) **Reducing the vulnerability to natural hazards in cities, other fragile environments, like coastal zones, in disaster prone Member States by interdisciplinary and cross-sectoral activities within the framework of the IDNDR.**

This include activities devoted to the strengthening of national, regional and global networks for natural disaster prevention programmes by launching natural hazard-related mitigation projects in the Arab and Mediterranean region and in selected countries of Asia and Latin America.

The specific activity, promoting the conservation and development of geological heritage through world wide recognized "UNESCO Geoparks", contributes also to the objectives of Agenda 21, the Agenda of Science for Environment and Development into the 21st Century, and constitutes an addition to the 1972 Convention for the Protection of the World Cultural and Natural Heritage.

UNESCO Geoparks are established to promote the integration of enhanced socio-economic development with conserving a healthy environment. They are a tool for a better understanding of the geological heritage and "wise use" of the Earth's crust by increasing the public awareness for the need of a balanced relationship between humandkind and the Earth. UNESCO Geoparks should be sites and areas of special geological significance where the heritage of the Earth is safeguarded and sustainably managed at the same time.

We are all conscious of the need to preserve the Earth's heritage for present and future generations. An heritage which must become globally recognized, preserved and developed for the sake of tradition, science, education, socio-economic sustainable development and, last but not least, for its beauty

MIOCENE TO PRESENT-DAY TECTONICS OF THE VIENNA BASIN TRANSFORM FAULT: LINKS BETWEEN THE ALPS AND THE CARPATHIANS

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Introduction

Extending from the central Eastern Alps through the Mur-Mürz-valley, the Vienna Basin and Moravia into the outer Carpathians of Polish Galicia, the 450 km long Vienna Basin transform system is one of the most conspicuous crustal structures between the Eastern Alps and the Carpathians. The fault developed during Miocene east-directed movement of Alpine crustal blocks into the Carpathian-Pannonian region (Fig. 1) which is referred to as eastward lateral extrusion (Ratschbacher et al., 1991; Decker and Peresson, 1996; Linzer et al., 1997). During lateral extrusion, parts of the central Eastern Alps moved eastwards between pairs of (E)NE-striking sinistral and (E)SE-striking dextral faults. Such pairs of faults are the sinistral Salzach-Ennstal-Mariazell-Puchberg fault and the dextral Periadriatic fault which were active during the Oligocene and the Early Miocene, and the sinistral Vienna Basin transform system and the dextral Lavanttal fault which moved mainly from the Early to the Late Miocene.

Earthquakes of low to moderate intensities along both the Vienna Basin transform and the Lavanttal fault show that kinematics of these faults is comparable to that of the Middle Miocene. It is evident that even moderate seismicity along the Vienna Basin transform which passes through densely populated and partially highly industrialized areas hosting numerous high-risk facilities causes high social and economical risks due to potential earthquakes. We therefore try to assess recent kinematics of the Vienna Basin fault system by drawing analogies to its Miocene history and by integrating microtectonic, geomorphological, seismological and 3D-seismic data provided by OMV. We show that this integrated approach provides information about the geometry and orientation of active faults, about the possible depth range of earthquake hypocenters, and about the average slip rate of the Vienna Basin fault through the Quaternary.

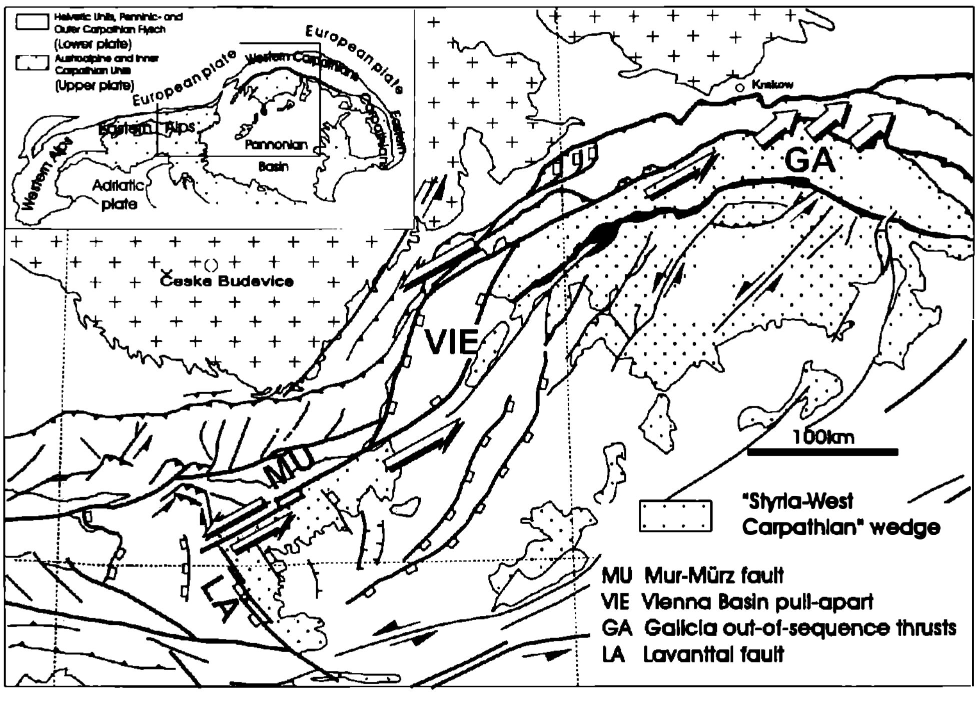

Fig. 1. Tectonic sketch map of the Vienna Basin transform fault extending over 450 km from the Mur-Mürz valley in the Eastern Alps to the Vienna pull-apart basin and to the Outer Carpathians of Moravia and Galicia.

Miocene tectonics

Sinistral movement along the Vienna Basin transform system started during the late Early Miocene (Ottnangian/Karpatian, c. 18-17 Ma) as indicated by initial subsidence of a series of small sedimentary basins along the Mur-Mürz-fault and by incipient pull-apart subsidence of the Vienna Basin. NE of the Vienna Basin, the sinistral fault crosses the flysch nappes of the outer Western Carpathians where NE-striking thrusts were reactivated as sinistral wrench faults. These faults link up with NE-directed out-of-sequence thrusts in Galicia. Together with the dextral Lavanttal fault, the Vienna Basin transform system deliminates a crustal wedge which moves towards NE and which is characterized by trailing-edge extension leading to subsidence of the Styrian Basin and to the tectonic exhumation of the Rechnitz metamorphic core, and by thin-skinned thrusting on its leading edge. Due to the kinematical linkage of strike-slip faults to thin-skinned thrusts we argue that deformation along the transform in the Vienna Basin and the continuation to the NE was restricted to the upper crust above the Alpine-Carpathian floor thrust. Miocene offset along the fault system in the Mur-Mürz-Vienna Basin area has been estimated with about 40±5 km. Since sinistral wrenching along the Vienna Basin transform continued up to the Late Miocene (c. 9-8 Ma; Peresson and Decker, 1997), this is equal to an average Miocene slip rate between 3.9 and 5.5 mm/year.

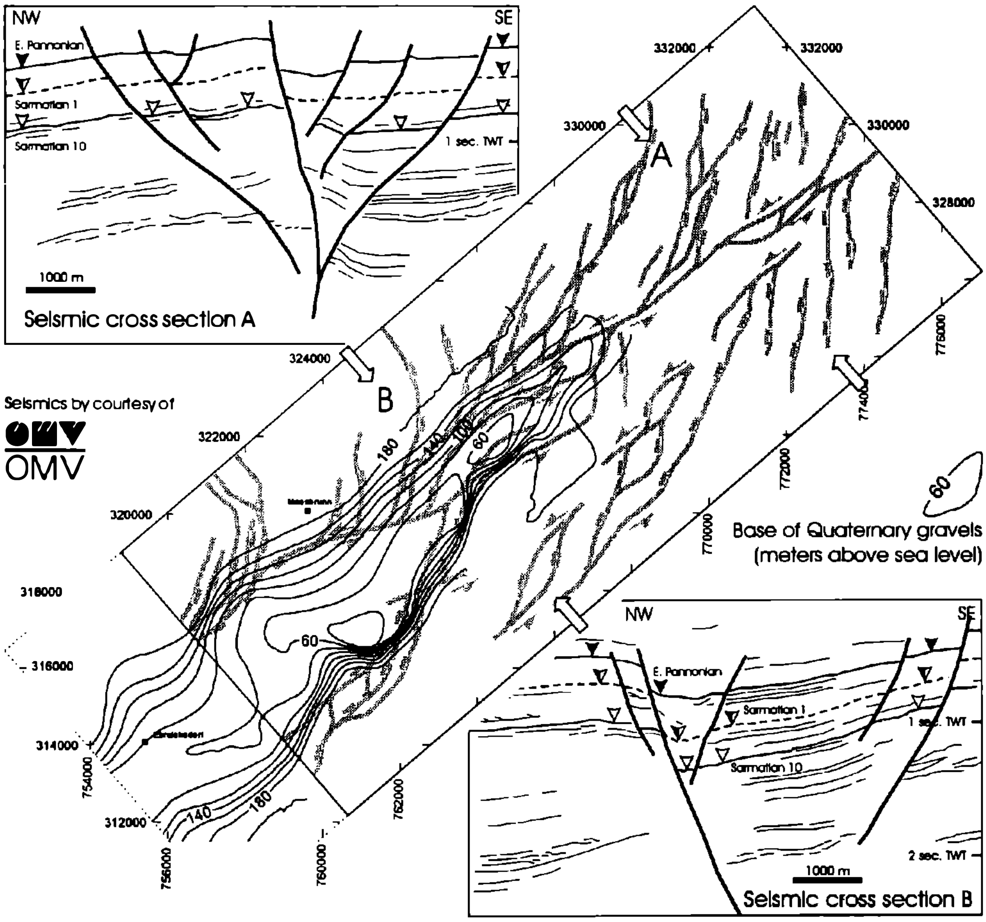

Fig. 2. Seismic cross sections and faults mapped from seismic data (OMV Moosbrunn 3D-seismic cube, southern Vienna Basin). Note the rhomb-shaped duplexes depicted by the offset of a mapped Sarmatian horizon and the negative flower structures shown in cross sections. The recent activation of the Miocene faults is indicated by thick Quaternary gravels incorporated in the flower structure.

In the Vienna Basin area, faults depict NNE-oriented extensional duplexes which are delimited by NE-striking sinistral faults and by N(NE)-striking normal faults. The latter are arranged in left-stepping en-echelon patterns. This surface fault architecture perfectly matches rhomb-shaped fault polygons mapped on Sarmatian and Pannonian horizons in 3D-seismic cubes in the Vienna Basin. In seismic cross sections, the N(NE)-striking normal faults define negative flower structures and merge into a subvertical principle displacement zone at depth (Fig. 2). Duplexing associated with substantial horizontal extension and normal faulting on NNE-striking faults is the main mechanism for the rapid subsidence of the Middle Miocene Vienna pull-apart basin. Growth strata show that normal faulting occurred from the Karpatian to the Pannonian (17-8 Ma). In 9 Ma, rift-type basement subsidence reached up to 5.8 km. Tectonic data, subsidence history and the thermal evolution of the Vienna pull-apart basin which is characterized by low paleo-heatflow throughout its evolution indicate that Miocene deformation was restricted to the uppermost 10-12 km of the crust above the Alpine floor thrust.

Active tectonics

The recent activity of the Vienna Basin fault system is indicated by moderate seismic activity recorded in the Mur-Mürz valley, in the Vienna Basin, the Little Carpathians and the Våh valley (Gutdeutsch and Aric, 1988). The epicenters line up to a NE-striking seismically active zone which extends to the High Tatra Mountains and which seems to terminate in the area of the Quaternary Orawa Basin N of the Tatra. Focal plane solutions and recent stress measurements indicate sinistral strike-slip motion along this fault (Gangl, 1975; Lenhardt, pers. comm.). Hypocenter depths mostly well above 12 km may indicate thin-skinned deformation which is restricted to the overthrust Alpine-Carpathian units. By analogy to the Miocene kinematics we speculate that the sinistral fault terminates in southern Poland where horizontal offset is transferred to thin-skinned thrust-type deformation. This model is generally supported by recent stress measurements from the outer Western Carpathians which indicate vertical stress partitioning and stress reorientation across the Carpathian floor thrust (Jarosinski, in press).

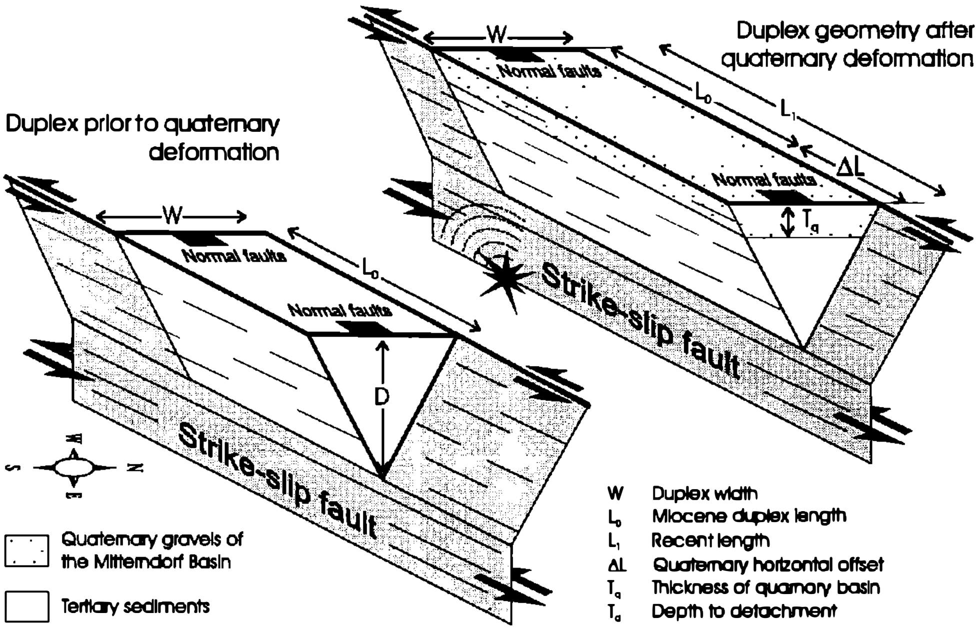

Fig. 3. Schematic drawing illustrating the duplex geometry which was used to quantify Quaternary horizontal displacement along the active faults of the Mitterndorf basin.

The active fault segment in the Austrian part of the Vienna Basin was mapped using analyses of microtectonic field data from Pliocene and Quaternary deposits, earthquake data, 3D-seismic cubes, thickness maps of Quaternary sediments, and geomorphological features like offset Quaternary terraces of the Danube seen in digital elevation data. Mapping of active faults shows patterns with N- and NE-striking faults which closely resemble the Miocene strike-slip duplexes. Sinistral movement along both, N- and NE-striking faults is proved by focal plane solutions from the Vienna Basin and the Mur-Mürz-Semmering region. Some of the faults delimit basins with up to 140 m thick Quaternary sediments. Comparison with seismic data of the 3D-seismic cube Moosbrunn shows that active tectonics use the pre-existing Miocene faults. The principle displacement zone imaged in seismic parallels a linear morphologic scarp of some 40 m height mapped in digital elevation data. The NE-trending scarp is traced over 15 km separating the elevated western block with Pannonian sediments at the surface from the eastern, downthrown block with up to 140 m thick Quaternary deposits. Short, pronounced valleys incise the fault scarp perpendicular to strike suggesting high syntectonic erosion partially compensating the vertical component of displacement. Wetlands and peats overlying thick Quaternary gravels of the downthrown block are interpreted as sag ponds along the fault zone. The distribution of Quaternary depocenters along the fault coincides with the fault patterns in Pannonian and Sarmatian horizons (Fig. 2). The amount of Quaternary sinistral lateral displacement along the fault zone crossing the southern Vienna Basin and the Moosbrunn seismic cube can be estimated by adopting a simple geometrical model which is able to quantify subsidence in divergent strike-slip duplexes. Fig. 3 shows that subsidence is achieved by lengthening the structure. By assuming constant volume of Miocene sediments inside the duplex prior to and after Quaternary deformation, it is possible to compute the lengthening of the duplex necessary for the observed subsidence (ΔL) which equals the Quaternary horizontal offset. Geometrical parameters appropriate for the Quaternary Mitterndorf Basin measured from seismic data and from Quaternary thickness maps indicate 1.5 to 2 km sinistral slip along the duplex during the Quaternary, corresponding to slip rates of 0.8 to 1.5 mm/year. These numbers are significantly higher than the slip rate of the Mur-Mürz fault which was estimated with 0.3 mm/year by seismic moment tensor summation (Aric, 1981).

Conclusions

We speculate that some aspects of Miocene tectonics along the Vienna Basin transform fault can serve as models for active tectonics in the Alpine-Carpathian transition area. Active faults seem to follow Miocene structures as shown by examples from the Vienna Basin. Other similarities between Miocene and recent tectonics are the thin-skinned nature of deformation and, eventually, the kinematical linkage of transform faulting and thrust-type shortening in the Carpathians of Galicia. Quaternary displacement along the transform fault in the southern Vienna Basin has been estimated with 1.5-2 km corresponding to a slip rate which seems to be significantly higher than the rate of seismic slip which was estimated from the energy released by earthquakes along the Mur-Mürz fault during this century.

Acknowledgements. Research in the Vienna Basin has been financed by the Austrian Academy of Sciences, OMV and by the Austrian Science Foundation (FWF). We acknowledge the allowance to use data by OMV, the Austrian Geophysical Survey (ZAMG) and Wolfgang Lenhardt.

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ORIGIN AND EVOLUTION OF THE FLUIDS FROM THE EASTERN CARPATHIANS

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In the Eastern Carpathians Chain (ECC) the youngest calk-alkaline (Calimani-Gurghiu-Harghita Mts.) and alkaline (Persani Mts.) volcanic activity of the whole Carpatho-Pannonian Region took place in the Neogene. This volcanism provoked an intense hydrothermal activity which partially is represented by the presence of a large number of mineral waters often associated with a gas phase, emerging mainly along the volcanic-flysch borders and along the tectonic limits of the overlapping units. Seventy-two samples from springs, wells and streams with 22 associated gas phase have been collected in an area of about 9,000 km^2 The sampling area includes the Easternmost part of the Transylvanian Basin (ETB) the Southernmost segment of the Neogene Calimani-Gurghiu-Harghita (CGH) andesitic volcanic chain, a large extension of the Carpathian Flysch Units (CFU) and the internal part of the Carpathian Foreland (CF), the latter including the highly seismic area of Vrancea.

Major, minor and trace elements analyses on water and gas samples have been carried out. In addition $\delta^{18}O$ in all waters and δD in the most representative samples have been determined, whereas $\delta^{13}C$ in CO_2 and in CH_4 and $^3He/^4He$ in selected gases has been measured.

Distinct chemical features of the ECC fluids have been recognized according to their physiographic units where they emerge: Ca-Mg-CO_3 compositions for most of the waters of the CGH and CFU related to supergenic environment with $\delta^{18}O$ values varying from -12 to -9‰ and δD from -89 to -73‰ (SMOW) according to the altitude of the ECC, indicating a meteoric feeding system; Na-Cl waters in the ETB, in the CF and in a deep faulted area of the CFU (Slanic). These waters are characterized by a very high TDS>10,000ppm (up to 307,000ppm) as a result of the interaction with Miocene saline domes as well as mixing processes with high saline waters of Na-Cl signature with $\delta^{18}O$ and δD varying from -6 to -2‰ and from -67 to -36‰ respectively, trending towards Corund sample end member ($\delta^{18}O$=+7‰, δD=-25); Na-HCO_3 waters with TDS>5,000ppm for a restricted area South the CGH in the CFU (Covasna), related to the Na-Ca ionic-exchange due to both CO_2 interaction and mixing between ground waters and high saline (fossil) waters of Na-HCO_3 signature ($-6<\delta^{18}O<-3$, $-70<\delta D<-49$) which may represent a fossil thermal system.

Gas emissions are characterized by a CO_2-rich composition (up to 99% in vol.) with a remarkable content of CH_4 of thermogenic origin ($\delta^{13}C$ in CH_4 ranging from -35 to -21‰) increasing from the Harghita Mts. to the CF where the gas composition becomes CH_4-rich (up to 98% in vol.). A variable content of N_2, exceeding the possible air contamination, has been detected in many gases suggesting a derivation from thermogenic processes of organic matter-rich sediments. $\delta^{13}C$ values in CO_2 (-4÷-2‰ PDB) are similar to the average value of -5±2.5‰ found in the central Carpathian Basin suggesting a mantle origin. This conclusion is in agreement with $^3He/^4He$ values expressed as R/R_A [R= measured value and R_A= air value ($1.39*10^{-6}$)] that show a strong mantle signature up to 50% if we consider a mantle R/R_A value of 8. The highest R/R_A value (=4.61) has been measured in the Ciumadul volcano, where the last eruptive manifestation of the Harghita Mts. occurred at 35ka. By contrast the CH_4-rich gases from the CF has a crustal related He (R/R_A=0.03). When $^3He/^4He$ ratios are plotted in an isocountur map together with heat flow values a significant overlapping is found. This suggests that the southernmost segment of Calimani-Gurghiu-Harghita volcanic chain is a degassing system in a distensive active tectonic regime.

MIGRATION AND RETARDATION OF POLLUTANTS FROM MUNICIPAL LADFILLS IN CLAYEY BOTTOM LINERS

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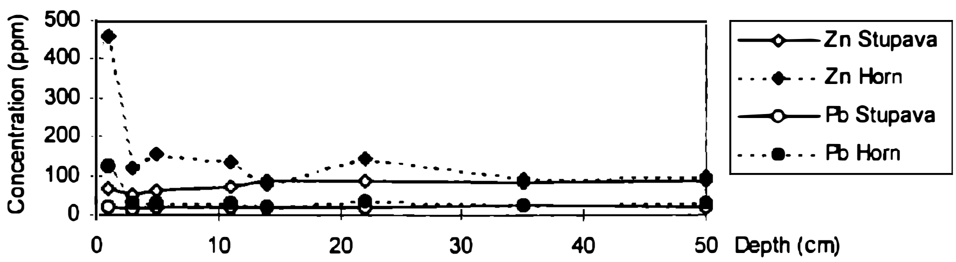
The sealing effect of clayey bottom liners of two landfills was compared. Both landfills were probably 10 years old. Municipal waste is prevailing in the ladfills, leachates should be quite similar. We were interested, how could the different mineral composition influence the migration velocity of some pollutants.

The ladfill "Stupava" is situated in Slovakia 10 km west of Bratislava in an old clay pit. The bottom liner is the natural clayey ground. The sediment belongs to the formations of the Vienna Basin and contains Miocene marine clays (Badenian) without sandy layers. The thickness of the clay layer is about 30 m. Undisturbed samples were taken from a core drilling through the landfill.

The ladfill "Horn" is situated in Austria in the region of Waldviertel near the town of Horn. The bottom liner is an artificial mineral layer, 60 cm thick, overlying an older part of the landfill. Probably, the clayey part of marine to freshwater bedded clay - silt - sand Miocene sediments of the Horn Basin was used for the liner. During remedial works at the ladfill, the waste covering the liner was removed. This was an excellent opportunity to take undisturbed samples directly from the liner surface.

The clay samples were mineralogically, geotechnically and chemically investigated. Some results are summarized in the table. Concentration profiles of heavy metal ions and chloride or sulphate anions in the liner were established. The figure shows the migration of both, the zinc and lead, ions.

Physical properties	Stupava	Horn	Mineral composition of the <2µm fraction (%)	Stupava	Horn
<2µm fraction (%)	51	33	smectite, illite, I/S-mixed layers	81	15 to 20
liquid limit w_L (%)	65	54	kaolinite	5	75 to 90
plastic limit w_P (%)	22	20	chlorite	9	0
plasticity index I_P (%)	43	34	Other adsorbents in whole samples (%)		
geotech. classification	CH	CS	carbonate	20	0
permeability k_f ($m.s^{-1}$)	1.10^{-8} consolid.	$1,3.10^{-11}$ triaxial	Fe-oxihydroxide	present	present



From the concentration profile, an estimate of the apparent diffusion coefficient was done for chloride in Stupava ($1,6.10^{-9} m^2/s$, corresponding with the relatively high permeability of the "fissured clay") and for sulphate in Horn ($>2.10^{-9} m^2/s$). An estimate for heavy metals was impossible. Higher contents were found only in first 1-2 cm (Cu and Cd in Stupava, all metals in Horn), skipping to natural background values in deeper parts. Heavy metals migrate very slowly in both clays. Due to high carbonate and swelling clay minerals content, there is still a high retardation capacity in Stupava. Neither the adsorption capacity of kaolinitic clay from Horn was exhausted yet. Near to the contact with waste, the heavy metal content in the liner is higher than in Stupava. But we did not find big differences in deeper parts after 10 years of landfilling.

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Gold-bearing iron sulfides geochemical evolution in carbonaceous rocks (Tavrian series , Crimea).

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The accumulation of carbonaceous-terrigenous flysh complex rocks is associated with initial stage of Crimea geosyncline development (Late Triassic - Early Yurassic). This thickness is composed by carbon-bearing siliceous-argillaceous rocks (organic substance content - from 0,6 to 1,2%) with siltstones and sandstone's intercalation's. Diagenetic processes in this thickness had been manifested in pyrite concretions formation. Characteristic feature of carbonaceous argillites is their heightened auriferity, that is mainly in pyriye concretions displayed. The gold content in pyrite concretions increase in zones of probable influence of intrusions; that is accompanied by high concentrations of copper, arsenic, silver, stibium..

On the base of mineralogical and geochemical investigations some peculiarities of gold and accompanying ore-elements were established: 1) clear connection of these accumulations with pyrite concretions (0,15 - 0,400 g/t); 2) gold concentrations increase in pyrites from flysh strata situated near the contacts with magmatic rocks (0,45 - 1,5 g/t).

The iron-sulfides formation took place in the course of 2 stages: first stage - diagenesis - pyrite concretions formation, were gold content is two - three times as much by comparison with enclosing rocks; second stage - epigenesis - secondary iron-sulfides formation, were the gold content increases in 2 - 5 times (table 1).

Metals behavour in the course of secondary sulphidization of pyrite concretions (samples number – 38).

METAL	CONTENT INTERVALS (g/t)	
	Central part of concretions	**Peripheral part of concretions**
Co	0 - 1	60 - 400
Ni	10 - 80	50 - 400
Cu	10 - 30	100 - 300
Pb	10 - 60	200 - 500
As	—	600 - 3000
Sb	—	100 - 200
Ag	0 - 1	2 - 5
Au	**0,150 - 0,400**	0,45 - 1,5

Phasic spectral analysis data show the presence of twc iron -sulfides phases: low-temperature (peripheral zone). Gold is associated with iron-suiphides and concentrated as a self-depended phase. On the base of microprobe analysis gold is localized on sulfides surface; it calls form the opportunity of its much more easy shebsequent mobilization.

Iron-sulfides genetic distinctions of central and peripheral concretions zones are confirmed by rent-genostructual analysis data: iron-sulfide of central zone corresponds to pyrite, concretion,, out side is presented by fine powdered aggregates of meinikovite-pyrite and somolnokite which were formed as a result of gel crystallization on the Diagenetic pyrite surface. It was proked that gold in sulfides is formed out of molecular solutions when temperature and pressure fall and especially, by chemical interaction reactions of solutions and solids.

Interlayered space in flysh rosh rocks served as conductors for hydrothermal solutions. They were mixed up with waters enriched with oxygen here. It was accompanied by concentration increase of sulphate iones and pH lowering.

Hence the elements paragenesis (Au, As, Cu, Ag, Sb, Pb) in peripheral concretions zones (reductive epigenesis zone), they, probably, were introduced by hydrothermal solutions in form of tiosulphate complexes.

By subsequent neutralization of acid solutions (pyrite barrier) finely dispersed gold excretion could take place in that way:

$$2Au\,(S_2O_3)_2^{3-} + 4H^+ \text{---} 4Au + SO_4^{2-} + 3SO_2 + 2H_2O$$

It is known, that the best gold sorbent is iron-monosulphide. Concentration increase of gold in finely dispersed melnikovite-pyrite aggregates is obliged to well developed surface of these secondary sulfide formations.

Thus, following the development of reductive epigenetic process, the peripheral part of Diagenetic pyrite concretions is possible to classify as a zone of superimposed sulphidization and ennoblement.

TRANSITION FROM 3-D TO 4-D AND 8-D MULTIDISCIPLINARY PARADIGMS ON THE GEOPHYSICAL INNOVATIONS FOR NEW SYNERGETIC STRATEGY TO RESERVOIR MODELING

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SUMMARY: **The study represents the main actual multidisciplinary paradigms and geophysical innovations for the transition from 3-D and 4-D models to 8-D new synergetic strategy to reservoir characterization, modeling and interpretation. The modus of reservoirs includes the contemporary innovative geophysical status, synergetic scientific strategies and integral investigations for *principal new multidimensional evaluation of reserves and resources for regional basins of Carpathian-Balkan Region and with advancing geological knowledge for global importance* basins as Black Sea Shelf; Caspian basin, North Sec; Gulf of Mexico, Persian Gulf, etc.**

THEORETICAL RESEARCH: **The main accents in the theoretical study are put on the multidisciplinary paradigms and synergetic geophysical innovations: *Space-Time Waved Paradigm; Gravitation Waved Singularity Paradigm; Biostratigraphycal Population Waved Singularity Paradigm (An example of a dissipative heterogeneous structure with multifunctionality centers); Cosmogeological Waved Singularity Paradigm; Complex Synergetic MultiWaved Singularity Paradigm.* The transition from 3-D to multidimensional 4-D and 8-D reservoir's modeling corresponds with innovative scientific strategies and advance GeoScience achievements - Geological, Geophysical & Digital Methods on the base of Complex MultiDimensional Information. Additional requirements for simulation and analysis are: GeoMapping and Geophysical Computing Programs for optimization methods about basin modeling; Minimum & Maximum Entropy Methods; Multiwaved analysis; $Q(v_\varphi(f))$-deconvolution; Complex seismic signal analysis - including Instantaneous phase velocity $v_\varphi(f)$; Instantaneous quality factors $Q(v_\varphi(f))$, Gridding Methods with optimizing approximations. Advanced IsoMaps and Synergetic $B(\alpha,\beta)$&Pareto Distribution multiplication's are predicted need for 3-D multiparametric expert systems for Oil & Gas Resources evaluations. The main theoretical an high technology reservoir problem concerned 8-D-reservoir modeling Res=F(Q) for Oil & Gas Resources Q - evaluation:**

$$Q = \int\int\int\int\int\int\int\int S*H*T*M*G*B*N*K \; ds.dh.dt.d\mu.d\gamma.d\beta.d\eta.dk , \quad \text{where :}$$

$S(x,y,h)$ - Common layer area (km^2); $H(x,y,h)=\Delta Z$ - Oil&Gas Power (m); $T(\Delta Q, t)$ - Time migration of quantity resources potential; $M(S(x,y),\Delta Z(h), \mu)$ - Effective Porosity; $G(S(x,y),\Delta Z,\gamma)$ - Oil&Gas Density (tone/m^3); $B(S(x,y),h,\beta)$ - Coefficient of Oil & Gas Saturation; $N(S(x,y),h,\eta) = 1 - 1/b = = 1 - V(h)/V(0)$ - Non-dimensional Volume Coefficient; $K(S(x,y),h,p,\Delta t,k)$ - Coefficient of Oil&Gas Analogy (p-Oil&Gas pressure).

EXPERIMENTAL DATA & RESULTS: **In the study are used some complex results from the territory of Carpatian-Balkan Region - especial Bulgaria and Bulgarian Black Sea Shelf; Caspian basin, North See; Gulf of Mexico and Persian Gulf with synergetic representation. The methodological results are connected with the 3-D & 4-D digital geochronological models of a typical paleovalleys for the genesis and evolution of the Balkan peninsula paleorelief during paleo 4D-representation. Practical results are announced to 8D-complex analysis as alternative to 4-D monitoring for more efficient and better control of producing fields.**

CONCLUSIONS: **Some new principal and synergetic conclusions about the innovative scientific methods, methodical and technological development for paleobasin's characterizing and reservoir's modeling, as for new proofs researching to the "Theory about The Earth's and Reservoir Evolution", are made. Multidimensional optimization methods for the identification and the estimation of the reservoir's resources & reserves, are developed on the base of optimal geoglobal RS&GIS&GPS scientific technology, alternatives and multidisciplinary integration of worldwide computing interactive systems with complex synergetic applications for applied geophysics and geology, actual in the transition from 3-D to 4-D and 8-D multidisciplinary paradigms. This is truly a "grand challenge" espetial problem, defined in the High Performance Computing & Communications "Blue Book" of the U.S. Office of Science and Technology Policy - section 2.6.1 # OILRESERVOIR.**

COMPARISON OF ANTIMONY ORE DEPOSITS OF THE EASTERN ALPS AND WESTERN CARPATHIANS USING GEOCHEMICAL DATA

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The synopsis of different geochemical data is an objective way to characterize and to compare ore deposits. The multivariate techniques enable correlation, evaluation and presentation of the data. This synoptical working method named geochemometry was successfully used to the metallogenetic map of Austria. It is suggesting itself to compare the data of ore deposits situated in the bordering geological units, such as the Western Carpathians. The stibnite bearing ore deposits are selected for this pilot project. In the crystalline basement of the Eastern Alps the occurrence of the antimony district in the Kreuzeck-Goldeck Gruppe such as Rabant, Gonnig, Gurskerkammer, Radlbergalm, Leßnig, Siflitz, Guginock and in Gailtaler Kristallin Abfaltersbach and Obertilliach including Brückl in the Gailtaler Decke, further the antimony ore district of Schlaining in the Penninic Rechnitz Window, in the Western Carpathians: Pezinok (Malé Karpaty Mts.), Dúbrava (Nízke Tatry Mts.) and Zlatá Baňa (Eastern Slovak Neovolcanites) deposits are the focal points of our investigation.

Based on studies of the mineral paragenesis and trace elements the antimony mineralizations of the pre-Alpidic basement are richer in Fe, Ni, Co, As, Au (arsenopyrite as carrier), Cu, Zn, Pb, Bi, W, sometimes Mo and U (Dúbrava) and relatively Hg-poor. The Alpidic ore district of Schlaining is more Hg-rich, but it shows a deficiency of Au and W The antimony mineralization in neovolcanic rocks of Zlatá Baňa is Hg-rich too, but also Au-, Ag- and Cu-rich. The model ages calculated from the lead isotopes of stibnite and lead sulfosalts correspond with the young Alpidic age of the vein deposits of Schlaining and Zlatá Baňa. The model ages of the other mineralizations can be interpreted as pre-Alpidic (the oldest model ages: Drau Valley 385 Ma, Dúbrava 390 Ma, and probably also Pezinok 220 Ma). The sulphur isotopes of stibnites are around zero more or less homogenous. Only the samples of Zlatá Baňa are characterized by a wider spread. The carbon and oxygen isotope values of carbonates from Zlatá Baňa show the largest spread in agreement with the sulphide isotopes indicating the water mixing in a subvolcanic environment. The isotope distribution from the carbonates of Schlaining is more homogenous. The carbonates from the Drau Valley occurrences may be formed by metamorphic water. From the fluid inclusion investigations homogenization temperatures between 100 up to 300°C can be deviated. The salinities reach maximum values of 24 NaCl equiv. wt % in Dúbrava and 30 % in Radlbergalm and Leßnig. The values from Schlaining, Zlatá Baňa or Pezinok are lower with an upper limite of 12 %. The formation age of Schlaining is approximately dated: 17 up to 19 Ma. Mica from the Gurskerkammer and Obertilliach show Ar/Ar plateau ages around 180 and 200 Ma. The subvolcanic type of Zlatá Baňa distinguishes clearly from the young Alpidic type of Schlaining. The antimony deposits of the pre-Alpidic basement show similarities. A primary pre-Alpidic enrichment can not be excluded.

THERMAL REGIME OF THE TRANSYLVANIAN BASIN; THERMAL EFFECTS OF SEDIMENTATION AND EROSION

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The paper examines some aspects of the thermal effects of the complex basin subsidence and erosion, in order to explain the present day surface heat flow in the Transylvanian Depression. A 2D model of the thermal basin evolution , which takes into account the time changes in sedimentation rate and in the lithology of the sediments, is proposed and solved numerically using the finite element method (FEM). The study is restricted to the investigation of the thermal effects of sedimentation and erosion on the thermal structure history in the Transylvanian Basin along a WNW-ESE geologic profile 240 km long, which crosses the depression in its central part . The main features of the heat flow distribution along profile are the higher heat flow at the sides of the profile (about 65 mWm^{-2}) and the low heat flow in the centre of the cross-section (30 mWm^{-2}).

A suggestion for the interpretation of the heat flux profile is provided by the structure of the basement, where a superposition of the maximum depths of basement with the minimum values of the surface heat flux is evident and , consequently, the transient effect of the sedimentation and erosion was first analysed. The low heat flux values obtained in model calculations (31-32 mWm^{-2} in the central part of the profile) can be explained by the effect of deposition of more than 4 km Neogene uncompacted sediments and by the lower heat flow generated in the upper crust. The increase of the surface heat flow towards the margins of the basin could correspond to the increase of the thickness of the upper crust and of the larger values for the heat generation rate in the upper crust in these areas (Apuseni Mountains and Neogene volcanic zone). The weak uplifts and erosion is likely to produce small thermal effects. The effect of the refraction of the heat is clearly pointed out in the final surface flux, as small waves of thc heat profile. The additional effect of the changing of the basal heat flow was studied, and in our opinion, the heat incoming from the mantle is not a significant factor in the modification of the shape of the surface heat budget along the profile.

CORELATION OF THE PALEOCENE AND EOCENE BOUNDARY IN UKRAINE AND OTHER CIS REGIONS BASES ON THE NANNOPLANCTON AND DINOCYSTS

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Nannoplankton and dinocysts have been studied from the Paleocene-Eocene boundary interval in the stratigraphical sequences of the North Slope of Ukrainian Carpathians and the Crimea (Ukraine), Armenia and Eastern Precaspian (Kazakhstan).

The Carpathians. The Paleocene-Eocene boundary interval of the North Slope of the Carpathians is represented with:1) The Yamna formation consisted with the massive sandstones with the rare interbeds of the argillites or the thin-rhythmical flysch. At the bottom of the formationYaremcha horizont represented by the variegated thin-rhytmical flysch is frequently observed. The age of the formation is determined as Later Paleocen the grounds of the finds of N.solitarius de la Harpe (Nemkov, Khloponin, 1957) and Discocyclina sp. (Portniagina, Sovchik, 1968), the benthos foraminifers (Vjalov et all. 1988), nannoplankton of zones NP6-8 in the formation bottom and NP9 in the upper argillite interbeds. The association of dinocysts is improverished and represented by zones Cerodinium speciosum and Apectodinium homomorphum.The Yamna formation deposits are without any break covered by the thin-rhythmical noncarbonate often flintationed flysch of the Maniava formation or by the Vitvitza formation thin-rhythmical noncarbonate clay flysch. The age of these formations is determined by the benthos foraminifers, the finds of N.planulatus Lam. in the upper formation part (Vjalov et al.,1988). The nannoplankton zone NP12 is ascertaine only in the marl facies of the upper part of the Maniava formation along the Opor river. Dinocysts are represented by the impoverished associations of zones Dracodinium simile and Charlesdowniella colyotrypta. So the boundary between the Paleocene and the Eocene in the North Carpathians is put up by the sharp lithological change. Tracing the changes in the development of the biota of nannoplankfon and dinocysts is not possible yet, and the additional investigations are necessary.

The Crimea. The position of the boundary between the Paleocene and the Eocene has been studied in the parastratotypical well N 1 been obrilled in the neighbourhood of the t. Bakhchisaray. The boundary interval is represented by maris of the Kachia formation in which the zones NP6 - NP9 and the lowest parts of the zone NP9and dinocysts zones C.speciosum and Apectodinium homomorphum were found out. The carbonate clays of the Bakhchisaray formation with the scouring in the clays the zones from NP11 to NP13 are determined. The dinocysts are represented by the zones D.simisle, D.variolongituda and the lowest parts of the C.coleotrypta one. So the boundary between the Paleocene and the Eocene coincides with the break in the sedimentation which corresponds to the most part of the zone D. multiradiatus and the zone M.contortus by time.

Armenia. Nannoplankton and dinocysts have been studied from the Vedy and Shagap sequences of the Erevan basin. The boundary's deposits are represented by the upper parts of. Katutska formation (Andreeva-Grigorovich et al., 1991) which are composed with the alteration of sandstones, aleurolites and argillites and also conglomerates and clays. The association of the nannoplankton zones NP6 and NP8 is established in the bed 17 and the upper part of the zone NP9 - in the bed 19. The dinocysts are represented by Deflandrea oebisfeldensis (akme-zone). The limestone succession with N.planulatus overcoveres these deposits. The group of aleurolite strata lies on the nummulite limestones in the Shagap sequence. In it the zone NP13 is determined by nannoplankton and the zone Charlesdowniela coleotrypta - by dinocysts. The boundary between the Paleocene and Eocene is put at the floor of the limestones with N.planulatus.

Eastern Precaspian. The rock samples have been studied from the stratotypical well SP-1. The boundary interval is represented by the Khamsaktysol's formation composed by opokas, sandstones and lays. The zone NP9 and the beds with Deflandrea oebisfeldensis (akme-zone) are found out in the upper part of clays. Above these deposits the Bailesail's formation lies with scouring. It is the noncarbonate clays with the glauconite sand in the bottom. The zones NP11, NP12 and NPI 3 determinations by I.P.Tabachnicova are found out in the single carbonate interbeds. And the zone D.similes,D.variolongituda and C.coleotrypta by dinocysts. So the boundary between the Paleocene and the Eocene coincides with the break which corresponds to the upper part of the zone NP9 and N Pl0 by time.

THE PRESENCE OF THE PRECIOUS METALS SUCH AS Au, Ag, Pt, Pd IN THE UPPER CRETACEOUS DEPOSITS - CENTRAL AND EAST PARTS OF BULGARIA

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The largest depositions of the ores in Bulgaria that contain precious metals are related to the Upper Cretaceous igneous activity. Most of them are located in the Srednogorie and Strandzia zones. They both are elements of the Global Euroasian ore-copper belt on the Balcan Peninsula (Balkan metallogenic zone). The geological setting allows to discussed the district as a part of the Balkan magmatic arc. The processes may be characterised by hypabyssal, subvolcanic and dike Ca-alkaline through high potash Ca-alkaline up to K-subalkaline magmatic activity. They cause own magmatic Fe, skarn Fe and hydrothermal porphyry copper, vein and stratifom copper as well as polymetallic ores. Srednogorie zone contains tree main units: East Srednogorie, Central Srednogorie and West Srednogorie. The deposits with precious metals in it occur in the Central and in the East Srednogorie metallogenic subzone and Strandza. Accordingly to Nachev (1997) the metal distribution shows transversal zonality of island arc type: Fe, Ti, Mo, Cu, Au, Pb, Zn. The ores are presented of endogenous massive copper sulphide, porphyry copper ores (enriched in gold) and gold-copper-polymetallic veins. There are also many deposits of the skarn type rich in iron, iron-uranium (+Ce, La, Y) or copper-iron-molybdenum.

The East Srednogorie and Strandza are situated in the Southeast part of Bulgaria. The first metallogenic subzones contain ore regions with many industrial deposits. The ore deposits and occurrences are incorporated in ore fields on the base of their structural features and location. Some ore fields are located close to the contacts of the intrusive bodies with the embedded carbonate rocks - Malko Turnovo, Krumovo, Varshilo, Oman and Fakia ore fields. The other ones are of veiny type and they are situated among volcano plutonic structures of central type - Rossen, Zidarovo, Varly briag. The creation of the third is determinate by reactivating of the intrusive massifs - Bardce, Prohorovo and Isgrev ore deposits. In general the ores are composed of the following major minerals: chalkopyrite, magnetite, uraninite (for Rossen ore field only), molibdenite, pyrite. The founded minor minerals are: galena, sphalerite, pentlandite, synchisite, parisite, tetradimite, tetrahedrite, tenantite, native gold, native silver, electrum, etc. Some of the trace minerals, (enriched in cobalt, nickel, silver, cerium, mercury, platinum) are lineaite, millerite, vitehtinite, fraibergite, carrollite davidite, hessite, Bi and Ag containing galena, guanajuatite, emplectite, schachnerite?, native platinum and many macrophases undetermined by now.

The Central Srednogorie is in the it's central parts of Bulgaria. The ore deposits (more than fifteen - Ellatsite, Tshelopech, Krassen, Radka, Elshitsa, Assarel, Medet, Petelovo, etc.) form the famous Panagyuriste-Etropole ore region. It is build up of copper-pyrite and porphyry copper ores, enriched in gold. The area is build up of Precambrian metamorphic rocks, Palaeozoic acid plutons and Mesozoic igneous rocks (Upper Cretaceous age). They include volcanics - andesites, tuffs and breccias and dazites as well as intrusive and subvolcanic rocks - diorites, granodiorites, quartzdiorites, quartzmonzogranodiorites. The copper mineralizations are the main raw materials source for maining industry. The ore bodies are with veiny-chapped form. Very frequently they are irregular or disseminated. The major ore minerals are: chalcopyrite, magnetite, bornite, pyrite. The minor ones embrace molybdenite, galena, sphalerite, pirotine, hessite, native gold, silver, electrum, nickel-pyrite, cobaltiferrous pyrite. Some of the trace minerals are karrolite, bismutinite, tenantite, tetrahedrite, ramelsbergite, palladium, paladoarsenite, nickel-lineite, karolite, gersdorfite, native tellurium and bismuth, palladium bearing ramelsbergite. Chalcopyrite and other sulphides commonly found in the mesothermal zone extended into the epithermal zone. Most of them have been mined out, and others still producing ore.
The recognition of the geological factors causing the metallizations (physical and chemical controls of ore deposition as well as the wall rock alterations and zoning) will lead to a better understanding of the processes of ore genesis and hence to sound exploration for new ore deposits.

NEOTETHYAN OCEANIC ASSEMBLAGES IN NE HUNGARY: A REVIEW OF PRESENT KNOWLEDGE

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Ophiolite complexes, representing the continuation of the Dinaridic Ophiolite Belt, displaced along the NW side of the Zagreb–Zemplin Line, occur in the NE part of the Pelsonia Composite Terrane, both in the Bükkia and Aggtelekia composite terranes of lower rank.

The *Szarvaskő Ophiolite Complex* has been transported onto the Bükk Parautochthon Unit from the NW (according to present coordinates). It consists of a lower, olistostromal unit (Mónosbél Unit) of Middle to Late Jurassic age and a higher, igneous–sedimentary unit (Szarvaskő Unit): pillow and massive basalts, gabbros, minor ultramafic cummulates, shales–sandstones, some black radiolarites and some olistostromes with radiolarite olistoliths. Geochemical character indicates back-arc, marginal sea-type setting, opened in Middle Jurassic and closed in Late Jurassic. K/Ar ages on gabbros and on muscovites from their contact concentrate between 165-170 Ma. Intercalated black radiolarites are of Bajocian to Oxfordian age, whereas the small-scaled olistostromes of the Szarvaskő Unit contain also some Ladinian–Carnian red radiolarite blocks. Sandstone petrography is similar to the Darnó Complex (see below), additionally, however, the presence of serpentinite fragments and chromite was also recorded. The magmatic rocks were affected by an earlier, ocean-floor hydrothermal metamorphism, succeeded by a younger regional metamorphism, which produced prehnite-pumpellyite facies in the igneous rocks and late diagenetic to low temperanıre anchizonal alteration in sedimentary rocks. Age of metamorphism is between 160–120 Ma (Eohellenic phase), probably contemporaneous with the emplacement onto the Bükk PA Unit.

The *Darnó Ophiolite Complex*, intimately related to the Szarvaskő Complex, consists also of a lower sedimentary unit and a higher igneous-sedimentary unit. The lower unit comprises proximal-type gravity flow deposits (slumps, debris flows, calcareous–marly turbidites) of inferred Middle to Late Jurassic age, with slide blocks of Ladinian–Carnian deep water, reddish cherty limestones, that include also some associated basalts. The upper unit is composed of up to a few 100m thick pillow and massive basalt "slices" as well as gabbros and minor ultramafic cummulates, with intercalated/intersliced abyssal sediments in a few m to a few 10m thickness: red mudstones, red radiolarites alternatively yielding Triassic (Ladinian–Carnian) and Jurassic (Bajocian–Callovian) radiolarians, as well as Jurassic bluish grey siliceous shales. Micaceous sandstone clasts of subarkose and quartzarenite types occur in debris flows. They contain fragments of neutral to acidic extrusives (andesites, dacite–rhyolites), acidic intrusives (granites), basalts and metasedimentary rocks (phyllites, sandstones, cherts). Both basalts and gabbros show MORB character. K/Ar data from gabbros show max. 175 Ma. The igneous rocks show only prehnite-pumpellyite facies ocean floor hydrothermal metamorphism, whereas the sedimentary ones suffered only diagenetic alterations. The lower unit represents a proximal-type trench complex, whereas the upper one an accretionary prism, containing remnants of oceanic crust probably formed in the Triassic and underwent renewed extension in the Jurassic behind an intraoceanic subduction zone.

The *Bódva Valley Ophiolite Complex* is represented by slices of serpentinites, basalts and gabbros, imbricated into the sole thrust of the Aggtelek Unit, formed by Upper Permian evaporites. Sedimentary rocks of the ophiolite complex are represented only by a single known, few m thick horizon of Ladinian red mudstone–radiolarite, and a ca. 15m thick slice of dark grey siliceous shale–siliceous sandstone of probable Jurassic age. The gabbros reveal an earlier blueschist facies metamorphic event with 7Kbar pressure and a later greenschist facies one with 5 Kbar pressure, both taking place before the incorporation of the ophiolite slices into their present non-metamorphic environment during nappe movements subsequent to ophiolite obduction. Inspite of these younger, strong metamorphic events, K/Ar age determinations on gabbros yielded mostly Middle Triassic (ca. 230 Ma) ages. The complex represents remnants of oceanic crust formed in the Middle Triassic and obducted probably in Late Jurassic.

ALPINE LOW-T PROGRADE METAMORPHISM IN THE POST-VARISCAN BASEMENT OF THE HUNGARIAN PART OF THE TISZA UNIT, PANNONIAN BASIN

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As to recent plate tectonic reconstructions the Tisza Unit (= Tisia microplate = composite terrane) represents a detached fragment of the northern ("stable European") border of the Neothetyan realm that occupied its present position mainly by meso-Alpine horizontal displacements. According to the generally accepted view that was being maintained until the latest years, Alpine metamorphism affected exclusively the pre-Variscan(?) - Variscan basement along certain tectonic zones causing low-T retrograde overprint, mylonite and cataclasite formation, while the post-Variscan formations were considered non-metamorphic.

Integrated stratigraphic, microstructural, mineral paragenetic, illite and chlorite crystallinity, white mica geobarometric, vitrinite reflectance and K/Ar geochronologic studies were carried out in selected areas of the Tisza Unit, in order to determine the diagenetic and eventual incipient metamorphic conditions of the late Paleozoic and Mesozoic formations.

In the Barcs-West area (Drava Basin, SW-Transdanubia) an Inner Dinaric type Mesozoic sequence, consisting of metarhyolite and -tuff, metasandstone, phyllite, marble and cipollino-like lithologies, was thrusted over the polymetamorphic basement. Similar rock types are found also in the Croatian part of the Tisza Unit (in the Drava Basin) as well as in the Central Hungarian (=Igal) Zone that represents a tectonic connection between the Inner Dinaric Zone and its detached northwestern part, i.e. the Bükk-Gemer Unit). This sequence suffered mainly anchizonal, partly epizonal, medium thermal gradient Cretaceous regional metamorphism overprinted by a meso-Alpine (ca. 30Ma) thermal effect.

In eastern Hungary, along the southern border of the so called Mecsek - Northern Great Plain Zone, the polymetamorphic complex was thrusted over a low-temperature, prograde metamorphic Mesozoic sequence (borehole Sáránd-I). Here the Mesozoic parautochthon is built up by an upper, dolomitic - fine clastic, a middle, carbonaceous - fine clastic and a lower, calcareous - basic to intermediate volcanoclastic sub-units. The upper part suffered anchizonal, the middle and lower parts epizonal Cretaceous regional metamorphism that proved to be older than the overthrusting.

Similar metamorphic conditions are known from several boreholes all located along various overthrust zones of the basement or penetrating imbricated structures of Mesozoic sequences in Eastern Hungary and also in the Duna-Tisza Interfluve. These new records suggest that the Cretaceous low-T prograde regional metamorphism was not an isolated but a rather common phenomenon in the region concerned.

PROGRADATIONAL TRENDS AND PALEOCURRENT PATTERNS IN THE EOCENE TURBIDITES OF THE PETROVA NAPPE (MAGURA ALLOGROUP - MARAMURES - ROMANIA)

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MUSCOVITE-PARAGONITE SERIES OF BOBOLOŠ (EASTERN SERBIA)

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The Proterozoic crystalline complex of Eastern Serbia is built mainly of gneisses, mica schists and amphibolites. In its southern part is Bobološ locality interesting because of the unique mineral assemblage within kyanite-corundum schist: kyanite (75-80%), corundum (15-20%), rutile, paragonite and chlorite (up to 5%), that are exposed here as the block 5x4x3m in size. Only in some parts of this block staurolite and tourmaline can be found. Below this block there are andalusite schists built of muscovite, andalusite, rutile, kyanite and chlorite. Under these rocks there are muscovite-paragonite schists composed of muscovite, paragonite, kyanite, rutile and quartz.

Correlation between the composition of micas within all the three mentioned rock-types showed that with variation of muscovite component in paragonite from kyanite-corundum schist and muscovite paragonite schist (X_{ms}=0,137-0,069) also vary the contents of Si (6,0845-6,1195) and Al (5,9225-5,8705). Also the amounts of muscovite component in muscovites from the andalusite schist and muscovite-paragonite schist (X_{ms}=0,794-0,725) influence the significant increase of Si (6,2757-6,2324) and decrease of Al (5,4297-5,5850). These differences in chemical composition between paragonites, as well as in muscovites influence the unit cell size of these $2M_1$ types of micas by effecting the parameter 1/2 c sin β, as well as volume (Guidotti *et al.*, 1992). So with change of Na component (Na^*=Na/Na+K ·100) from 20,64 in muscovite from andalusite schist to 93,07 in paragonite from muscovite-paragonite schist we notice decrease of 1/2 c sinβ parameter (9,932-9,648) and decrease of V (9,281(1)-881.0(1)A^3).

On the basis of mineral association we presume that primary rock was kaolin with some amount of Na component. The origin of Na can be connected with alteration of Na-plagioclase. By using theoretical thermodynamic calculations for possible formation of kyanite-corundum schist for T (400-700°C), on the basis of reaction: $Na^+ + 3.5Al_2Si_2O_5(OH)_4 + 0.5H_2O = Al_2SiO_5 + Al_2O_3 + NaAl_3Si_3O_{10}(OH)_2 + 3H_4SiO_4 + H^+$ for $[H_4SiO_4] = 10^{-2}$ mol/dm^3 and formation of muscovite-paragonite schist by using reaction: $Na^+ + K^+ + 4Al_2Si_2O_5 + H_2O = Al_2SiO_5 + NaAl_3Si_3O_{10}(OH)_2 + KAl_3Si_3O_{10}(OH)_2 + SiO_2 + 6H_2O + 2H^-$ for $[H^+]/[Na^+][K^+] = 10^{-6}$ mol/dm^3 we have obtained p(3.75-5.42 Kbar) for the first association and p(2.24-3.23 Kbar) for the second association.

Chemical analyses gave us the amounts of muscovite component ($X^{Ms(Pg)}$ = 0.725 and $X^{Pg(Ms)}$ = 0.069) for muscovite and paragonite in muscovite-paragonite schist, so we were able to calculate temperature of their common creation (Blencoe, *et al.*, 1994)(equation 11) T^{width} = 590+/-50 °C. The equilibrium temperature for creation of this association ranged within interval T(530-640°C).

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THE SCIENTIFIC VALUE OF GEOLOGIST'S BEQUESTS USED FOR THE RESEARCH IN THE HISTORY OF GEOSCIENCES IN AUSTRIA

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1. The archives of the Geologicial Survey of Austria

Archives are the most important units of geological surveys. Their aim is the collection of written or drawn documents. In the Imperial Foundation – Act, dated November 15th, 1849, of the former Imperial Geological Institut (Geologische Reichsanstalt) the unit „Archive“ was planned. In this time only a few printed geoscientific literature existed. Geological maps existed only as manuscript – sheets. In reality the unit „Archive“ didn't exist in the beginning of the Geologische Reichsanstalt. Only the activities of the library and the map – collection, administrated by the drawing – section, were reported annually by the director. After the first World War we can find annual reports on a unit called „Museum and Archives“ This unit was probably extended during the time of the „Geologisches Reichsamt, Zweigstelle Wien“ between 1938 – 1945. After the second World War in the frame of the departments concerning applied geology so called „Karteien“ where established. These were collections of unpublished documents. For search of documents systematic card – catalogues were used. As consequence of the reorganization of the Geological Survey of Austria (successor of the Imperial Geological Institute) a special unit „Scientific Archive“ within the frame of the library was founded. Later the Graphic Collection was added. The Scientific Archiv of the library contains geological manuscript – maps of Austria and the former Austrian – Hungarian Monarchy, field – reports, field – diaries (Feldtagebücher), biographical materials und research reports. An important part of the stock of the Scientific Archive of the Library depends on bequests, which were donated in the last decades to the Geological Survey of Austria.

2. The bequests of geologists at the Geological Survey of Austria: useful sources for the history of geological sciencies in Austria

The study of some important material of the Scientific Archives from the time of the beginning of the Imperial Geological Institute (Geologische Reichsanstalt) in 1849 to the 3rd International Geological congress in Vienna is the aim of the reported research project. Special attention is given to the correspondence of Franz von HAUER <1822-1899> and field – diaries of 9 geologists. The correspondence of Franz von HAUER, who was the second director of the Imperial Geological Institut (Geologische Reichsanstalt) is very important. He had contacts with the most significant geologists and scientiest of his time. More than 660 letters are preserved, which allow an interestic view in scientific discussions and the social surrounding. Franz von HAUER exchanged scientific information with 84 addresses e.g. Wilhelm HAIDINGER <1795-1871>, Andreas BAUMGARTNER <1793-1865>, Sigmund AICHHORN <1814-1892> etc. to solve general and financial problems. Additionally historical – political events and personal problems where discussed.

The 225 field – diaries of the Scientific Archive of the Geological Survey of Austria contain many precious information of the field – activities. Intensive researches on the field – diaries of Marco Vinzenz LIPOLD <1816-1883> are in progress. The research was started with 26 field – diaries of Marco Vinzenz LIPOLD <1816-1883>, wich are outstanding with respect to their formal and artistical out-look. Last but not least they have still most important scientific value. The first step is the transcription of LIPOLD's old hand-writing in latin letters. The next step is the comparison of LIPOLD's unpublished field-diaries and published papers, dominantly printed in the „Jahrbuch der Geologischen Reichsanstalt“ and search for unknown results. The routes of LIPOLD's fieldsurveys where exactly reconstructed. At least in the Administration – and Registration – Archives of the Geological Survey of Austria the written reports to the director of the Imperial Geological Institut (W.HAIDINGER) were controlled and compared. On the basis of searching these archival materials and geologist's bequests it is possible to give a better and complete description of the historical development of the geosciences in Austria. The development of theories and results in the geosciences is considered with this autopsic method. At least the influence of the conditions of life and the historical – political circumstances in respect to the development of science could be better documented and presented.

OLIGOCENE STOMIIFORMES (TELEOSTEI) FROM THE EXTERNAL FLYSCH OF THE ROMANIAN EAST CARPATHIANS

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This paper discusses the osteology of three genus from *Sternoptychidae* and one genus from *Gonostomatidae* (Stomiiformes) of the Oligocene formations in Vrancea Nappe (Marginal Folds) of the external flysch in East Carpathians. In the Moldavides (Sandulescu, 1984) the Oligocene formations are involved in the Tarcau, Vrancea (Marginal Folds) and Subcarpathian Nappes. The Vrancea Nappe is cover by Tarcau Nappe and appear like tectonics windows and demi-windows. The lithostratigraphy of the Oligocene formations (L. Ionesi, 1971) in the demi-window Bistrita-Rasca (C. Grasu, 1980) is: lower menilites, bituminous marls, lower dyssodilic shales, Kliwa sandstone, upper dyssodilic shales and menilites. The Oligocene fish fossils described were discovered in bituminous marls and lower dyssodilic shales. The osteological and morphological analysis allowed to complete the diagnosis of the species described and compare with recent species. To exclude errors in identification of *Argyropelecus*, *Polyipnus* and *Sternoptyx*, tribe *Sternoptichini* (Baird, 1986) from *Sternoptychidae*, their most important osteological characters have been compiled in next table.

No	Character	*Polyipnus* Gunther 1887	*Argyropelecus* Cocco 1829	*Sternoptyx* Herman 1781
1	Vertebrae*	32-35 (precaudal vertebrae 11 or 12)	34-40 (precaudal vertebrae 11 or 12)	29-31 (precaudal vertebrae 11)
2	Large pleural ribs*	6 pairs between the 3-8th vertebra	7 pairs between the 4-10th vertebra	5 pairs between the 6-10th vertebra
3	Posttemporal and supracleithrum**	appears fused	appears fused	not fused to
4	Eyes**	normal, parasphenoid straight	telescopic, dorsally oriented; parasphenoid strong curved at posterior	normal; parasphenoid straight
5	Dorsal blade**	two fused dorsal pterygiophores forms short spine anterior dorsal fine	7 supraneurales, last two fused forms large dorsal blade anterior dorsal fin	one specialised supraneural bears a large bladelike anterior dorsal fin
6	Abdominal keel**	10	12	10 (not ossified)
7	Preanal scales**	5	4	3
8	Caudal skeleton*	SN1 - flattened and expanded; hypurals 3-6 separate; 1-3 fused	SN1 - flattened and expanded; hypurals 1-2 and 3-5 co-ossified	SN1 - flattened; hypurals 1-2 and 3-6 co-ossified

x S.H. Weitzman, 1974; xx R.C. Baird, 1971

Argyropelecus cosmovicii Cosmovici and Pauca 1943, from Oligocene formations in Vrancea Nappe, represent the single fossil species of the genus *Argyropelecus* described from Oligocene deposits in Caucasus-Daniltchenko 1960, Polish Carpathians - A. Jermanska 1968, Moravia - R. Gregorova 1993. This species has some common osteological charactes with recent *A. hemigymnus* Cocco.

About *Sternoptyx prisca* Pauca 1933, Baird 1971 and R. Gregorova 1993 suggest that this fossil belong to genus *Argyropelecus*. We examined the three specimenes no. 36 from collection Bucharest University described by M. Pauca 1933 and the specimen no. 116 from the collection of P. Neamt Museum described by M. Ciabanu 1977 and all these specimenes are *Argyropelecus cosmovicii* Cosmovici and Pauca 1943.

In the collection of P. Neamt Museum are *Polyipnus oligocenicus* Ciobanu 1977 (no. 124), *P. anteasteroides* Ciobanu 1977 (no. 125) and *P. subnoviensis* Jermanska 1960 (no. 115). From these three species only *Polyipus anteasteroides* Ciobanu 1977 presents specific characters of genus Polyipnus, the other two are the same species, may be *Maurolicus* sp. *Scopeloides glarisianus* Agassiz 1844 and *Scopeloides paucai* Ciobanu 1977 *(Gonostomatidae)* have some distinct characters. Especially *S. glarisianus* described by M. Pauca 1929, 1931 in Romania, Kalabis 1948 in Moravia, Daniltchenko 1960 in Caucasus, Arambourg 1967 in Iran, Jermanska 1968 in Polonia.

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TECTONIC EVOLUTION OF THE MOLDAVIDES SEDIMENTARY BASIN (TARCAU AND MARGINAL FOLDS DOMAINS), EASTERN CARPATHIANS, ROMANIA

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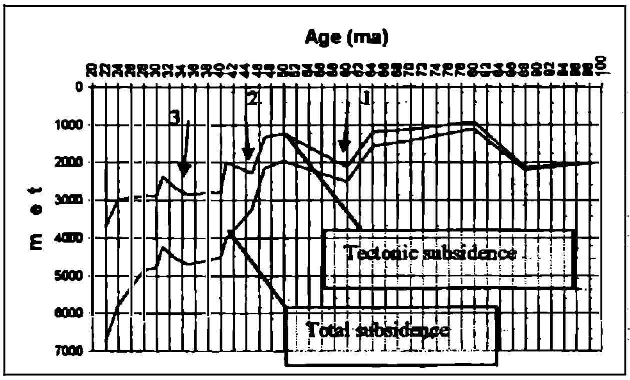
The Eastern Carpathians were structured during several peaks of alpine deformations: Lower Cretaceous, Upper Cretaceous and Neogene. During Lower Cretaceous were structured the Median Dacides and, partially, the External Dacides. In Upper Cretaceous were structured the External Dacides and, during Neogene, the Moldavides (the most external tectonic units of the Eastern Carpathians).
Between Lower Cretaceous and Lower Miocene the peripheral foreland Moldavides sedimentary basin axis migrate from west to est. The sediments originated in: a) the adjacent mountain range, in west and b) the green schists of platform type, in est.
Three moments of uplift were established during Upper Cretaceous and Lower Miocene by studding the shape of several subsidence curves: Paleocene, Ypresian-Lutctian and Priabonian (see figure).
Obviously, these "crisis" could be explained by:

1) Re-rifting of the Moldavides sedimentary basin.
2) Emplacement of thrust plate loads on the westem side of the Cretaceous-Paleogene Moldavides sedimentary basin.



Subsidence curves for the internal part of Tarcau basin. The numbers mark Paleogene short term uplift.

First hypothesis was proposed by Sandulescu (1992) to explain the thick Eocene coarse-grained succession in the Tarcau thrust sheet.

The second one (this paper) assume tectonic movements associated with thrust loads in the External Dacides, Median Dacides and, possibly, in Transylvanian basin realms. Hinterland loads are significant in determining the subsidence of Moldavides basin.

The values of tectonic subsidence changes along the Moldavides sedimentary basins. This fact could indicate different values for flexural rigidity of the lithosphere as it supposed by Badescu (1997). Higher values of flexural rigidity, corresponding to a stiffer lithosphere, create profiles with less subsidence and with the outer bulge (platform debris source) at a greater distance from the thrust load. The reason for this scenarios is the pre-Cretaceous tectono-thermal evolution of European plate.

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AGE OF THE YOUNGEST STRATA IN THE SILESIAN UNIT IN THE SE PART OF THE POLISH CARPATHIANS

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The youngest deposits in the Silesian Unit are the Krosno Beds, up to 3.5 km thick flysch sequence, composed mainly of carbonate-rich polimictic sandstones and grey marly shales, varying upsection from thick-bedded sandy flysch, through normal flysch to shaly flysch. A distinct facies variety of the Krosno Beds is present in the Silesian unit in the Bieszczady range - the SE part of the Polish Carpathians. Their most characteristic feature is the presence of a series of thick-bedded sandstones in the middle part of the sequence - the so-called Otryt Sandstones, up to 1,800 m thick. The Otryt Sandstones have palaeotrasport directions from S and SE, in clear contrast to the remaining part of the Krosno Beds, which have palaeotransport directions from NW. A 40m-thick sandy mudstone layer with blocks of metamorphic rocks and Eocene-?Oligocene mollusc-bearing limestones lies in the lower part of the Otryt Sandstones. The lowest division, of which up to 700 m is exposed in the cores of anticlines, consists of medium- and thin-bedded typical Krosno sandstones and shales. The upper division is shale-dominated with thin-bedded sandstones and two marker chronohorizons of coccolite limestones, distinguished as the Jasło and the Zagórz limestones. Lenticular packages of thick-bedded sandstones (up to 300 m thick) occur in the highest part of the upper division.

Biostratigraphical data are based on analysis of foraminifers, calcareous nannoplankton and dinocysts in a total of 150 samples. The oldest part of sequence represents the P18-19 plantonic foraminiferal zones and NP23 calcareous nannoplankton zone.

Diversified calcareous nannoplankton (with *Reticulofenestra lockeri* and *Cyclocargolithus abisectus*) in marly shales of the middle division of the Krosno Beds is correlated with the NP23-24 nannoplankton zones. The occurrence of scarce planktonic foraminifers (*Globigerina officinalis, G. praebulloides, Globoquadrina tapuriensis*) and dinocysts confirms the Early/Late Oligocene age of these deposits.

The deposition of the mudstone layer with exotics lies within the NP24 nannoplankton zone (*Cyclicargolithus abisectus, P enormis, Reticulofenestra lockeri*). The age is confirmed by dinocysts (*Wetzeliella gochtii, Chiropteridium lobospinosum, C. dispersum*) and planktonic foraminifers (*Paragloborotalia nana, Tenuitella angustiumbilicata, Globoquadrina tapuriensis, G. tripartita*).

The upper division of the Krosno Beds contains more diversified microfauna and microflora. It belongs to the NP23-NN1nannoplankton zones (Late Oligocene - Early Miocene) documented by *Reticulofenestra lockeri, R. ornata, Cyclicargolithus abisectus* and *Helicosphaera scissura*. Planktonic foraminifers and dinocysts, found in the lower part of this division confirm its Late Oligocene age.

The Jasło limestone and the Zagórz limestone correspond to the NP24-?NP25 nannoplankton zones (Late Oligocene). Nannoplankton in accompanying shales is scarce, with dominating *Cyclicargolithus floridanus, C. abisectus* and rare *Reticulofenestra lockeri.*

The age of the thick-bedded sandstones in the upper part of the upper division has not been precisely determined, because of the lack of microfossils. The position of the sandstones in the sections suggests that they can correspond to the Late Oligocene - Early Miocene.

RADIOLARIA FROM THE K/T BOUNDARY DEPOSITS IN THE MAGURA UNIT (POLISH AND CZECH OUTER CARPATHIANS)

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The radiolarian assemblage from the upper Maastrichtian to lower Palaeocene deposits of the Magura Unit has been investigated on the territory of Poland (Grybów and Szymbark area) and in the Czech Republic (vicinity of the Uzgruň settlement near the Slovak border). These deposits are represented by deep-water facies, composed of dark-grey and greenish shaly silts and argillaceous shales, alternated with thin- and medium-bedded, fine and medium grained, calcareous sandstones. They correspond to the Inoceramian Beds (Polish part) and to the Soláň Formation (Czech Republic)

The preliminary research documented abundance of radiolarian fauna in the upper Maastrichtian part of the sections. Well preserved, mostly pyritized radiolarians are dominated by the nassellarians belonging to the genera: *Theocapsomma, Gongylothorax, Cryptamphorella, Siphocampe, Rhopalosyringium, Myllocercion, Eostichomitra, Stichomitra, Dictyomitra, Amphipyndax* and *Cryptocapsa.* Common and characteristic species are *Cryptocapsa asymmetros, Dictyomitra lamellicostata, D. multicostata, Theocapsomma teren, T. comys, Gongylothorax verbeeki, Siphocampe daseia, S. bassilis, Rhopalosyringium magnificum, Amphipyndax pseudoconulus, A. tylotus, Stichomitra stocki, S. bertrandi, Eostichomitra asymbatos, Myllocercion acineton* and *Afens liriodes.* Spumellaria are less frequent in the association investigated. They are represent by such genera as *Pseudoaulophacus, Patellula, Praeconocaryomma* and *Orbiculiforma,* with numerous specimens of *Pseudoaulophacus floresensis* and *Orbiculiforma renillaeformis.*

The position of the K/T boundary in these deep-water deposits was estimated approximately, based on agglutinated foraminifera and calcareous nannoplankton (Bubik *et al.*, in print; Ślączka *et al.*, 1993). Radiolaria in this interval and in the earliest Palaeocene were very similar like in the Late Maastrichtian. A content of radiolarian assemblage change did not directly at the K/T boundary, but in the Early Palaeocene. A number of species and abundance of radiolarians decreased, and the assemblage is dominated by spherical spumellarians.

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CENOMANIAN/TURONIAN DEEP-WATER DEPOSITS IN THE WESTERN PART OF THE SILESIAN UNIT (POLISH OUTER CARPATHIANS)

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Several outcrops of the Cenomanian/Turonian deposits in the western part of the Silesian Unit (surroundings of Kalwaria Zebrzydowska), represented by deep-water facies have been studied in relation to their age and palaeoecology, based on foraminifers and radiolarians. These deposits are known in the Polish Outer Carpathians as the "green shales with radiolarians and radiolarites", and they are used as a correlation horizon within mid-Cretaceous flysch. They occur between the Lgota Beds (Albian - Cenomanian) and the Godula Beds (Turonian - Senonian) in the Silesian Unit. The studied deposits are composed of green siliceous and marly shales alternating with red, green and black radiolarites, black manganese shales, glauconitic mudstones and sandstones. The series is folded and broken into several scales.

The age of these deposits was determined on the base of foraminifers and radiolarians. Planktonic foraminifers are very scarce (few specimens per sample), however, the occurrence of *Rotalipora cushmani*, *Helvetoglobotruncana praehelvetica* and *Dicarinella ?canaliculata* in various parts of the section suggests the latest Cenomanian/earliest Turonian age. It is confirmed by the presence of *Plectorecurvoides alternans* in the lower part of the green shales and the occurrence of a few marginotruncanids together with *Uvigerinammina jankoi* in the red shales, which lie close above of the green shales.

Radiolarians are very abundant in the whole series of green shales. The assemblage is diversified with frequent cryptocephalic and cryptothorasic Nassellaria as: *Holocryptocanium tuberculatum*, *H. barbui*, *Gongylothorax siphonofer*, *Cryptamphorella conara*, *Squinabollum fossile*. Moreover, there occur multisegmented Nasselaria as: *Pseudodictyomitra pseudomacrocephala*, *Dictyomitra montisserei*, *D. formosa*, *Stichomitra stocki* and *S. communis*. Spumellaria, such as *Praeconocaryomma lipmanae*, *P. universa*, *Pseudoaulophacus putahensis*, *Crucella cachensis*, *Cavaspongia antelopensis*, *Patellula andrusovi* and *Alievium superbus* are rare in the deposits. The Late Cenomanian age is documented by *Crucella messinae*. The occurrence of *Pseudoaulophacus putahensis*, *Crucella cachensis*, *Patellula andrusovi* and *Alievium superbus* is correlated with the Early Turonian.

Benthonic foraminifers are scarce, low-diversified (1 to 7 species), with dominance of agglutinated thin-walled epifaunal forms (ammodiscids, glomospirids and trochaminids), practically devoid of tube-shaped forms. Some specimens of *Trochammina* are characterized by test morphologies with loosely agglutinated grains. The features of microfaunal assemblage in the green shales of Cenomanian/Turonian age reflect a development of oxygen-depleted bottom and interstitial water conditions, which changed upsection (in red shales of the Godula Beds) to more oxygenated, as shown by rapid radiation of agglutinated foraminifers.

GEOLOGICAL, STRUCTURAL, FLUID INCLUSIONS AND STABILE ISOTOPE STUDIES OF THE Zn - Pb - Ag DEPOSITS, NORTEAST FAGARAS MOUNTAINS AREA, ROMANIA

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In the northeast Fagaras Mountains Area part of South Carpathians,the stucture of cristallyne rocks reflect the superimposition of many phases of Alpine deformations.

The structure is complicated by presence of Birsa Fierului granitoid intrusion and a verry large dyke suites , with different petrochemical compositions.

Numerous mineralisations related to discordant shear zones and quartz ±- calcite ±-sulphides veins have been invesigated by crush - leach technique and capillary ion analysis to determine the cationic and anionic composition of fluid inclusions.

The fluid inclusions related to Pb - Zn - Ag mineralizations are verry complex as composition. This composition is built up of NH_4^+ K^- ,Na^+ ,Ca^{2+} Mg^{2+} Mn^{2+} Fe^{2+} as major cations. Major anions or ligands wich have been detected are Cl^- SO_4^{2-} HCO_3^- $HSiO_4^{3-}$ less frequently appear SO_3^{2-} and $S_2O_3^{2-}$ According to Na - Ca - K geothermometer the temperatures of the ore depositions in Norteast Fagaras Mountains correspond probably to the following domains 15o^0 - 2oo^0 C for sulphides, 1oo^0 - 12o^0 C for quartz and 1oo^0 - 110^{0}C for calcite.

The isotopic values $\delta^{34}S$ for sphalerite and galena are ranged between + 2,29 $^0/_{00}$ + 2,79 $^0/_{00}$ and - 0,25 $^0/_{00}$ - + 0,65 $^0/_{00}$ respectivelly.

The ratio $\delta^{34}S_{sp}$ $\delta^{34}S_{gn}$ as a conclusive of partial studies,reflects the equilibrium state of ore forming solutions.

DISTRIBUTION OF SELECTED MINOR ELEMENTS IN MAFIC AND ULTRAMAFIC ROCKS OF THE EASTERN FAGARAS MOUNTAINS . ROMANIA

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Fagaras Mountains represents the Eastern part of The South Carpathians.

The area consists of Upper Proterozoic polymetamorphics and sometimes migmatised formations. It includes relatively numerous mafic and ultramafic rocks petrographically very various (lamprophyres, metaperidotites, eclogites, amphibolites).

The great majority of mafic and ultramafic rocks is found as lenticular bodies with superimposed metamorphic structures, showing mixed mineral asemblages magmatic relics (pyroxenes, amphiboles, sphen,ilmenite) am metamorphic minerals (actinote, clorite, epidote-clinozoisite, calcite).

The associations of elements in this rocks have a distinct geochemical features wich confirm the different origin deduced by mineral assemlages.

We underline the folowings two exemples:

1. Bardas and Venelu occurences ,ultramafic rocks gradually passes into the metabasites are caracterised by the presence of 26-6oo ppm Cu, 37-55ppm Zn, 3-5 ppm Ga, 33o-15oo ppm Ni, 6o-loo ppm Co, 7o-3.1oo ppm Cr, 17 - 24o ppm V, 5-14 ppm Sc, 1o-13 ppm Y, 16-2o ppm Zr ;

2. Crucisoara occurrence eclogites caracterized by 5-7 ppm Ga, 27o-3oo ppm Ni, 29-34 ppm Co, 3.oo-3.4oo ppm Cr, 165-22o ppm V 32-38 ppm Sc, 14-18 ppm Zr, 1-2 ppm Yb, 55-18o ppm Sr, 15o-3oo ppm Ba, 5-36 ppm Pb, 42-55 ppm Cu.

On the geochemical study the amphibolitic rocks are divided in two groups ortho--amphibolites richer in Ti, V, Cr, Co, Ni and para--amphibolites more poor in thise elements.

LANDSLIDES IN THE LIPTOV BASIN IN SLOVAKIA AND THEIR INFLUENCE ON AN ENVIRONMENT

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The Liptov Basin represents an extensive intramountainous basin, which is bounded on the north by Chočské vrhy Mts., West Tatras Mts. and in the south by Low Tatras Mts.

In Liptov Basin are created the suitable conditions for generation of slope deformations, which are generated on typical slope deformational structures. First of all it is structure where quarternary (respectively neogene) terrace gravels lie on the flat interhands on weathered claystone, respectively flysch development of Paleogene, or where the transversal valleys of Vah River and its tributaries cut front of Paleogene sandstones and claystones.
Owing to favourable activity of the natural factors (for example stream erosion, weathering, rainfall and temperature anomalies) as well as antropogeneous factors (wrong soil agricultural, slope undercuting, or loading) slopes of presented geological structures are modeled prevallingly by processes of slope gravitational landslides of rocks especially by sliding.

By Liptov Basin mapping we have registered 728 landslides. The landslides occupy 58,24 km2 accounting for 15,3% of the whole mapped area. The Liptov Basin so represents one of the most failured Slovak regions, where failured slopes occupy 3,39% of its total area.
According to surface form we distinguished the areal, stream-like and frontal landslides. The biggest dimensions (500x1200m) as well as numerousness acquire the landslides, which occure on mildest slopes. The stream-like landslides are formed in partial depressions on slopes and they are up to 200-1400 m long and 50-450 m wide. The frontal landslides were caused by lateral stream erosion, which slopes are almost coherently flanged by these landslides. They are up to 100-400 m long and thousand meters wide.

With regards to the level of their activity, sensitivity to relevant factors and therefore partly also their temporary stability acquired after the completion of the sliding stage we distinquished three principal types of landslides: stabilized, potential (dormant) and active.
The landslides formation and development is affected first of all by composition and properties of the subjacent Paleogene rocks as well as slope geomorphology and its history. The most intensively are failured areas for med by typical flysch development of Paleogene. On these substratum we have mapped 478 landslides which occupy 40,02 km2 area. Prevailing type of landslides here are stream-like landslides. From activity point of view are prevailing the potential and active landslides types. The average angle of failured slopes is 10,5°. Relatively high number of landslides, 205 are developed on the Paleogene claystones. These landslides occupy 15,4 km2 and they are mostly areal and they are considerably reshaped. Stabilized types prevail, but still they are very sensitive to human-caused changes in the current stability regime. The average angle of slope is 9,26° Other 45 landslides are formed either on sandstone-conglomerate development, or on periphery of accumulation terraces.

The large number of landslides have a major negative impact on the land's economic value and environment. The agricultural land is frequently devalued by the landslides. The slope failures mostly do not enable to use area as a farmland, but only as meadows, or as pastures. The landslides endanger, or damage single settlements as well as industrial plants. Our mapping has revealed that 30 villages and settlements lie on, or are treatened by landslide slopes. In 48 cases the landslides endanger communication routes, some railway lines and high-voltage poles of power lines. In the present the landslides affect on principle the layout, respectively realization of motorway D-1. Finally landslides were one of the major problems in the realization of water reservoir Liptovská Mara construction, which required costly stabilizing precautions.

The landslides in the Liptov Basin are the most extended geodynamic processes which on principle affect engineering-geological conditions in this region. With regards to serious economics damages caused by landslides reactivation mainly unsuitable antropogeneous interventions we compiled special analytic engineering-geological slope-failure maps on scale 1:25.000, respectively a part of region on scale 1:10.000, which can considerably affect safety and the efficiency of construction in this region.

K-Ar AND Ar-Ar DATING OF THE SOPRON MTS., EASTERN ALPS, HUNGARY

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Muscovite, biotite and feldspar were dated from leucophyllite and gneiss of the Sopron Gneiss Formation (SGF, Grobgneiss) and from the andalusite-sillimanite-biotite schist of the Obrennberg member of the Sopron Micaschist Formation (SMF). In SGF muscovite, biotite and feldspar resulted ages from 160 Ma to 76.6 Ma, from 102.8 Ma to 78.5 Ma and from 258 Ma to 85.7 Ma, respectively. Muscovite is present in two generations, the younger generation is phengite. It was formed under hydrothermal conditions in the course of Alpine deformation. Phengite is concentrated in the finer grained (< 200 μm) fraction and there is a tendency that older ages are measured on coarser grained muscovite. This suggests that radiogenic Ar was not completely released from the older muscovite when phengite was formed in the SGF

The youngest ages on muscovite (76.6 Ma), biotite (78.5 Ma) and feldspar (85.7 Ma) are close to each other, this indicates that formation and closure of the new muscovite and closure of biotite and feldspar happened likely near to this datum. An invers relation has been observed between ages and K concentrations of feldspars. Plotting the feldspars from Kópháza in the ^{40}Ar(rad) - K diagram, the fitted straight line defines an age of 74 ± 11 Ma. This proves that older ages on feldspar are caused by excess Ar incorporated likely when the Austro-Alpine Nappe System was formed. The youngest white mica age (76.6 ± 2.9 Ma) was measured on the fine grained (63 - 100 μm) white mica from the leucophyllite at the Vashegy quarry Ar-Ar spectrum was recorded on the coarse grained (500-630 μm) muscovite from this rock. Low temperature ages are around 90 Ma and they increase over 160 Ma at higher temperature steps. This involves, that previously accumulated radiogenic Ar was not fully released when leucophyllite was formed. A surprisingly low, but well defined activation energy of 31.6 ± 1.7 kcal/mol has been obtained for ^{39}Ar release from the muscovite.

There is no correlation betwen biotite age and grain size in the SGF. The range of biotite ages (102.8 - 78.5 Ma) is explained in terms of variable concentration of excess Ar when the rock cooled below the closure temperature. In SMF muscovite and biotite ages range from 177.3 Ma to 95.6 Ma and from 328.5 Ma to 235.7 Ma. Biotites in the SMF are much older than muscovites from the same rocks and biotites from the SGF. The scatter of biotite ages is attributed to variable loss of radiogenic Ar during the hydrothermal tectonic process. Younger muscovite ages are tentatively attributed to the higher closure temperature of biotite in a metamorphic rock, unfortunately, the heterogeneity of grain sizes and/or activation energies did not allow the calculation of closure temperature from an Ar-Ar age spectrum.

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K/Ar DATING OF THE YOUNGEST CALC-ALKALI ROCKS IN THE CENTRAL SLOVAKIA NEOGENE VOLCANIC FIELD

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An abrupt change from calc-alkali andesitic and rhyolitic volcanics towards alkali basalt volcanics is one of the peculiar features of volcanic activity in the Carpatho-Pannonian region, reflected also in Stille's concept of subsequent and final volcanism. As this change corresponds to a fundamental change in geotectonic setting, it is of a great interest to tectonists as well as petrologists. In the Central Slovakia Neogene Volcanic Field (CSVF) the change occured during the Pannonian time. Ages of CSVF alkali basalts are in the interval 8.0 - 6.6 Ma. The youngest calc-alkali rocks in the CSVF are represented by two volcanic formations of high alumina basalts and basaltic andesites, which postdate Late Sarmatian rhyolite volcanics with K/Ar and FT data in the range from 12.9 to 10.7 Ma, however, their more exact timing is unknown. How long is the gap, if any, between the last calc-alkali rocks and first alkali basalts?

The Vlčí vrch formation in the northern part of CSVF represents remnants of a small stratovolcano. Volcanic cone about 2 km in diameter is surrounded by a small volcanic plateau. In the central part erosion has exposed dykes, necks and subvolcanic intrusions. Volcanological analysis indicates a simple volcanic form without significant periods of erosion, what points towards a creation in short time interval - probably not exceeding 50 000 years with exception of intrusions (?). Rocks of the volcano are mostly porphyritic high alumina basalts and basaltic andesites in the range 50 - 56 % SiO_2 with rare late stage hornblende-pyroxene andesites (Konečný et al. 1995). Volcanic rocks of the formation rest over an eroded surface of Badenian and Sarmatian andesite volcanics, relationship to Late Sarmatian rhyolite volcanics can not be directly established. A high degree of original volcanic form preservation indicates relatively young age. K/Ar dating of 7 whole rock samples from lava flows as well as intrusions has given ages from 12.2 ± 0.6 to 9.8 ± 0.6 Ma. Such a large spread in time is not compatible with geological assumptions, it is caused likely by insufficient degassing or possibly Ar loss. At the present stage of our study the most likely time of volcanism is within the average interval of K/Ar ages (11.1 ± 0.8 Ma) corresponding to the Sarmatian/Pannonian boundary.

The Šibeničný vrch complex in the central part of CSVF represents a group of spatially dispersed dykes, sills, necks, lava flows and phreatomagmatic pyroclastic rocks, which are with few exceptions intruded in or rest upon Late Sarmatian rhyolite volcanics (Konečný et al. 1995). Some of the dykes cut Early to Middle Sarmatian andesitic volcanics. Rocks are mostly almost aphanitic olivine-bearing high alumina basalts and basaltic andesites in the range 48 - 56 % SiO_2 and rare two pyroxene andesites in the range 56 - 59 % SiO_2 (Konečný et al. 1995). There is no reason to think that all the occurences are contemporaneous. K/Ar dating of 14 whole rock samples points towards several magmatic pulses in the time interval from 13.7 (?) to 8.2 Ma. Contrary to geological relationships the oldest one with ages from 13.7 to 12.3 Ma overlaps with known ages of Late Sarmatian rhyolite volcanics; this is caused likely by excess Ar and additional work is in progress to solve this problem. Ages from 10.6 ± 0.5 to 11.0 ± 0.6 Ma of dykes in the southern part of Vtačnik mountain range, 11.3 ± 0.5 Ma of the dyke east of Šášovské podhradie and 9.0 ± 0.4 to 9.6 ± 0.4 Ma of a group of necks southwest of Sklené Teplice are not in conflict with geological relationships. Youngest age of 8.2 ± 0.5 Ma is shown by an intrusion near Pitelová.

Latest products of calc-alkali volcanism in the CSVF are represented by overlapping (?) suites of Sarmatian pyroxene, hornblende-pyroxene andesites with ages in the interval 14.5 - 12.5 Ma, Sarmatian (mostly Late Sarmatian) rhyodacite and rhyolite volcanics with ages in the interval (14.4 ?) 12.9 - 10.7 Ma and Late Sarmatian Pannonian high alumina basalts and basaltic andesites with ages in the interval from the questionable 13.7 ± 0.8 Ma or the most likely age of 11.1 ± 0.8 Ma to 8.2 ± 0.5 Ma. The youngest basaltic andesites come very close in time to alkali basalt/basanite activity with ages in the interval 8.0 - 6.6 Ma.

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EXPERIMENTAL SETUP FOR Ar-Ar DATING IN HUNGARY

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The K/Ar method is widely used for geochronological studies in Hungary for more than 20 years. Application of the ^{40}Ar-^{39}Ar method has been necessary in order to decipher the complex thermal and tectonic history of different terranes in Hungary.

The tank-type nuclear reactor of the Atomic Energy Research Institute of 10 MW nominal power has been used for irradiation, where the parameters of irradiation could be adjusted to the requirements of the geochronological laboratory. Irradiations were planned so, that without decreasing the accuracy of ages, the radioactivity of the samples be kept at a minimum. This required the application of Cd shield and irradiation of the samples with the lowest fluence sufficient for the accurate measurement of the ^{39}Ar isotope. In our case a $^{40}Ar/^{39}Ar$(rad) ratio of 50 was sufficient for the accurate measurement and this was achieved with a fluence of about 5×10^{17} n/cm^2 for Hercynian minerals in 7-8 hours.

The position 229/3, within the core, but away from its center, was selected for irradiation. This is a compromise, the fast neutron flux is sufficient here, but the danger of overheating the samples is avoided and the fast/epithermal neutron flux ration is also favourably high at this position. As a result of Cd shield, the low fluence and selection of channel 229/3 for irradiation, the activity of the samples remained sufficiently low and an attempt was made to perform a simultaneous nuclear activation analysis of the irradiated minerals.

Samples and standards were wrapped in 0.1 mm aluminum foil and compressed to cylinders of 6 mm diameter. The cylinders were placed in Al tubes of 50 mm length and 6.5 mm inner diameter. Neutron flux was monitored with Ni and Fe foils along the Al tube. 4 Al tubes were placed in a cylindrical Cd box of 0.5 mm wall thickness, the Cd box was closed hermetically in an Al "bomb" by cold welding. The Al "bomb" was placed in the irradiation can. The monitors indicated a flux variation of 1.45 - 1.65×10^{13} n/cm^{2}sec, under these conditions a great number of standards had been necessary for the accurate measurement of ^{40}Ar-^{39}Ar ages. Instead, a simple solution has been found to rotate the Al "bomb" within the irradiation can by fixing the "bomb" in the can by axis equipped with a propeller. This way, the scatter of fluence at a vertical position of the Al tubes decreased to < 0.3 %.

Typical production ratios are 2.3 -3.2×10^{-6} cc STP ^{39}Ar/gKxhour and 1.0 - 1.8×10^{-6} cc STP ^{37}Ar/gCaxhour. The total activity of irradiated samples after 70 days cooling was < 25 μC.

Stepwise degassing was performed in a furnace attached to the Ar extraction line. The furnace was constructed of 2 concentrical resistance heated cylinders prepared from molybdenum sheet of 0.07 mm thickness. Samples were degassed in a quartz tube placed within the inner cylinder.

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INFLUENCE OF CARPATHIAN MINING REGION ON DNIESTER BASIN SURFACE WATER

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Dniester is one of big river of Europe. Its water is in wide use in drinkable and industrial water supply of many settlements of Ukraine and Moldova. Significant quantity of valuable fish is got out from Dniester. The Carpathian section of water basin is the main area of water flowing of Dniester. At the same time a great number of objects of mining (of Carpathian petroleum and salt producing region,) and chemical industries are concentrated in this region. The ecological condition of Carpathian flows of Dniester was studied during 1997 and 1998 to estimate the influence of Carpathian industrial region on the surface water.

In the results of hydrochemical investigation it has been established that the most of river, including Dniester, are in the satisfactory condition by the hydrogen index (pH), the total mineralization, the macrocomponent composition, contents of iron-, ammonium-, nitrite-, nitrate-ions and the most of microelements those were analyzed. Rivers Tysmenytsa and Syvka, water of which is of sulfate-chloride sodium and chloride sodium compositions with values of total mineralization 0.6 and 2.2 g/l, stand out sharply against others. There is no question that technogenic factors play a major part in forming of their total chemical composition.. The effect of enterprises of cities Stebnyk and Kalush is evident. But the influence of those rivers on Dniester is local and variable, depending on periodic dumps of sewage.

Rivers Bystrytsa-Nadvirnyanska and Dniester before Stryy mouth are most polluted by microelements (metals). It is obviously connected with industrial sewage (enterprises of cities Novy Rozdil and Ivano-Frankivsk), but this fouling is local owing to insignificant ability of metals for migration.

Phenols and oil-products significantly pollute all studied rivers. Their concentrations are more than maximum permissible concentrations for water of cultural purposes respectively in 9-54 and 2.3-15 6 times. High contents of these components are also established in water of Dniester water reservoir, however there are no springs of such pollution there. The materials on the fouling of such type are borne out by the results of the hydrobiological investigations. There is now doubt, that so high contents of phenols and oil-products are the results of the Carpathian mining complex activity. Its influence on the surface water is regional by the fouling of phenols and oil-products.

CRETACEOUS MOLLUSCS FROM CARPATHO-BALKANIDES – EASTERN SERBIA

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The paper presents molluscan specimens collected from shallow water Cretaceous sediments near the city of Pirot (SE Yugoslavia). There are several excellent exposures of cretaceous beds, south of Vlase village in the locality of Sv. Jovan monastery.

Rocks are predominantly thin-bedded basal rudites, claystones, sandy limestones and marls. Based on macrofauna assemblage (*Glauconia kefersteinii, Pyrgulifera boecki, Cyrena cretacea, Pholadomya rostrata, Exogyra colomba* etc.) Turonian-Senonian age was proposed (Andjelkovicj J., 1977, Andjelkovicj M., 1976, 1978). However, the sparse specimens collected from the outcrops determined as *Grammatodon (Nanonavis) carinatus, Entolium orbiculare, Pseudolimea gaultina, Cyprimeria plana, Flaventia ovalis, Panopea acutisulcata*, and *Pyrgulifera stantoni*, indicate earlier age, such as Albian Cenomanian. Aforementioned specimens enable us to suppose that sedimentation here started earlier than it was suggested in the refereed literature.

REGIONAL DEPOSITIONAL MODEL FOR LARGER FORAMINIFERAL DEPOSITS IN THE PODHALE BASIN (LUTETIAN - LOWER BARTONIAN), WESTERN CARPATHIANS, POLAND

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On the northern border of the Tatra Mountains often crop out marine sediments of the Podhale basin of Paleogene age. For the detailed reconstruction of the depositional area were studied 30 sections between the Sucha valley in the east and the Mala Laka valley in the west (BARTHOLDY 1997, BARTHOLDY & BELLAS 1998). The deposition took place on a narrow shelf that deepened to the north into the Tethyan sea. The convergent tectonism of the area controlled the development of the present stratigraphic architecture in the Podhale basin which is a forearc basin in type. On the base of vertical succession of the recorded lithofacies, micro- and nannofossils and their integration as biostratigraphic control, two 3rd order depositional cycles could be identified. They are correlated with the 3.5 and 3.6 3rd order cycles sensu HAQ *et al.* (1988). During the time of deposition of both cycles the rate of subsidence might have been very low.

For the 1st depositional cycle (Upper Lutetian/Lower Bartonian) our model proposes long term, more or less stable environmental conditions. Five parts may be distinguished there: 1) A shore face area with clastic sediments, 2) Back bank facies in a longshore trough with a characteristic association of Larger Foraminifera (LF). 3) Longshore bar, which under these stable environmental conditions is constructed by a monospecific Nummulitic association (bank facies). 4) Shallow to deep neritic succession of, distinct LF communities with a depth dependence in shape (fore bank facies) and 5) deep water deposits of the bathyal with Glaukonite and Globigerinids in it.

A small scale, rapidly change in the microfacies types marks the 2nd depositional cycle of our model (Middle/Upper Bartonian) There has been distinguished the following subdivisions: a back- and foreshore setting with clastic sedimentation, longshore trough setting with partly restricted, oligotrophic conditions, land-plant remains, in deeper parts a mass-occurrence of crustose red algae, a longshore bar, consists of bioclastic material, a shallow neritic area with a biogenetic stabilized bottom and *Heterostegina* sp. and deep neritic to bathyal parts of the basin with calcareous turbidites and *Globigerina* marls. Non stable environmental conditions are supposed for this 2nd cycle by the model being characterized by a distinct decrease in the diversity of the recognized LF communities. This paper is a contrib. to IGCP 393.

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QUATERNARY TECTONICS OF THE ORAVA BASIN GEOMORPHOLOGICAL AND GEOPHYSICAL DATA

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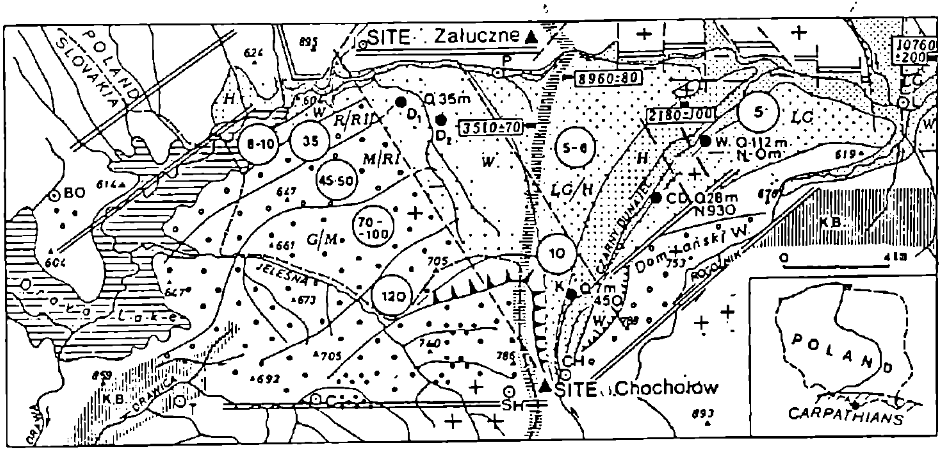
Fault-bounded Orava Basin was formed during Neogene and was enlarged in its NE part during the Quaternary. This intermontane tectonic depression is filled with Upper Badenian through Pontian, fluvial, mainly flood-plain (backswamps) series up to 950 m thick. The extend of tectonic depression was analysed by use geophysical methods (gravimetry - Pospisil 1993, Pomianowski 1995) in relation to 4 deep borings and geological survey (Watycha 1976). From the Upper Pliocene (Rumun) and during Quaternary the main part of Orava Basin with its surrouding was uplifted and only in the NE part new system of grabens and horst was formed. Both the borings and interpretation of seismic refraction and reflection profiles elaborated by geophysists from Academy of Mining and Metallurgy in Kraków (Ślusarczyk and Dec 1998) indicate, that tectonic subsidence was acitive during the Quaternary. Flat surface of Late-Vistulian and Holocene alluval fan of Czarny Dunajec River represents subsiding part. This fan is now dissected up to 6 m. The part which was uplited during Quaternary in relief represents system cut-and-fill terraces forming complex system of Czarny Dunajec fan flowing together with Orava River to Wah and Danube that means to Black Sea. There are 6 terraces: 12, 35, 45-50, 60-70, 100 and 150 m in height with Neogene rocky socles. In the zone between uplifted western part and subsiding north-eastern one the würmian part of complex fan with paleo-braided river system was conserved under thick Holocene raised peat bog. These paleo-channels indicate the outflow to the west. But 112 m thick Quaternary deposits in Wróblówka graben and ca 50 m in Pieniążkowice graben document Czarny Dunajec river outflow from the Tatra Mts to Dunajec and Vistula system. Such situation was interpreted as tectonically conditioned shift of European water-divide during the Quaternary.

Tectonic process of grabens formation in NE part of Orava Basin is continuing till now because present-day activity of earth-quake concentrates on the boundary of uplifted marigin of Orava Basin along the Domański Wierch hill built with Pliocene uplifted molassa. The secondary epicentres are localised in subsiding area. The last earth-quake of 11 Septenber 1995 had magnitude Ms =3,7 and intensity I= 5° Such earth-quake was repeated each 30 years. Macro- and microseismic analysis of this earth-quake was elabotated by M.Hojny-Kołoś from the Institute of Geophysics, Polish Academy of Sciences (Baumgart-Kotarba, Hojny-Kołoś 1998). The depth of last earth-quake focus was calculated at 6 km that is in agreement with tectonic model elaborated by Lefeld and Jankowski (1985). Domański Wierch hill belongs to important tectonic line which is well visible on satellite image and was named „lineament of western marigin of Tatra Mts" (Baumgart-Kotarba 1981). Nemčok (1995) has distinguished this line as „Prosecno tectonic system" This line consists southern fault of Chocz Mts, tectonic contact between uplifted Tatra Mts and Inner Carpathian Flysch, and its NE prolongation is Krowiarki pass fault described by Bac-Moszaszwili (1993) and Domański Wierch fault interpreted by Birkenmajer (1958). Continuation of this line seems to be waste Lepietnica Valley where prevously NE direction is changed to NNE. Author's hypothesis is that this line represents left lateral strike-slip fault which was very important during formation of Neogene Orava Basin. The Orava Basin became open due to block type horizontal movements being common for both Inner and Outer Carpathians. According to this hypothesis Orava Basin was openning due to tension between rotated to NW so-called Orawa block and shifted to NE Tatra block (Baumgart-Kotarba 1996). Probably, Quaternary subsidence in the NE part indicate, that the same tectonic mechanism is active till now, while the SW and S part is now rather in compressional regime.



WÜRM GLACIATION IN THE TATRA MTS WITH COMPARISON TO THE AUSTRIAN ALPS

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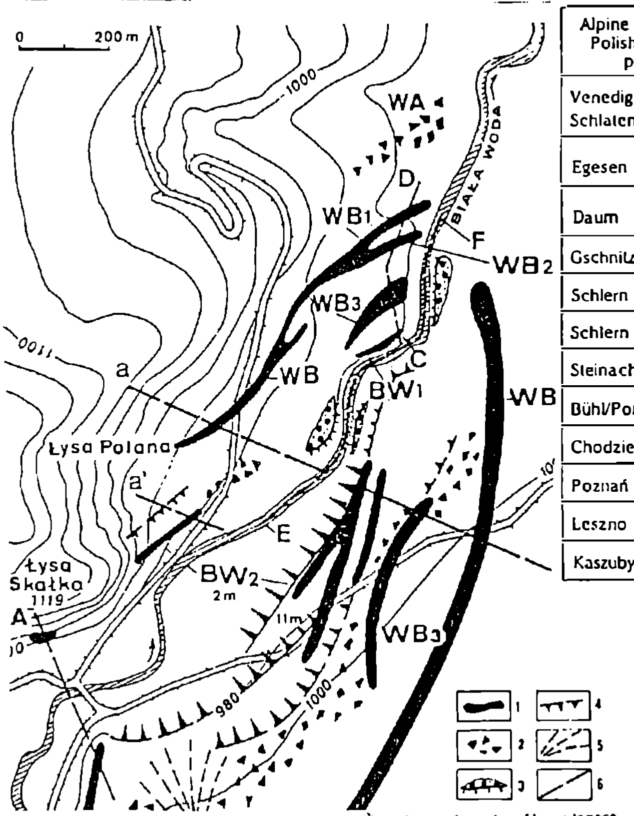
Würm glaciations in the Tatra Mountains related to the last glaciation period (Vistulian) are presented on the Biała Woda valley example. In this valley the longest glacier system (ca. 12.5 km) was formed on the northern slope of the mountains. The extent of two maximal stadials: older than 60 ka BP from early Würm (WA) and younger one related to main stadial WB (ca. 20 ka BP), and lateral and terminal moraines of recessional stages were reconstructed. In the Biala Woda valley 10 stages of recession was established (BW1-BW10) and in tributary valley 7-8 stages. The chronology of recessional stages was elaborated at several crucial sites due to radiocarbon datation of lacustrine deposits and deposits from dead-ice hollow. In three valleys it was possible to distinguish moraine ridges correlated with Gschnitz and Daun Stages in the Alps. The radiocarbon data 8.300 BP from the bottom of peat bog within dead-ice hollow (at 1390 m. a.s.l.) below Morskie Oko morainic ridge, and palynological analysis give the possibility to conclude that the last glaciers in the Tatra Mountains survived until Venediger oscillation in the Austrian Alps (8,700-8,400 BP) and disapeared at the beginning of the Atlantic period when the upper timberline reached the height about 1400 m a.s.l. Present-day position of the timberline on the northern slope of the Tatra is 1550 m a.s.l. and mean annual temperature 0°C is situated at 1850 m a.s.l. An attempt to paralelize glacial stadials and recessional stages in the Tatra Mountains and in the Austrian Alps is shown in the table. The Austrian Alps chronology is based on Patzelt and Bortenschlager publication (INQUA Excursion Guide-Book, 1995). On the figure the maximal extent of stadials WA and WB at Łysa Polana site in the Biala Woda valley and two oscillations related to glacier recession BW1 and BW2 are shown. These recessional stages were also correlated with Polish Lowland chronology - Chodzież Phase (17 ka BP) and Pomerania Phase (15 ka BP). The age of Early Würmian stadials was established due to archeological data from Obłazowa Cave (Valde-Nowak, Madeyska, Nadachowski 1995). There are three Mousterian culture layers, and younger Szeletian and Gravetian layers. The main stadial WB in the cave was documented by large block deposition marking strong periglacial weathering. The main stadial in the valley in manifested by climate conditioned aggradation on the foreland of the Tatra Mountains. The series from stadial WA was deposited in the cave below Mousterian layers.



. 1 — moraine ridges, 2 — bouldery covers, 3 — transitional cone, 4 — edge of kame terrace, 5 — road, 6 — course of the profiles

Alpine stages and Polish Lowland phases	BP ka	Biala Woda	Rybi potok	Roztoka
Venediger Schlaten	8.7–8.4 9.5	BW10 1,950 1,760	RP6–RP7 > 1,840 2,050	R7 1,950
Egesen	10.7–10.2	BW9 1,600	RP5 1,600 (1,800)	R5–R6 1,840 1,890
Daum	12	BW8 1,300 BW7 1,280	RP4 1,416	R4 1,700
Gschnitz/Gardno Ph.	13	BW6 1,150	RP2–RP3 1,360	R3 1,350 (1,580)
Schlern II	—	BW5 1,080	RP1 1,300	R2 1,260
Schlern I	—	BW4 1,020	tributary glacier	R1 1,220
Steinach	14	BW3 1,000	tributary glacier	
Bühl/Pomeranian	15	BW2 980		
Chodzież Subphase	17.2	BW1 957		
Poznań Phase	18.4	WB3 970		
Leszno Phase	20	WB1–WB2		
Kaszuby Stadial	> 60	WA 950		

SEDIMENTOLOGICAL FEATURES OF THE CARBONATE CRETACEOUS/TERTIARY BOUNDARY SECTIONS FROM THE EAST BULGARIA

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The Cretaceous/Tertiary boundary in Bulgaria was described first near the Black sea coast in the vicinity of Bjala town (Stoykova, Ivanov, 1992). The investigated sections are complete, uninterrupted across the Cretaceous/Tertiary boundary interval. Biostratigraphical, mineralogical, geochemical and magnetostratigraphical sudies have been provided in the recent years (Preisinger et al., 1993a, 1993b; Ivanov, Stoykova, 1994; Ivanov, Stoykova, 1995; Rogl et al., 1996 et al.).

The presented investigation is provided in order to characterized the sediments and the depositional processes near the boundary interval. It is based on the microscopical study of the three sections.

Upper Maastrichtian sediments are presented of irregular alternation of marles (predominately) and clayey limestones with grey colour. The bed thickness is from 10-15 cm to 50 cm, sometimes indistinct. Trace fossils (including Zoophicus) are typical. Textures are mud supported with 10-15% allochems (mainly planctonic foraminiferas, calcareous nannoplancton, radiolarians, single small fragments of echinides and ammonites). Foraminifer waskestones and mudstones/waskestones are determined. Calcium carbonate content in the samples is from 66 to 80%. Admixtures of terrigenous aleuritic quartz and authigenic pyrite and glauconite are insignificant. The bottom water dinamics in the time of sedimentation was weak. Predominately presence of the planctonic fauna as well as deep water ammonite genera indicated deep water environment during the sedimentataion. It may be considered that Upper Maastrichtian sediments were deposited in the open sea shelf facies.

The boundary clay is 2-4 cm thick with dark grey to black colour. Poorly preserved nannofossil fragments have been determined very rare in it. This layer is composed of smectite, quartz, feldspar, mixed-layered clay minerals and calcite. Highest iridium content (7,1 ppb) is recorded in the lowermost part of the boundary clay. It is very possible that the boundary clay is strongly condensed because of the calcite dissolution.

Sedimentation in the earliest Danian continue with the deposition of marles and clayey limestones. Planctonic fauna (foraminifers and calcareous nannofosils) is typical for this sediments again. Foraminifer waskestones and mudstones/waskestones are established. Terrigenous admixtures are insignificant. Water debth in the earliest Danian was considerable. Till now there are not indications for shellowing of the basin after the boundary event.

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THE IONIAN BASIN, A POTENTIAL FOR HYDROCARBON EXPLORATION FIELD: BIOSTRATIGRAPHIC-SEDIMENTOLOGIC DATA USING CALCAREOUS NANNOFOSSILS AND LARGE FORAMINIFERA (NW. GREECE, EPIRUS)

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It is far well known the westward moving direction of the Hellenic nappes, their subsequently stacking and thus, producing of the arc-shaped geologic pattern usually known as „isopic zones". The latter pattern is consisted of nappes with a present NNW-SSE strike at the north Greece bending on Crete island to an almost W-E strike, therefore, developing a form closely resembling that of the seismically active Aegean Arc and Trench System which partly governs today the geology of the eastern Mediterranean Sea. During the latest Eocene, Oligocene and Early Miocene, in the External Hellenides orogenic belt, the Ionian palaeobasin was largely a clastic sedimentation area, bordered to the east and to the west by the Apulian and the Gavrovo carbonate platforms respectively. Tectonic deformation of the primary basin, caused development of many smaller asymmetrical su(b)asins usually oriented along the prementioned NNW-SSE direction. The general younging of the onset of Flysch sedimentation from the east to the west has been considered an important evidence for the thrusting migration in Greece, the palaeobasins evolution and in turn the present complex geo-tectonic situation (complete list of literature in BELLAS 1997).

This work is related to the clastic, mostly marine deposition of the Flysch rock-sequences of the Ionian palaeobasin (formely a foreland basin depocenter of the present signifi-cantly shortened through the thrusting Ionian isopic Zone sequences) of the northwestern Greece (Epirus area). Based on a combination of revised biostratigraphic data, elements of sequence stratigraphy and primary Total Organic Carbon (TOC) and Total Sulphur (S) data we attempt herein to establish the hierarchy of the stratigraphic pattern of the Plataria su(b)asin (eastern External Ionian Zone subdivision). That is made, after the recent interest of oil companies, in order to better understand this basin's stratigraphic framework and thus, predicting in the future localisation of new provinces of energy accumulations (hydrocarbons and relative reservoirs), thereby increasing the effectiveness of exploration and promoting the economic development of this region.

We reinvestigate the Argyrotopos, National Road and Monos outcrops, all located in the Plataria syncline which is situated at the eastern part of the external Ionian Zone. Stratigraphically the Plataria su(b)asin considers the following succession (from bottom to top): 1) Transitional Beds Unit (latest Eocene), 2) Ayii Pantes Formation, 3) Turbidite Unit and 4) Upper Flysch Unit, the latter straddling the Oligocene/Miocene boundary (IGRS/IFP 1966, BELLAS 1997).

Abundant, well preserved Larger Foraminifera (LF) of the Lepidocyclinidae group were recovered from two graded limestone beds of the Ayii Pantes Formation (Argyrotopos section). These beds are interbedded in a thick marly sequence which yielded abundant calcareous nannofossils and planktonic foraminifera, therefore permitted precise placement of the association in the *Sphenolithus predistentus* Interval Zone (BELLAS 1997) of the latest Rupelian (partly equivalent with the lower part of NP24 sensu MARTINI & MUELLER 1986 and the P20/P21 zones of BERGGREN et al. 1995). Occurrence of the studied shallow-water members of the euphotic zone LF resulted from slightly transport and subsequent redeposition and not from reworking. Such cases are well differentiated, the former being clearly related to turbidite and debris flow processes. Both events of redeposition at certain levels, are mainly linked to fluctuations in sea level and lesser to tectonic events. The very good biostratigraphic control assures accurate dating of these events which were found to be coeval with a lowering of sea level during the upper Lower Oligocene. Additionally, the Oligocene/ Miocene boundary was determined in Monos section, at the top of the *Reticulofenestra scissura* Interval Zone (correlated with the NP25 and CP19 Zones of MARTINI 1971 and OKADA & BUKRY 1980). Upsection, many associated bioevents occur like the LO of *Ilselithina fusa*, and *Zyghrablithus bijugatus*.

In terms of sequence stratigraphy the biostratigraphically demonstrated younging of the Flysch base (Transitional Beds Unit-latest Eocene) may be interpreted on a large scale, as an onlap in a westward direction. The onlap surface of the External Ionian was not subaerially exposed. During the upper Lower Oligocene, followed the prementioned lowering of the sea-level which corresponds to the 4.5 (TA4) to 1.1 (TB1) third order cycles of the sea-level pattern (after HAQ et al., 1988).

First estimations of the base level values (lowest) of the TOC in the lighter in colour marly limestones and mudstones of the Plataria su(b)asin gave values which range between 0,01 and 0,67% per weight. Total S values are lower than 0,01% per weight. Samples of dark-brown material (highest values expected) are under preparation and a correlation of them is going to be undertaken between the Middle and the Internal Ionian Zone as well.

As it is inferred from the recorded microfauna and flora bioproductivity was high enough to produce a relatively high concentration of organic material (OM) within the Ionian palaeobasin. Development and migration of hydrocarbons, together with the structural and diagenetic framework, is much affected by halokinesis and preservational fluctuations of OM. Oxygen is a significant factor controlling the preservation of OM and poor conditions of it are related to maximum flooding surfaces. Therefore, the present documentation of certain sea-level fluctuations in the Ionian supported by high resolution biostratigraphy is of major importance for the programming of future explorational directions.

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FOSSIL AND RECENT ALLUVIAL GOLD MINERALIZATIONS IN ROMANIA

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Gold mineralizations of Romania can be classified in following according to general temporal relations to magmatism, sedimentation, metamorphism and deformation:

A. Volcanic-subvolcanic rock associations vein, breccia pipe, lense, disseminated types.

B. Intrusive rock associations stockworks, veins and complicate veins and all rock alternation types.

C. Metamorphic rock associations concordant and discordant quartz veins, quartz veinlets and disseminated types related with shear zones or with ortorocks.

D. Sedimentary rock associations gold bearing conglomerates and placers.

The A, B, C types have been studied better than D type, and at present time main gold produce form Neogene volcanic area. We note an unsignificant amount of gold produce from placer deposits.

The source of gold from D type are the A, B, C types of mineralizations. The content of gold in fossil and recent placer mineralizations as confined by the crust of weathering (cw) in geohystorical evolution of source areas. In these areas the crust gold content increases 3.5-5 times more as compared with the primary deposits or occurrences.

In general all the rivers and their tributaries from Romania have gold in alluvial deposits, but the richest are in South and North Apuseni Mountains (Aries, Crisul Alb, Mures, Somes Rivers) and in piemonts or western border from South Carpathians (Olt, Arges, Sebis, Nera, Timis Rivers). In these regions are known the gold deposits related with Neogene volcanic-metallogenetic products and, respectively, shear zones in cristalline schists. Aries, Mures, Crisul Alb and Pianu Rivers could have potentially productive gravels in many areas.

Gold occurrences related with Upper Cretaceous conglomerate in continental facies from Pianu de Sus (Cibin Mountains), Vartop and Haragusu (Metaliferi Mountains) have been intensely exploated and are nearly exhausted.

Most of the gold is finely-divided, but occassional smale nuggets, flakes and wires have been found, sometimes attached to fragments of rusty quartz.

NEOGENE VOLCANIC-SUBVOLCANIC STRUCTURES AND ASSOCIATED PORPHYRY GOLD-COPPER, GOLD-BEARING EPITHERMAL DEPOSITS IN SOUTH APUSENI MOUNTAINS, ROMANIA

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Romania can be boardly divided into Tethys-Himalayan and Marginal East Europen two tectonic domains. In spatial distribution, these are represented as the through-arc-basin (TAB) tectono-stratigraphic patterns the former and as the continental margin (CM) tectono-morphologic features the latter. We can divide the geohistory of Romania into Cryptozoic and Phanerozoic rift and plate tectonic movements. Numerous Pre- and Alpine nappes, dextral and senextral faults have been remarked within Romania.

In South Apuseni Mountains (SAM), the Neogene volcanic-subvolcanic activity and related metalogenesis have been manifested in an active continental margin represented by inter-montane basin and intracontinental rifting.

The volcanic products have calc-alkaline feature and have developed in three main episodes: 1. Langhian (rhyodacite tuffs); 2. Kossovian-Pontian (andesites, quartz andesite, dacite, basaltic-andesites, 13.5-7.39 M.y.) and 3. Pliocene (latites, 1.6±0.11 M.y.). The andesites, quartz andesites and dacites present a great diversity of volcanic structures, such as: extrusive and intrusive domes, lava flows, talus, pyroclastics, stratovolcanoes (Cetras, Barza), caldera (Talagiu), dyke, stocks, plugs. The subvolcanic bodies are characteristic for stratovolcanoes and caldera structures.

The major Neogene metal deposits of SAM can be classified as volcanic-subvolcanic hosted (Au-Ag, Pb-Zn-Au-Ag and Pb-Zn±Cu, Au, Ag epithermal low sulphidation veins, stockworks, breccia bodies, lenses; As-Cu high sulphidation veins; Cu-Au porphyry in andesite-porphyry microdiorite rocks) and sediment-hosted (Hg dissemination, pyrite±Au and Pb-Zn skarnes). The time of ore deposition correspond with Upper Badenian-Lower Sarmatian and Upper Sarmatian-Pontian. The veins, magmatic-hydrothermal breccia bodies and porphyry ore bodies are the most representative; in many cases, there is a spatial co-existance between the epithermal and porphyry systems.

The formation temperature (° C), pressure (bar) and salinity (NaCl equiv, wt%) in each system, based on fluid inclusion studies, are 700 - 1000, 200 - 250 and 78 - 87 for porphyry system and 450 - 125, <150 and <20 for epithermal system. Boiling fenomena are recognized in primary fluid inclusion in comb quartz precipitating alternatively with magnetite-hematite, pyrite, chalcopyrite, bornite, gold in porphyry system and adularia with free gold, silver, sulphosalts and common sulphides in epithermal system.

ENGINEERING GEOLOGICAL AND GEODYNAMIC MODEL OF SOFIA GRABEN

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Sofia graben is a negative tectonic structure filled with Neogene and Quaternary sediments. The basement of the graben consists of different age rocks limestones, sandstones, marls, andezits. The bedrock is irregular sinked. A great number of secondary horsts and grabens are formed during the normal faulting (Fig. 1). The most subsided parts of the basement are the areas of the town of Elin Pelin (approx. 1200 m) and between the villages Chepinci and Miroviane (800 - 900 m). The bedrock of the central part of Sofia city is risen and the thickness of the covered soft soils is about 30 - 50 m. As a whole, the Sofia graben has mosaic-block structure in depth. Neogene- Quaternary filling consists of gravels, sands, clays and coal strata. They have limnic facies which determined their irregular thickness and continuity.

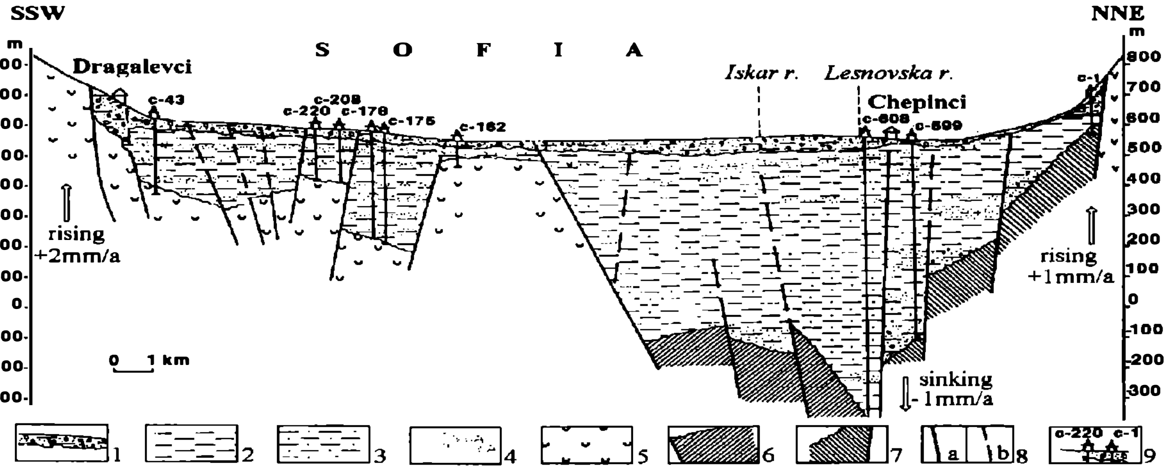

Figure 1. Geological cross-section of Sofia graben: 1-Gravels, sands, clays (Q); 2-Clays (N_2); 3-Sandy clays (N_2); 4-Sands (N_2); 5-Volcano-terrigeneous formation (K_2); 6-Sandstones, marls, limestones (K_2); 7-Sandstones (T_1); 8-Faults: a-established, b-supposed; 9-Borehole, ?

The recent vertical earth-crust movements and the earthquakes are the appeared endogenic processes. They have acted permanently during the past geological periods and nowadays they predominate the contemporary development of the graben. The main trends of the recent tectonic movements are the uplifting of north and south parts of close mountains (up to 2 mm/a) and sinking of the central part of the graben (approx. 1 mm/a). The vertical tectonic movements hold on the geodynamic activity of physico-geological processes.

The Sofia region reacts to local and outside earthquakes. The Sofia seismic zone includes the Sofia graben and the neighbour areas. According to historical sources a few destructive earthquakes are occurred there. The strongest one accurate documented, has appeared on September 18th 1858. Almost all houses, churches, mosques have been affected, cracked and many of them completely destroyed. The magnitude is assumed to be M=7.0 and intensity according to MSK-64 - I_0=IX. The seismic statistics show that earthquake activity in the Sofia seismic zone is concentrated mainly along the active faults in Sofia graben.

A few groupes exogenic processes are occurred in this region. The weathering, rockfalls and screes are appeared in the areas consist of hard brittle rocks with strong structural bounds. The erosion, landslides, creep of slopes and mudflows are occurred in the periphery of the graben, on the hills and riverslopes. In the lowland part of the kettle seasonal fluctuations of groundwater table, liquefaction of sands, marshlands and volume inconstancy of clays are observed.

Two engineering-geological zones are separated according to geological structure, geodynamic development of the Sofia graben and the distribution of destructive geological processes. The first zone includes the peripheral areas of the graben where the bigger part of contemporary active faults and the epicentres of destructive earthquakes are localised and the intensive geodynamic processes are occurred. The second zone covers the central part of the kettle where the relief is plane and the appeared phenomena are connected with the groundwater table fluctuations. The main tendency determined by the interaction of endo- and exogenic processes is an increas of the destructive geological effects from the centre to the periphery of the kettle.

ALPINE STAGES OF DEFORMATION AND METAMORPHISM IN SOUTH CARPATIANS

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The geographic South Carpathians (SC) represent the Inner South Carpathians Cretaceous fold and thrust belt (Dacides) and are bordered southwards by the Tertiary fold and thrust belt of the Outer South Carpathians, burried below Plio-Quaternary deposits, but outcropping estwards as Moldavides of the Eastern Carpathians. From the beginning of this century a nappe structure of the SC was recognised and refined by many geologists; the broad picture is, from top down: Getic-Supragetic Units; Severin (or Krajina, for serbians) Units and Danubian Units. Severin (Krajina) Units are composed only from Upper Jurassic-Lower Cretaceous turbidites and basic-ultrabasic rocks and were considered to represent an oceanic crust, sandwiched between the continental Getic-Supragetic and Danubian blocks.

Like in most regions of the Alpine belt of Southern Europe, in SC the Cretaceous collision between Europe and Africa generated nappe stacking. The stratigraphic and tectonic data point to two stages of severe compression: 1) Mid Cretaceous overthrust of several units in the Getic-Supragetic realm and the underthrusting of Severin realm in respect with the Getic-Supragetic one; 2) Late Cretaceous internal thrust in the already built Getic-Supragetic nappe pile, overthrust of Getic-Supragetic plus Severin units on the Danubian realm and several thrust inside the latter, giving the Danubian units. Strain indicators point to SSE directed nappe stacking in the east of the Danubian Window (Schmid et al.), but in the west previous top to N and ENE directed contractions were found (Neubauer et al.). Upper Cretaceous deposits outcrop both in Getic-Supragetic (here as post-nappe cover) and Danubian, where their position as normal top of the Mesozoic cover was recently contested by Seghedi et al. and Bojar et al., due to their turbidic and andesitic nature, showing an accretionary wedge envinronment. Because Upper Cretaceous turbidites outcrop at the top of several distinct Danubian units, this geometry imposes a first phase of regional thrust of Upper Cretaceous flysch on top of Upper Jurassic-Lower Cretaceous carbonatic deposits, followed by the imbrication of individual Danubian units. In Petreanu Mts a main tectonic plane cuts thrust planes in both upper and lower walls and was used to separate Upper Danubian Nappes from Lower Danubian ones; according to Seghedi & Berza, this plane separates two Danubian duplexes, the roof thrust being the sole of the Getic nappe and the floor thrust being a precursor of the intra-Sarmatian thrust of the South Carpathians on the Moesian Platform.

Post-nappe orogen-parallel extention was advocated by Ratschbacher et al., Linzer, Neubauer et al. and Schmid et al., as an efect of inversely directed translation of the limiting blocks: eastward at North of the SC and westward at the South. Both the age and rheology of this deformation where differently stated: Late Cretaceous or Eocene and ductile, or Middle Miocene to Pliocene and brittle, but the main proposal of these papers is the Alpine metamorphic core complex nature of the northern and eastern parts of the Danubian "Window" in respect with the Getic-Supragetic. The main argument is the strong contrast between directly superposed cataclasites on gneisses at the base of the Getic Nappe and underlying greenschist facies Danubian mylonites, from either pre-Alpine basement formations or Alpine cover sequences; in general Getic-Supragetic Units do not show Alpine metamorphic imprint, while Danubian and Severin Units present strong structural amd mineralogical imprints. In SW Romania (Banat) and in Serbia this contrast vanishes, as Danubian and Krajina (Severin) Mesozoic sedimentary or igneous rocks preserve original features.

Alpine metamorphic imprint is thus confined to the northern (Tarcu, Petreanu, Retezat Mts.) and castern (Vulcan, Parang Mts.) parts of the Danubian Window, where chloritoide-chlorite-pyrophyllite-illite-meta-anthracite are common in Liassic slates (Iancu et al.), pumpelyite+/-prehnite+/-actinote are found in Upper Jurassic–Cretaceous basalts of Severin Nappe or in Upper Cretaceous Danubian andesitic tuffs (Seghedi et al.), Upper Jurassic-Lower Cretaceous carbonatic deposits are schistose marbles (Berza, Draganescu) and basement pre-Alpine metamorphics and granites are regionally transformed in mylonites with chlorite- actinote-epidote-albite-stilpnomelane-white mica-carbonates-quartz, etc. In Petreanu Mts. the deeper part of the Danubian metamorphic core complex is exposed in a westward plunging antiform and if the Liassic shales bear the usual chloritoide, Upper Jurassic marbles contain biotite, and basement mylonites are rich in Alpine olive biotite and a poikilitic blue-green amphibole, pointing to the highest grade conditions of Alpine metamorphism in the South Carpathians (Neubauer et al.). K-Ar and Ar-Ar ages date the thermal peak in the 90-70 Ma interval (Grunenfelder et al., Dallmeyer et al.) and forbid a model of regional thermal dome, like in the Alps, as pan-African ages are frequently found in the basement of the lowest danubian units and reset ages are dominant in the Upper Danubian Units; frictional heating has to be invoked for the SC.

Tertiary tectonics are recorded in the Inner SC mostly by dextral strike-slip faults, generating pull-apart basins, as effect of the rotation of Tisza-Dacia Block in respect with the Moesian Platform; later compression inverted and folded these basins and turned to reverse faults some of the bounding faults (Linzer). In the Outer SC, Matenco has recently found that for Latest Cretaceous to Early Burdigalian prevailed NW-SE directed tension, while in Late Burdigalian NE-SW contraction was compatible with overall dextral shearing north of the Moesian Platform. No metamorphism is related with Tertiary tectonics in South Carpathians.

CORRELATION OF THE WESTERN AND EASTERN CARPATHIAN LITHOSPHERIC STRUCTURES

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Recent knowledge about the structure and tectonics of the Carpathian mountain belt is going out from geology, deep boreholes and gcophysical measurements. The fundamental geophysical methods which were used are: reflection and refraction deep seismic profiling, gravity, magnetometry, magnctotellurics and geothennics. Gross lithospheric structures in the Carpathian orogen are modelled along profiles which cross the Westem, Eastem and Southcrn Carpathians. In our study we present two-dimensional modcls of the lithospherc using complex interpretation of the single geophysical fields and geological data.

Lithosphere of the Carpathians is result of rcpcating compressional and extensional processes in the space between two continental megablocks (Laurasia, Gondwana, and Africa, Europa respectively) during Paleozoic, Mesozoic and Tertiary. All generations of Hercynian and Alpine structures are conserved in present lithospheric structure.

The principal role for the present lithospheric structure of the Carpathians has relations between the European platform and the Carpathian-Pannonian-Transylvanian plate, the interaction of asthenospheric and lithospheric processes and their mutual dependencies during the evolution of this mountain belt. The profiles document differences in the structurc of the lithosphcre in the Western, Eastern and Southern Carpathians, mainly in platform configuration, position and gcometry of the subduction zones, composition of crustal fragments, various influence of extension proccsscs and relief of the lithosphere/asthenosphere boundary.

The latest stage of the development of the Carpathians arc and the Pannonian and Transylvanian Basins was characterized by a lithospheric disintegration which occured as a consequence of the transition from a transpressional to an extensional regime. In the Pannonian basin the process was accompanied by both crustal and lithospheric thinning. It was associated with an uplift of asthenospheric, partially molten masses and local asthenoliths.

THE COMPARATIVE ANALYSIS OF QUARTZ CRYSTALS FABRIC FROM METAMORPHIC NAPPES OF CRYSTALINE-MESOZOIC ZONE (ROMANIAN EAST-CARPATHIANS)

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The Crystaline-Mesozoic Zone of the East Carpathians consists of a overthrusted structure with nappes of different ages. There were established by means of geological reasons two moments for the movements, one pre-Alpine and another Alpine. Each nappe is boarded by intense mylonitic zones. Usually, owing to the absence of the mineral relics these kinds of blastomylonites are described as common entities like the metamorphic substrata which was retromorphosed. For understanding of these aspects, related to both metamorphic and tectonic evolution of the crystalline of the East Carpathians, a real help comes from the fabric analyses of the quartz. The diagrams obtained show the quartz c-axis orientation for the metamorphics of Rebra Group (ReG) (situated to the bottom of the structure), for the retromorphosed schists from Negrisoara Series (NS), for the epimetamorphics of Tulghes Group (TG), for blastomylonites of the Balaj Formation (BF), for Rarau Group (RaG) metamorphics (situated at the top of the structure) and also for a blastomylonite from Tectogenetic and Retromorphic Tibau Zone (TRTZ), and some mylonites situated inside of the Rarau Unit. For the BF were sampled two samples from two outcrops, situated one from the other at approx. 100 km. Thus it was possible to check the steadfastness of the deformational process at the scale of the entire entity, and in the same time, the trust in this method. Reverse: for the ReG were analysed in an outcrop (Litiu quarry) some sectors of the same fold. There were obtained two series of diagrams which show the image of the c-axis orientation of the grains with two different sizes. (Normal and greater). All the diagrams seems to be alike. This means that the outdistance and the microscopic selection are not important in the case when the analyse is focused on the only one deformational process. The diagrams obtained for the TG rocks are of triclinic type with the same development of the maxima. This means that all members and formations has a common deformational history. Monoclinic symmetry shows the diagrams obtained for BF metamorphics as well as for the NS metamorphics. Instead orthorombic symmetry show the diagrams obtained for mesometamorphics rocks of RaG, for mesometamorphic rocks of ReG and for blastomylonitic rocks from TRTZ or from Tighes Zone (TZ). The first mentioned orthorhombic diagrams are different one by the other but the last two have the same disposition of the maxima. This means that the last metamorphic reorganisation for both was the same. If the Tibau blastomylonites were generated during the movement of the Alpine Bucovinic Nappe over the Sub-Bucovinic Nappe result that the mylonitisation effect from TZ (situated at 300 km distance) is due to the same metamorphic reorganisation, Alpine in age. Thus by the fact that BF is always in contact with the retromorphosed margin of the RaG which contains rocks just partly transformed but with identical types of quartz c-axis orientation diagrams demonstrate that the BF was formed by reorganisation of a Rarau metamorphics substrata. This observation is available also for the origin of NS, where it can describe the same relation with ReG. Much more, because the quartz c-axis orientation diagrams of Balaj and Negrisoara rocks seems to be alike in principle, the similarity of its generator processes is resulting.

PIENINY KLIPPEN BELT, CARPATHIANS: STRIKE-SLIP TECTONICS, TERRANES AND PSEUTOTERRANES

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Pieniny Klippen Belt represents trace of a major axial suture zone in the Carpathians. Along most of its length (c. 600 km), the Belt is bounded on the south and north by longitudinal strike-slip faults. The Belt was a mega-shear zone of translation during early Neogene clockwise rotation of the Inner, respective to the Outer Carpathians. A problem arises which of the tectonic units of the present Klippen Belt were spatially related to each other during their Mesozoic history.

Northern boundary (strike-slip) fault zone. In the Polish part of the Belt, this fault zone is steeply dipping south. It involves the Czorsztyn Unit - the northernmost tectonic unit of the Belt, and its contact with the Tertiary Magura Nappe. Along this contact, Early Jurassic through Maastrichtian, mainly deep-water sequence of the Magura Succession occurs. It was folded at the Cretaceous/Tertiary boundary (Laramian phase) as a result of subduction of the Lower Jurassic oceanic crust of the Magura Basin under the Czorsztyn Ridge, and represents the Grajcarek Unit. The unit is traceable from Poland to Romania, at a distance of some 400 km, always forming the base of the Tertiary Magura Nappe. The Magura Nappe, together with the Grajcarek Unit, is cut by an andesite dyke swarm forming two systems. The older system, parallel/subparallel to the northern boundary fault, post-dates the Savian deformation. The younger system post-dates the Mid-Miocene (Styrian) transversal strike-slip faults.

Southern boundary (strike-slip) fault. In the Polish part of the Klippen Belt, this fault is vertical to subvertical. Podhale Palaeogene cover of the Inner Carpathian (Fatric and Tatric) mid-Cretaceous nappes comes into contact with the Klippen Belt along this fault. There, the Podhale Flysch (Eocene-Oligocene) and the Pieniny Klippen Belt are cut by transversal strike-slip faults of Mid-Miocene (Styrian) age. A small tectonic Maruszyna Scale, built of Maastrichtian through Middle-Eocene condensed pelagic marls and shales, separates the Pieniny Nappe (Subhercynian-Laramian) from the Podhale Flysch near Nowy Targ. Further east, a small tectonic scale of Middle-Eocene pelagic shales separates the Haligovce Nappe (Subhercynian-Laramian) from the Podhale Flysch. These tectonic scales, correlatable in their facies development with the Myjava Succession in West Slovakia (Gosau facies *sensu lato*), are traces of a narrow back-arc basin (with respect to the Laramian Klippen Belt) which was closed during mid-Eocene. The amount of lateral displacement of the Maruszyna-type tectonic scales was probably considerable. Thus, they might be considered as terranes with respect to the proper Klippen Belt successions/tectonic units.

TOSUDITE - A PRODUCT OF POSTMETAMORPHIC FLUID-RELATED ALTERATION OF LOW-GRADE METAMORPHIC ROCKS (IŇAČOVCE-KRICHEVO UNIT).

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Tosudite, a regularly interstratified di-dioctahedral chlorite/dioctahedral smectite, has been identified in low-grade metasedimentary formations of the Iňačovce-Krichevo Unit (pre-Neogene basement of the Eastern Slovakian Basin). It occurs in quartz-dolomite veins cutting hydrothermally altered metapelitic rocks in association with dickite, illite/smectite mixed-layers, siderite and (locally) pyrite, chalcopyrite, tetrahedrite and hematite. Tosudite forms unusually large (up to 10 μm in diameter) platy crystals arranged in fan-shaped aggregates, which infill the vein cavities. X-ray diffraction data reveal a basal spacing of 2.66 nm in Na-saturated, air-dried state that shifts at 3.10 nm after ethylene-glycol solvation. Heat treatment of K-saturated tosudite at 550°C/1 hour produces collapse of the structure to ≈2.39 nm. Coefficients of variability calculated for air-dried (8 basal reflections) and ethylene-glycol solvated (8 basal reflections) tosudite are 0.16 and 0.03 %, respectively. This is indicative of exceptionally well-ordered interstratification (R1) of chlorite and smectite component layers with almost ideal 50:50 ratio. A chemical composition of tosudite (mean of 30 quantitative EDS analyses) corresponds to the structural formula:

$$(Si_{6.86}Al_{1.13})_{\Sigma=8.00}O_{20}(OH)_4(Al_{5.97}Mg_{0.28}Fe^{+2}_{0.06})_{\Sigma=5.31}(OH)_6Ca_{0.06}Na_{0.31}K_{0.09}.$$

Assuming that the octahedral sheets in the 2:1 layers are occupied by Al and negative charge originates from the expandable layer, the structural formula for the chlorite layer is:

$$(Si_{3.39}Al_{0.61})_{\Sigma=4.00}Al_{2.00}O_{10}(OH)_2(Al_{1.97}Mg_{0.28}Fe^{+2}_{0.06})_{\Sigma=2.31}(OH)_6,$$

and that for the expandable layer is:

$$(Si_{3.48}Al_{0.52})_{\Sigma=4.00}Al_{2.00}O_{10}(OH)_2Ca_{0.06}Na_{0.31}K_{0.09}.$$

The small amounts of Mg and Fe suggest that the chlorite layer belongs to donbassite rather than sudoite. The structural formula of expandable layer is compatible with a beidellite with a negative charge of -0.52/ O_{10} $(OH)_2$.

The textural relationships (i.e. exclusive occurrence in veins) prove that tosudite is not a part of metamorphic assemblages. Moreover, it was found in metasedimentary formations of all known stratigraphic ages (Upper Triassic - Middle Eocene) and metamorphic conditions ranging from higher anchizone to biotite-isograde rocks. It is unlikely, that this highly expandable mixed-layer phase could withstand the metamorphic temperatures as high as ≈450°C. Thus, its origin is most probably related to the post-metamorphic hydrothermal alteration of the Iňačovce-Krichevo Unit, occuring probably durring its uplift. This is evidenced by strong kaolinization of the host rock white-micas, which could released a plenty of material needed for tosudite precipitation. In addition, a close relationship between kaolinization of K-Na micas and tosudite appearance is supported by the fact that in rocks with low mica content, like metasandstones or metabasalts, fluid-related alteration has led to the formation of dickite or dioctahedral smectite, respectively.

FORMATION OF BISMUTH MINERALISATION OF BEREGOVO AU-AG-BASE METAL EPITHERMAL DEPOSITS (TRANSCARPATHIAN, UKRAINA)

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Bismuthinite and Bi-sulfosalts are widespread in central part of the ore field. For its obligatory are associations with fine-graned quartz-I. Aggregates, where Bi-minerals are observed, always contain chalcopyrite. Bismuth sulfosalts are fine (0.001 0.35 mm) grains in cryptic-grained quartz, frequently in intergrowth with chalcopyrite, galena, seldom with pyrite and bismuthinite. Quartz-chalcopyrite-bismuthinite-Bi-sulfosalts association marks the beginning of quartz vein formation.

In quartz with widespread relicts of galena the minerals of ourayite groups are dominant. In case of absence in quartz of such galena relicts, grains of minerals with the composition close to treasurite and gustavite-lillianite are observed. Appearance of chalcopyrite is accompanyed by development of Ag-Cu-sulfosalts. Complete disappearance of galena in quartz-chalcopyrite-bismutite association is accompanied by formation of gladite-krupkaite minerals. In massive chalcopyrite and chalcopyrite-pyrite aggregates where the replacement processes are shown fully, Bi-sulfosalts are not found. Bismutite is detected in pyrite-chalcopyrite aggregates. These observations prove that Bi-minerals accompany the formation of chalcopyrite aggregates with their maximum developement in the front of chalcopyrite crystallisation. Bi-sulfosalts can be also considered as methastable phases, emerging in the early moments of replacement of galena by chalcopyrite going under influence of solutions with high activity of Bi and Ag. Spreading of Bi-sulfosalts in ores of Beregovo deposit is controlled by the kinetics of several interconnected processes that finally lead to the formation of copper ores and quartz veins.

At the beginning the replacement of carbonate-sulfide aggregates by cryptocrystalic quartz causes the isolation of single galena grains in a quartz matrix. Diffusion wave of Bi outpaces copper at the incipient moment of the chalcopyrite crystallization. Bismuth localizes in the most convenient for it traps – in galena grains. Its gradual accumulation in galena structure causes changes in phase composition of galena-matildite-ouraite track. The next following increase of Cu activity leads to the extrusion of Pb out of the sulfosalts and changes in their compoition in direction of Ag-Cu-Bi and Cu-Bi phases. More detailed analises of the reasons of such variations in the composition of this association is impossible due to the insufficient study of phase equilibrations in Ag-Cu-Pb-S system. The top of chalcopyrite crystallisation develops in the conditions of instability of most of the Bi-minerals. This is the cause of disappearance of Bi-sulfosalts and bismutite in pure chalcopyrite aggregates.

Analisys of our observations lets us assume, that we deal with metastable phases – intermediate lincs in the chain of galena-chalcopyrite replacements that preserved through the isolation in a tight quartz matrix. Their appearance, evolution and presevation are determined by kinetic factors and filtration of hydrotermal solutions trough the nonuniform and constantly changing medium of forming and tranforming mineral aggregates.

Accretional sequences of the Tethys suture (Lower Cretaceous, Gerecse Mts., Hungary)

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On the basis of the ammonite fauna the clastic sequence of the Gerecse Mts. was by FÜLÖP (1958) as Neocomian (Berriasian to Barremian). Recently micropaleontological and nannoplankton investigations have shown that the siliciclastic, turbiditic formations (Bersek Marl=BM, Lábatlan Sandstone=LS, Neszmély Sandstone=NS) are of Berriasian to Albian/Cenomanian age (BODROGI 1993,1995). The oldest formation is allodapic limestone (Felsõvadács Breccia=FB) which underlyes the BM and NS Fms. It is Berriasian on the basis of the occurrence of *Fauriella boissieri*. Ammonites, calpionella, nannoplankton, foraminifers, calcareous algae confirm the Late Berriasian to Early Valanginian age of the FB. In its type locality (Bersek-hegy, Lábatlan) the BM develops continuously from the FB. Previously it was considered as Valanginian-Hauterivian (FÜLÖP 1958). This opinion has to be revised:

1. The entire sequence of the outcrop was considered by these authors to be Late Valanginian - Hauterivian. The 66 m thick lower part of the BM was uncovered by the borehole B 1, continuously overlying the FB. The upper part of the marl (65 m) found in the outcrop was substantially younger, Aptian - Albian (FÉLEGYHÁZY & NAGYMAROSY 1992). Fogarasi (1996) carried out new nannoplankton investigations in the interval between the unconformity level (FOGARASI 1995) and the FB. His investigations documented three regional events in the interval from Middle Hauterivian to Early Barremian: 1. the last occurrence (LO) of *Cruciellipsis cuvillieri* (in the BM); 2. the first occurrence (FO) of *Assipetra terebrodentarius* and 3. the LO of *Calcicalathina oblongata* (in the LS). These events are included in the NC4-5 calcareous nannoplankton zones. The age of the lower part of the BM is probably Early Valanginian to Early Hauterivian, but it is not yet dated by nanno-events. *Calcicalathina oblonga* appears in the first BM layers above the FB showing the lowest part of the NK3 zone (Late Berriasian to Early Valanginian).

2. Slumping and hardgrounds were described at the basis of the LS (?Barremian). Repeated collections in this interval uncovered 4 new ammonite genera and Pulchellidae. Some of them are only known from the Albian: *Phylloceras (Hypophylloceras) velledae, Anisoceras* sp., *Hamites (Stomohamites)* sp., *Hypohoplites* sp. All these observations were neglected when FÕZY (1995) drew his conclusions. There is some difference between the ammonite and nannoplankton ages. Further ammonite investigation would be necessary. In the Urgonian limestone olistolithes of the Köszörûkõbánya Conglomerate Mbr. of LS Fm. *Conicorbitolina corbarica* and *Conicorbitolina conica* were identified. They prove an Upper Albian - Cenomanian age of the conglomerate. Pebbles containing *Orbitolina (M.) texana* are derived from the lower part of the Albian - Cenomanian carbonate platform. In the stratotype of the borehole N 4 *Costidiscus reticostatus* and *Barremites gr. difficilis* indicate Late Barremian ag, and *Costidiscus gr. microcostatus, Pseudohaploceras gr. matheronites* and *Phylloceras albrechtaustriae*. indicate the Early Aptian. The lower boundary of the Aptian is by *Praeorbitolina cormyi* and the upper one by *Globigerinelloides algerianus Hedbergella trocoidea, Globigerinelloides ferroelensis, Hedbergella cf. labocaensis* and *Ticinella cf. bejauensis*. The following stratigraphic units are represented in the stratotype sequence of the Vértesomló Siltstone (borehole Agt 2): a./ the Aptian/Albian boundary (*Ticinella bejauensis* Zone=Z), which is confirmed by the benthic foraminifers *Haplophragmoides nonionides, Osangularia schloenbachi;* b./ older Early Albian strata (*Hedbergella planispira* Z); c./ Middle Albian strata (*Ticinella primula* Z). Near Tata the lower part of the formation was placed in the the *Leymeriella tardefurcata* Z (SCHOLTZ in FÜLÖP 1975). In the the stratotype of the Tata Limestone Formation (Kálvária-hegy, Tata) the Upper Aptian *Globigerinelloides algerianus* and the "*ticinella*" Z were separated by SIDÓ (in FÜLÖP 1975) while the *Diadochoceras nodosocostatum* Z (HORVÁTH in FÜLÖP 1975).

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TERTIARY MAGMATIC ACTIVITY IN THE REPUBLIC OF MACEDONIA (PETROLOGICAL, GEOCHEMICAL AND ISOTOPE GEOCHEMICAL DATA)

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The Tertiary magmatic activity (volcanic and intrusive) in the Republic of Macedonia is part of a large magmatic activity that took place in the middle parts of the Balkan peninsula.

The spatial distribution of the magmatic activity is due to the geotectonic evolution of the area, whereas the development of various kinds of magmatic differentiates is due to the evolution of the primary melts developed in individual parts of the earth's crust/the marginal parts of the crust and the mantle from Oligocene to Pleistocene. It is calc-alkaline magmatism that, based on its characteristics, is comparable to the magmatism in the active continental margins.

The age of this magmatic activity (determined by K/Ar method) ranges from 29.0 m.y. to 1.8 m.y., or from Oligocene to Pleistocene with pronounced lower values from east to west (Table 20).

The values of the isotope $^{87}Sr/^{86}Sr$ ratio range from 0.706318 up to 0.710641. The lowest values have been determined in the rocks located deep in the basement of the Serbo-Macedonian mass that is essentially made up of metamorphic rocks.

Table 20. K/Ar age and $^{87}Sr/^{86}Sr$ for the Tertiary magmatic activity in the Republic of Macedonia

Locality	**Rock type**	**Age in Ma**	$^{87}Sr/^{86}Sr$
Kozuf	Latite	1.8 ± 0.1	
Kozuf	Latite	$5.o \pm 0.2$	0.708546
Kozuf	Quartzlatite	6.5 ± 0.2	0.709019
Kozuf	Andezite	4.8 ± 0.2	
Bucim	Latite	24.6 ± 2.0	0.706928
Borov Dol	Andezite	29.0 ± 3.0	0.706897
Damjan	Andezite	28.6 ± 0.6	0.706633
Zletovo	Quartzlatite	26.5 ± 2.0	0.706318
Zletovo	Latit	24.7 ± 0.4	
Zletovo	Monconite	21.9 ± 0.4	0.707770
Sasa	Andezite-latite	14.0 ± 3.0	0.710641
Sasa	Quartzlatite	24.0 ± 3.0	0.710244

The Lithostratotypus of Hierlatz Limestone (Alpine Liassic) – Preliminary Report

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The classical locality of Hierlatz Limestone is situated on Mt. Hierlatz/Feuerkogel on Dachstein Plateau in the Northern Calcareous Alps. Prevailing NW/SE-striking neptunian dykes are filled by up to several generations of predominantly red Liassic limestones comprising a variety of lithologies and fauna. The width of the fissure fillings can range from a few centimetres up to a few meters. Some of the fissures cut vertically for more than 100 meters deep into Norian/Rhaetian lagoonal Dachstein Limestone.

The Hierlatz Limestone is famous for an extremely rich fauna dominated by crinoids and brachiopods. Some fissure fillings are also rich in cephalopods, gastropods and bivalves. The multiple successive opening of the fissures is mirrored by several generations of sediment infillings. The lithologies comprise red and white crinoid/brachiopod-limestones – the white variety yields the main part of the ammonite assemblage! – also mudstones with gastropods and/or bivalves, „zebra-limestone" („Stromatactis"-limestone) and a lithology resembling the Adnet Scheck with rounded lithoclasts up to 3 mm in diameter. The microfacies comprises mud- to packstones with various biota – including besides the afore mentioned macrofauna – calcite-replaced sponge spicules, fissure-encrusting sponges, foraminifera, ostracods and peloids. Bioturbation is very common.

Among the foraminifera arenaceous taxa are predominant (up to 90%), followed by Lagenids, Miliolids and very rare Involutinids. Crinoids may occur in rock-forming frequency. Brachiopods constitute also a dominating element. Also the ammonite assemblage is quite rich in taxa, less in specimen, comprising so far 27 taxa. The afore mentioned red and white crinoid/brachiopod-sparites can be dated stratigraphically by brachiopods and ammonites as Upper Sinemurian. However, red biomicritic limestones yielded a brachiopod assemblage of Pliensbachian age. The ammonite taxon *Gemmellaroceras abnorme* (HAUER, 1853) points to Lotharingian/Carixian and *Phicodoceras taylori* (SOWERBY, 1826) is known only from the Lower Carixian. Indications for Hettangian infillings into the neptunian dykes of classical Hierlatz Limestone region are missing so far!

The bivalve fauna of Hierlatz Limestone shows moderate diversity and is dominated by epibyssate and shallow burrowing suspension feeders, while cemented forms are much less frequent. The gastropod-assemblage consists of 18 taxa indicating varying biotopes. The abundance and diversity of Trochoidean species suggests lower infralittoral biotope. However, *Pleurotomaria* and *Pyrgotrochus* probably lived below the base of storm influence. Only sporadic findings of typical bathyal forms, as *Discohelix* and *Eucyclomphalus*, occur.

BIOSTRATIGRAPHY OF TERTIARY HOLOPLANKTONIC MOLLUSCA IN HUNGARY

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The aim of this lecture is to present latest contributions to the research of Tertiary 'pteropods' in Hungary, with particular regard to biostratigraphic aspects.

Great extent of the territory of Hungary is covered by Tertiary marine sediments (from Middle Eocene to Middle Miocene) containing a rich fauna of plankton gastropods (Euthecosomata). Nearly twenty species, assignedeight genera (Limacina, Creseis, Praehyalocylis, Ireneia, Styliola, Clio, Diacrolinia, Vaginella) have so far been known from 33 Eocene, 21 Oligocene and 42 Miocene localities.

A number of contributions to biostratigraphy have been achieved despite the fact that the taxonomic study is still in progress. It is of particular importance that the nannoplankton, plankton foraminiferal and magnetostratigraphic zonations are available for most part of boreholes yielding pteropods, which offers an excellent opportunity for a multidisciplinary approach in correlation.

In Hungray, the first plankton gastropods - Limacina, Creseis, Praehyalocylis - appeared some 43 Ma ago, in the NN16 nannozone, the Morozovella lehneri plankton foraminiferal zone and the C20n magnetic zone. The appearance of Clio genus in the NP-16 nannozone is particularly noteworthy.

Oligocene marine rocks (NP22-25) also contain a rich fauna of pteropods. Among other things, the mass occurence of Limacina (NP22), the occurrence of Ireneia tenuistriata (NP24) which is an index fossil for pteropod zone 16 in NW Europe (Janssen & King 1988), and Vaginella tricuspidata (NP24-25) which is an important species of a correlation of Late Oligocene deposits in Europe, are noteworthy (Zorn & Janssen, 1993).

Of pteropods in Miocene marine sediments (NN4-5), Clio pedemontana, C. fallauxi and Diacrolinia aurita (Early Badenian) and Vaginella austriaca (Early and Middle Badenaian), are of importance for a further classification of the Middle Miocene. The species mentioned above exhibit the same time range not only in Hungary but in the Central Paratethys as well (Bohn-Havas & Zorn,1993,1995).

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BIOSTRATIGRAPHIC POSITON AND PRELIMINARY RADIOMETRIC AGE OF MIDDLE MIOCENE RHYOLITE TUFFS IN BORSOD BASIN (NORTHERN HUNGARY)

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The poster shows latest contributions to the biostratigraphy and K/Ar dating concerning the „Middle Rhyolite Tuff" and the final Badenian marine sequence in the Borsod region (Northern Hungary).

In Hungary, 3 rhyolite, or dacite tuff levels are usually found among the Miocene volcanic tuffs. These leves are referred to as lower, middle and upper rhyolite tuff levels. The „Middle Rhyolite Tuff" level we have investigated dominantly consists of dacite tuff. In Northern Hungary, the major part of the „Middle Rhyolite Tuff" has an uncertain lithostratigraphic position and the analytical and geological error of ages on altered biotit used for defining the radiometric age is relatively high.16,4±0.8 Ma is accepted for the „Middle Rhyolite Tuff" in Northern Hungary (Hámor et al. 1987) and this is the average of „Middle Rhyolite Tuffs" in Hungary and the end of the Karpatian stage.

In the Borsod Basin the „Middle Rhyolite Tuff" occurs in an accurately identified stratigraphic position and its biotites are excellently suitable for K/Ar dating due to their high K and low atmospheric Ar content.

At the southern part of the western Borsod region, the Early Badenian rocks usually follow a Karpatian schlier sequence without any detectable unconformity, comprising a maximum 70 m thick „Middle Rhyolite Tuff" (=dacite tuff) which in some cases also contains a sedimentary marine intercalation (Radócz, 1975). In the northern part of the area, the Badenian sequence overlies older Miocene sequences with a considerable unconformity and contains mainly reworked tuff substances (tuffaceous sand, tuffaceous siltstone, etc) only.

As shown by the biostratigraphic and magnetostratigraphic studies of boreholes in Borsod, Early Badenian marine rocks are encountered in the Borsod Basin beneath and over the „Middle Rhyolite Tuff" The direct underlying and overlying beds of the tuff (nannozone NN5) have a comparatively abundant plankton gastropodal (Euthecosomata) fauna, among others such species (Clio fallauxi, Clio pedemontana, Diacrolinia aurita) that are - according to pteropodal stratigraphy relating to the Central Paratethys (Bohn-Havas, Zorn 1995) - index fossils of the Early Badenian and not known from older rocks.

17 biotite samples from boreholes in Borsod were subjected to K/Ar dating. Out of them, 13 data yielded an average value of 14.88±0.40 Ma where 0.40 Ma represents the standard deviation.

In addition to biostratigraphic examinations and K/Ar dating, from now on Ar/Ar examinations are intended to be used to make our data and conclusions more precise.

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Mezozoic to Cenozoic evolution of southwestern South Carpathians as inferred from fission track geochronology and stratigraphic data

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The Southwestern South Carpathian orogen is composed of various nappe complexes which were assembled during the Cretaceous-Cenozoic orogeny. These are from footwall to hangingwall: (1) the Danubian nappe complex including a Cadomian/Variscan basement; (2) the Arjana and Severin units with Jurassic to Early Cretaceous rift and ocenic sequences; (3) the Getic nappe complex with Variscan continental basement.
Fission track (FT) thermochronology on apatite, zircon and sphene from various units of the South Carpathians, in conjunction with field constrains and previous geochronology enable us to estimate the role of tectonic events responsible for the building of South Carpathian mountain chain as well as to constrain the distribution of various exhumation paths between different regions since Cretaceous.
Zircons from the flysch unit and the Danubian Liassic cover sequences yield FT ages around 200 Ma suggesting cooling of the rift flanks prior to the opening of the Severin rift. Zircon and sphene from the Getic and Danubian basements units, in the klippen region, yield FT ages averaging 110 Ma indicating cooling under 300°C of the basements contemporaneous with, or postdating an Aptian-Albian thrusting phase. During this phase the rift deposits were deformed in an accretionary wedge between Danubian and Getic domains and partially overridden by the Getic crystalline.
Apatite FT ages dispaly a decreasing age trend from the hangingwall (65 Ma) to the footwall units (30 Ma). The age data and corresponding horizontal confined track length distributions suggest that exhumation of the nappe pile occurred in two stages: a) During Late Campanian to possibly Early Maastrichtian, when Severin flysch was emplaced on the top of the „wildflsch" deposits; b) During Late Oligocene to Sarmation when the South Carpathians were thrusted onto the top of the Moesian platform.
Apatite FT ages along major brittle wrench faults indicate reheating above 120°C during fluid flow associated with fault (re)activation during Oligocene and Neogene. Thus shear zone rocks experienced a higher temperature overprint during Cenozoic time than rocks of the unaffected nappe pile. Temperatures of hydrothermal flow along these zones decreased progressively starting with Late Oligocene - Early Miocene when the area began to override the Moesian platform.

ON MECHANISM OF FORMATION OF NAPPE-FOLDING STRUCTURES OF THE UKRAINIAN CARPATHIANS (BASED ON THE RESULTS OF PHYSICAL MODELLING)

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The Alpine structure of the Ukrainian Carpathians is the result of a huge horizontal compression of the collision of European and Aravian-African lithospheric plates. Both Jurassic - Early Cretaceous oceanic crust subduction and then continental subduction during Cretaceous-Paleogene determined sedimentation of flysch complex and formation of the nappe-folding structures in it simultaneously.

One- and polylayered elastic-ductile-viscous models of various clays have been used to study initiation and evolution of these structures within the flysch complex. Vertical succession of clay layers were formed by means of precipitation of water clay parts. The experiments were performed using a simple apparatus: the bath (70x10x20 sm), rigid wedge and driving mechanism. The both bottom and sediment assemblage lying on it imitate subducting plate. The rigid wedge sunk into sediments served as a lithospheric block of the overriding plate. All the models were deformed at the same horizontal rate on the wedge 30 sm h^{-1} At the constructing models there were accounted the most characteristical peculiarities of structure and development of the real structures; lithological composition of the rock masses, character of bedding availability in flysch of rigid rock heterogeneity and the relief of subducting surface. The modelling was implemented being provided with the criteria of similarity concerning such parameters as: yield limit, density, rock mass thickness and acceleration of gravity

The following types of models were tested:
Type I - homogeneous sedimentary layer. Two ranks of thrusts were formed: a) large-sized profound layers which cut short and sleep asymmetric folds (simultaneously formed) and b) small surface thrusts. The thrusts appeared in succession one by one, but each rank had its own divisibility step range.

Type II - multilayered upper part of model possesses a lower average yield limit than lower homogeneous part. Different deformations were observed in those areas. Extremely complicated nappe-folding structures were formed in the upper part. Besides, frequent overlaps one and the same layer were observed. The large-placed uplift aggravated by two systems of conjugate faults was formed in the lower part.

Type III - basement high of high strength is presented in the sedimentary layer. The deformation was quite different from those ones observed in the types I and II. First, the series of microfolds and fault-upthrow fault dislocations appeared in front of the basement high, later a part of modelling sediments was overthrusted the arch basement high and overflow it and finally, typical folding structures (the same we can see in sediments of the type I and II) appeared at the back of the uplift. Neither folds nor faults were seen in the very basement high, but it itself was stripped from the basement and moved forward (in the direction of the wedge movement).

Type IV - sedimentary layer involving depressions filled by material of lower strength. Two processes took place simultaneously. At first there was partial stripping (tectonic erosion) and sediment accretion in front of the moving wedge and forming of fine asymmetric anticlinal folds, removed of each other at equal distance. Later, at the stage II there was filling of the depressions with the material of tectonic erosion and forming of accretion prisms from the folds having appeared before. At the final test stage, depressions were filled completely with the material of the entangled structure.

The models, described above are not only good reflection of the structural style of the Ukrainian Carpathians, but they also reveal unknown structural peculiarities forming them. That is why we can state that the realized mechanism of structure-forming is physically possible and the results of the experiments may be used for interpretation of geological-geophysical date and forecasting of the profound structure of the flysch assemblage.

AUSTRALASIA AND AUSTRIA - GEOLOGISTS AND GEOLOGICAL COMMUNICATION

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The best known geological association between Austria and Australasia is the work of Ferdinand von Hochstetter, mainly in New Zealand during the late 1850s, work which is still highly regarded, and which laid the foundations of New Zealand geology. Hochstetter also spent brief periods in Australia, but this work is less well-known, although some of it was published. Hochstetter maintained contacts with antipodean geologists, particularly Julius von Haast, with whom he co-operated in the early mapping of New Zealand and with G.H. Ulrich in Victoria. Other members of the 'Novara' expedition, including Karl Scherzer also made geological observations and collections. An earlier visitor to Australia was Baron von Hügel, who spent nine months travelling widely, mainly in the southeast of the continent in 1833-4. Although Hügel's interest were mainly in biology, he made useful observations on palaeontology, caves and underground water, and took some "mineral" samples to Vienna. Robert Townson went to Australia as a settler in 1807, perhaps intending to continue his scientific work there, but he did almost no geology, being concerned with pastoral activities until his death in 1827. He spent the winter of 1792-93 in Vienna studying the respiration of amphibia, before setting off to travel through Hungary. He is well remembered in Hungary for his book "Travels in Hungary" which he published in 1797, and which includes an important geological map of that country.

Although Joachim Barrande never visited Australia, like most palaeontologists of the mid-19th century he was interested in the fossils there, and examined samples of Silurian cephalopods from Tasmania. Palaeobotanists such as F. Unger and C von Ettingshausen made particular contributions to the comparison of Australian flora and European Tertiary forms. A later, little-known, geological contact between Hungary and Australia was the examination of the mining district of Nagybanya then in NE Hungary (now Romania) in 1910 by Douglas Mawson. It was proposed by the Antarctic explorer Ernest Shackleton to develop the mines to finance further Antarctic exploration. Most recently a useful English summary of the geology of Hungary was prepared by G.Z. Foldvary, an Australian resident. This brief outline indicates that non-British influences played an important role in the understanding of geology in these antipodean British colonies during the 19th century. Many avenues of fruitful research concerning historical central European-Australasian geological contacts await interested researchers. In particular rock, mineral and palaeontology collections, and correspondence, mainly in Vienna, offer splendid opportunities for co-operative undertakings.

LITHO AND BIOPHACIES OF THE "CLAYS WITH *CRYPTOMACTRA*" FROM THE MOLDAVIAN PLATFORM

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The Moldavian Platform represents the western boundary of the large Eastern European Platform, and it also constitutes an important structural unit during the foundation of the Romanian territory.
As every platforme type it consist in a basal structure and a sedimentary level. Particularly, the last one is represented by Paleozoic (the upper period), Mesozoic and Cenozoic deposits. During the latest sedimentary cycle there also had ben accumulated Sarmatian deposits, which have a large spreading within the Moldavian Platform.

Considering the Sarmatian deposits, begining with the Lower Basarabian, there have been accumulated the pelitic deposits which predominantly contein the taxon *Cryptomactra pesanseris* (May) as part of the fauna assemblages. Alongside that on it may be noticed the presence of *Obsoletiforma barboti* (Hoern), *O. michailovi* Toula etc. These deposits are also known as the "*Cryptomactra* clays" The thickness of this unit is abot 320 m, and it is specific only for the eastern part of the Moldavian Platform. Considering the macrofauna assemblages, at the upper part of these deposits there are *Cryptomactra pesanseris* (May) and *Plicatiforma fittoni* d'Orb., *Mactra fabreana* d'Orb. etc.

The fauna association, characteristic to the "*Cryptomactra* clays", allows us to afirm that these deposits had been accumulated from the Lower Basarabian to the first part of the Upper Basarabian.

SIMILARITIES BETWEEN THE PERIADRIATIC LINE (PAL) OF SOUTHERN EUROPE AND THE INSULAR-INTERMONTANE SUPERTERRANE LINE (IIL) OF NORTHWESTERN NORTH AMERICA

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The IIL of southeastern Alaska in northwestern North America and the PAL of Switzerland and Italy in southern Europe are both present-day boundaries between lithotectonic superterranes. The former separates the Insular and Intermontane superterranes and the latter separates the European plate from the Adriatic superterrane. The evolution and present expression of the IIL and PAL are similar.

The term IIL is used here to denote the crustal-scale geomorphic and structural feature described twenty years ago as the "Coast Range Megalineament" (Brew and Ford, 1978, CJES, v. 15, p. 1763-1772). The Coast Range Megalineament zone (CRMZ) or IIL is the final expression of tectonic and intrusive events that occurred near and along the superterrane boundary from the Late Jurassic through the Cenozoic. Those events include five in-part-super-imposed shear zones (Brew, 1996, 1998; Brew and Ford, 1997, 1998) as well as spatially coincident sedimentation, volcanism, and intrusion (Brew and Ford, 1985). The CRMZ/IIL is a 800-km-long, narrow, NNW-SSE-trending essentially straight fault zone whose youngest movement post-dates the dominant 50-Ma granitic rocks of the Coast Mountains to its east. It is readily recognizable because of Pleistocene/Holocene erosion. It varies from <1 km to a few km in width, is parallel to the strike of the adjacent rocks, bounds contrasting plutonic and metamorphic belts, and has associated steep aeromagnetic and gravity gradients. To its west are country rocks of the Late Jurassic to mid-Cretaceous Gravina overlap assemblage, Late Proterozoic to Mesozoic Alexander and Wrangellia terranes, and (in two places) Late Proterozoic and early Paleozoic Nisling terrane. Crystalline rocks derived from the Late Paleozoic and Mesozoic Wrangellia, mid-Paleozoic and Mesozoic Stikine, and Nisling terrane rocks are to its east, together with abundant granitic plutons. Shear-sense indicators or other evidence for lateral movement.have not been reported on the CRMZ/IIL.

The main western part of the Periadriatic Line (PAL) is the Insubric Line and the main eastern part is the Pustertal Line. The PAL is the final expression of tectonic and intrusive events that occurred near and along the boundary between the European plate to the north and the Adriatic superterrane to the south during the Cenozoic. Those events include both N- and S-directed contractional faulting. The PAL is at least 800-km long and varies from a NE-SW orientation to the west to E-W to the east. It consists of several connected and overlapping faults that together in some places result in a prominent several-km-wide valley. It is generally parallel to the strike of the adjacent rocks, bounds contrasting plutonic and metamorphic belts, and has associated aeromagnetic and gravity gradients. Crystalline rocks of the Austro-Alpine nappes are to the north and Late Paleozoic, Mesozoic, and Cenozoic strata and intrusive rocks of the southern Alps and of the Dolomites are to the south.

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PERMIAN ACID MAGMATIC ACTIVITY IN THE WESTERN CARPATHIANS, SLOVAKIA

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Post-orogenic Permian A- and S-type granites and bimodal volcanic activity is recorded in the Western Carpathian region. Permian magmatism was active after main Hercynian thrusting and collisional tectonometamorphic events when the huge masses of the S and I-type granitoids were emplaced into middle and upper crust during Carboniferous period in Western Carpathians..

A-type granites. Permian plutonic intrusions of A-type and related volcanic rocks occur in several places of the Western Carpathian area. Hrončok granite represent the largest body of A-type, it is situated on the present Alpine shear zone (Pohorelá fault). Post-orogenic A-type nature is confirmed by specific geochemistry with high K_2O. Rb. Ga. HREE. Y. U. Sn. low CaO, MgO, Al_2O_3, P_2O_5, Sr and Ba contents. Zircon typology mainly P_1. P_2 subtypes. zircon low Zr/Hf ratios. iron biotite and fluorine-rich chemistry of granites also correspond with A-type granite. Elongated shape of the Hrončok granite body is related to Permian deep crustal faulting in extensional environment of post-Hercynian Pangea (cf. Bonin, 1990). In this sence the Pohorelá fault represent a rejuvenised older Permian strike-slipe lineament. The Turčok body and Úpohlav granite pebbles represent other A-type granite occurrences with higher HREEs and Zr as well as P_5-D zircon. Average Zr saturation temperatures of Turčok and Upohlav granites in comparison to Hrončok granite are higher: Turčok 900 °C. Úpohlav 850 °C, Hrončok 780 °C, which are also in good correlation with REE-geothermometer.

S/A-type granites of transitional geochemical features occured several small bodies of two mica monzogranite and granite-porphyries of the Klenovec type. They show high K, Rb, B, Y, Be, Sn, W, (F) and reduced Sr, Ca, Ba. and Rb/Sr ratio. Fe-rich biotite and miwed zircon populations.

S-type granites. Small bodies of Spiš-Gemer granites show isotopic ages from the Permian-Carboniferous boundary to the Upper Permian: 290-250 Ma. They represent highly fractionated tin-bearing S-type granites in Western Carpathians with high Sn, W, Rb, Cs, Nb, Ga, B, F, but very low REE, Y, Zr, Ba. Sr and V contents. Presence of schorl in Sn-bearing S-type the Spiš-Gemer granite suite indicates a boron-rich protolith in their source rocks possible represented by illite- or muscovite-rich marine sediments.

Volcanic activity. Acid volcanic activity is represented by Permian rhyolites to dacites and its pyroclastic products (ignimbrites and tuffites) in the Tatric. Veporic. Gemeric and Zemplinic Units. In North Veporic zone subvolcanic granite-porphyries and dacites form elongated bodies similar to Hrončok A-type granite geometry. Trace element geochemistry and zircon typology both show subalkaline to alkaline character of magma, locally with elevated K. REE and Zr contents. The zircon saturation temperatures indicate 800 °C. Besides the acid volcanic activity. basic volcanics (the Ipoltica group) are also present in the Permian of the Alpine Hronic nappe system. They show within plate characteristics and may represent initial rifting.

KT BOUNDARY IN FLYSCH SEDIMENTS OF THE RACA UNIT AT THE UZGRUN SECTION (OUTER CARPATHIAN FLYSCH, CZECH REPUBLIC)

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The biostratigraphy in the Magura group of nappes of the Carpathian Outer Flysch is limited by usually missing or poorly preserved calcareous micro- and nannofossils especially in the Cretaceous to Lower Eocene sediments. Relatively rich fossil content in the Uzgrun section allows to subdivide the Late Maastrichtian to Paleocene sediments of the Raca Unit (Solan Formation). The presence of rare planktonic and abundant benthic foraminifers, radiolarians and calcareous nannofossils has enable to apply the integrated microbiostratigraphy approach in the Maastrichtian part of the section.

Predominantly thin-bedded flysch with high claystone/sandstone ratio represents the Solan Formation. Green-grey and grey hemipelagic non-calcareous and turbidite calcareous claystones prevail over fine-grain sandstones, siltstones and marlstones in the Maastrichtian part. Thicker and more frequent sandstone beds occur in the completely non-calcareous Paleocene part. Two trends in sedimentology were observed on the K/T transition: 1. Increase in turbidite thickness; 2. Disappearance of calcareous turbidite claystones. Autochthonous agglutinated assemblages and distal turbidites indicate the sedimentation in lower turbidite fan below the CCD.

The integrated microbiostratigraphy enable to find the Cretaceous/Tertiary (K/T) boundary interval in one partial outcrop of the Uzgrun section undisturbed by faults. The highest turbidite calcareous-claystone intercalation provided the index species of the Abathomphalus mayaroensis Zone and nannofossils of Micula prinsii local zone. The stratigraphically "youngest" nannofossil assemblage contained the so called "survivor species", such as *Markalius apertus*, *M. inversus* and *Placozygus sigmoideus*. All these fossils are probably synsedimentary redepositions indicating Late Maastrichtian age. Radiolarian assemblage of the Amphipyndax tylotus Zone found in hemipelagic claystone only 75 cm below also indicates Maastrichtian age.

The first occurrence of index species of the Rzehakina fissistomata Zone evidencing Paleocene age was observed in non-calcareous hemipelagic claystone above the last calcareous claystone intercalation. There is a potential chance for precise determination of the K/T boundary using a palynology (dinocysts) and geochemistry (iridium anomaly).

Although the single fossil groups itself did not enable subdivision of the given stratigraphic interval, integrated microbiostratigraphy enable to define three nannozones within the Upper Maastrichtian and one agglutinated foraminifera zone through Paleocene with prospective subdivision based on potential new marker species. There is no disproportion between the results from single fossil groups at the studied section.

The Uzgrun section provided interesting data on the radiolarian biostratigraphy considering the fact, that the well-documented sections across the Upper Cretaceous to Paleocene deposits with biostratigraphic control are very rare. The nannofossils evidence the influence of both Boreal and Tethyan bioprovince on the Magura depositional area.

CORRELATION OF VARISCAN GRANITOIDS OF TISZA- AND PELSO MEGAUNITS WITH GRANITOIDS OF MOLDANUBICUM AND SOUTH ALPS

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Variscan granitoids of South part of the Central Bohemian Pluton (CBP) and South Bohemian Pluton (SBP) have been correlated with granitoids occurring in West Carpathians (WCA), South Hungary (SH, Tisza Megaunit), along Balaton-Velence tectonic line (BV, Pelso Megaunit) and South Alps (SA) in order to carry out a paleotectonic reconstraction.

CBP occurring in the Moldanubicum zone of Variscan collision belt shows very similar features with SH granitoids in the Tisza Megaunit. They are mainly metaluminous with small amount of pyroxe (salite), actinolitic hornblende, actinolite, low oxidized Mg-biotite with calc-alkaline characters, plagioclase (An_{30}), quartz and microcline (mostly forms megacrysts and showing replacement texture). Characteristic accessory minerals are allanite, titanite, zircon, apatite. The low oxidation form of biotite indicates a low oxygen fugacities during the crystallization. The main rock types are syenite, quartz syenite, monzonite, quartz monzonite and granite. They have K-calc-alkaline characters (Na/K=0.9). The SH granitoids mostly I-type ($\delta^{18}O$=8.84‰), the $^{87}Sr/^{86}Sr$ rations (0.7073-0.7108) suggest continental crustal contribution.

The eastern part of SBP (Rastenberg) is similar to CBP and SH metaluminous granitoids, containing Mg-biotite and megacrysts of microcline. The western part of SBP has peraluminous crustal granitoids with monazite as a common accessory mineral. They are mostly postcollisional S or S/I-type granitoids.

The WCA crystalline rocks are mostly peraluminous granodiorite, tonalite (Na/K=1.7-3.4). The inner zone is more metaluminous with calc-alkaline Mg-biotite with allanite and outer zone contains peraluminous granitoids with Fe-biotite and monazite. Biotites are highly oxidized most probaly crystallized from a high temperature water-undersaturated melt. They are mixed crustal-mantle subduction related origin.

SA and BV (Pelso Megaunit) granitoids are peraluminous, S-type, postcolllisional (280 m. y.), hypabyssal intrusions with small amount of fayalite and with Fe-rich highly oxidized biotite. These granitoids have eutectic composition.

The south zone of CBP, eastern part of SBP and SH granitoids formed a belt in the Moldanubicum zone of the Variscan orogenic range containing old probably Pan-African (620-650 m.y.) crustal remnant and formed in the tectonic zone of postcollisional uplift. Later on the South Hungarian crystalline plate (Tisza-Megaunit) was disconnected by the eastward movement of South Alps (Pelso Megaunit) and moved south-east direction. (Project was financed by HNRF 023762).

GOLD-BEARING PLAGIOGRANITES OF GRABOVA REKA (EAST SERBIA) - A NEW TYPE OF GOLD DEPOSITS

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West margin of Carpathians-Balkanides of east Serbia within river Pek is known by numerous deposits and occurrences of gold (Au, Au+Ag, Au+Scheelite). Within the Wendian-Cambrian zone of metamorphic rocks, from Danube on the north to Debeli Lug on the south, two ore fields of approximately 150 km^2 in total can be identified: Brodica in the north and Blagojev Kamnen in the south. In the southern margin of Blagojev Kamen ore field Grabova reka deposit comprising of quartz veins with Au+Ag and sulphide Pb-Zn-Cu mineralization is situated.

Beside the gold-bearing quartz veins attention is drawn by low mineralized protrusions of plagiogranites within the deposit itself, which were treated so far as dump material in the process of production. Large masses of plagiogranites and favourable conditions of possible exploitation (open pit mining) make these low mineralized rocks economically very interesting.

In the deposit Grabova reka (also in the ore field of Blagojev Kamen) plagiogranites occur as small dykes of complex morphology, thickness up to 100 m and length of several hundred meters to over 1 km. They are composed of plagioclase (albite to oligoclase), quartz, biotite, muscovite, calcite and accessory minerals (apatite, zircon, sphene), Structure is massive while texture is hypidiomorphic granular to porphyroid. The chemical composition of plagiogranites varies ir the range (in %): SiO_2 61.46-69.30, Al_2O_3 9.04-11.34, FeO 3.33-4.34, K_2O 1.05-1.43, Na_2O 4.02-5.35, MgO 1.21-2.9, CaO 2.43-3.15, P_2O_5 0.13-0.69, H_2O 0.61-1.09 and loss of ignition 2.03-6.54.

The gold-bearing sulphide mineralization in plagiogranites is of stockwerk-impregnation type. By microscope investigation presence of two mineral associations was established: quartz-pyrite, older and younger polymetallic sulphide (galena, sphalerite, chalcopyrite, tetrahedrite, elementary gold, electrum and other). First mineral association is syngenetic which was subsequently activated and enriched by younger polymetallic sulphide association with gold and silver. Micro fissures of pyrite are filled with gold and electrum which are sometimes suppressing pyrite altogether while cataclised pyrite occurs only in relict forms. Elementary gold occurs in fine grains (5-10 μm rarely over 100 μm) in quartz, pyrite or galena (alloyed with Bi and Cu). Electrum is the main carrier of gold in plagiogranites. It cements cataclised grains of pyrite and other Pb-Zn, Cu sulphides or it is concentrated along the contact between galena and pyrite.

The analysis of the plagiogranite age (complete rock) indicated diffusion argon that is explained as rejuvenation of the rock that happened less than 100 million years ago. Analysis of non-electromagnetic fraction determined the real age of plagiogranites originating some 518 million years ago. It can be certainly stated that the plagiogranites were exposed to substantial hydrothermal alterations since they represent the media where stockwerk-impregnation mineralization has been determined including gold, silver and sulphides Pb-Zn and Cu. That substantial rejuvenation probably happened according to all indicators during Alpine metallogenetic epoch (Petkovic ,1995).

On the basis of preliminary investigations (exploration drilling, mining works) the average gold content is around 1,7 grammes per ton, silver also, while the content of other metals (Pb+Zn+Cu) is about 0.3%. Geological reserves of mineralized plagiogranites which can be mined by open pit (with ore dump ratio 1:3) are around 20 million tonnes.

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Platinum-group-element enrichments in the 'supra-subduction' belt of the Mirdita ophiolite, Albania

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The N-S trending Mirdita ophiolite in Albania encloses two belts with distinct petrological features: A western belt with mid-ocean-ridge characteristics (e. g. the rare occurrence of chromitites) and an eastern zone of supra-subduction affinity with numerous chromite concentrations in the mantle section up to the base of the gabbro sequence. In addition, unusual platinum-group-element (PGE) enrichments were reported from the eastern zone by an Albanian-French research group. Our presentation documents new results from studies of the Pt concentration in Bregu i Bibes, Tropoja massiv (Northern Albania) and of the Pd mineralization near Krasta in the Southern Bulqiza complex (Central Albania). The investigations were more focussed on aspects of economic relevance (extension of the mineralizations, relations between the PGE-bearing phases and host rocks, average PGE content of bulk samples, and mineral processing).

The Pt-dominated mineralization of Bregu i Bibes is associated with orthopyroxene-rich chromitites in an interlayering sequence of chromite, olivine and pyroxene cumulates between basal dunite and pyroxenite (hanging wall). Conspicuous are coarse-grained orthopyroxene chromitites which follow the layering. The sequence dips to the west, but the general structure, either a flat-lying syncline or a funnel-shaped arrangement, is not yet clear.

The former studies and our work resulted in a large number of discrete platinum-group minerals (PGM) in several textural sites in the hosting chromitites (decreasing order of frequency):

- inclusions in chromite (mainly Pt_3Fe; few sulphides of Pt, Os and Ru)
- attached grains on chromite surfaces (alloys of Pt, Pd, Rh with Fe and Cu; PGE tellurides and Pt arsenides)
- fissure fillings in chromite (alloys of Pt and Pd with Fe and Cu; Pt arsenide)
- inclusions in silicates (Pt and Pd alloys with Fe and Cu; Pt arsenide).

A geochemical investigation (INAA, all six PGE) of 20 bulk samples from Bregu i Bibes yielded a maximum content of 25 ppm Pt and a predominance of the Pt-Pd-Rh group: [Pt+Pd+Rh]/ [Os+Ir+Ru] = 0.6-77.5 (mean: 41). The Pt/Pd varies between 0.1 and 43.5 (mean: 19.3). The analytical results of 51 channel samples: Pt 0.01-4.3 ppm (mean: 0.86); Pt/Pd = 1.4-50.3 (mean: 15.3) are in congruence with these values. Further a comparison between the modal amount of PGM and the analytical data demonstrates that Pt is exclusively bound in PGM and not incorporated in chromite or primary silicates. The close textural association of the PGM with chromite is verified by an excellent correlation between Pt (and Pd) with Cr.

The chondrite-normalized PGE abundances of Bregu i Bibes with a strong Pt enrichment (average of Pt/Pd = 15.3) and a strong depletion of the osmiridium group differ from those of 'normal' ophiolites (mean of [Pt+Pd+Rh]/ [Os+Ir+Ru] < 1) and of the patterns from 'layered intrusions' (Pt/Pd < 1). However, the PGE patterns of Bregu i Bibes are comparable with those of 'Alaskan-type intrusions' although the latter display lower Pt/Ir and Pd/Ir ratios.

The chromites in the Bregu i Bibes mineralization are Cr-rich and Al, Fe^{3+}, and Ti-poor. They are clearly distinguished from chromites in ultramafic cumulates of other ophiolites, which are characterized by lower Cr but higher Al, Fe^{3+},and Ti contents as a consequence of an advanced differentiation. The composition of the chromites of Bregu i Bibes is, on the other hand, similar to that of chromites in the mantle-crust transition of ophiolite sequences. Disequilibrium conditions in the chromite-silicate association are also indicated by preliminary $\delta^{18}O$ data. It is tentatively suggested that the PGE-bearing (orthopyroxene-) chromitites were squeezed (or filtered) out from deeper parts of the unconsolidated cumulate pile by compaction. The chondrite-normalized trough-shaped rare-earth-element patterns of the PGM-rich orthopyroxene chromitites with HREE < 1 and their distinct negative Eu anomaly support this explanation.

The close textural relationship between chromite and PGM can be used as guideline for further exploration. A pre-concentration of the PGM could be achieved via selective quarrying or stoping (underground) of chromitite, upgrading of chromite and subsequent separation of the PGM (which reach sizes up to 0.1 mm, with an average of 0.03 mm) by physical processes.

Initial results of a re-examination of the **Pd-anomaly near Krasta** (Bulqiza Complex) in 'supra-moho dunites' with chromite-pentlandite associations yielded Pd contents (whole rock) between 1.6 and 2.1 ppm and Pt/Pd ratios of ≤ 4. The maximum of total PGE is 3 ppm. Pentlandite-rich samples yielded positive $\delta^{34}S$-values ≤ 0.7 which is in harmony with a magmatic origin of sulfur. However, PIXE studies of Krasta pentlandites indicate that this mineral is a major carrier of Se and Te, but not the main Pd host (as it was postulated before). Future PIXE and SIMS analyses are focussed on the identification of the main Pd carrier.

CELESTITES DIAMICTITES (MIDDLE MIOCENE - BADENIAN) IN THE VALEA SĂRII-ANDREIAŞU AREA, VRANCEA DISTRICT, ROMANIA

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The Middle Miocene (Badenian) celestite (sulphate) diamictites, genetically associated with salt (evaporite Formation), occur on the external last lineament of the Subcarpathian nappe.

The celestite (sulphate) diamictites have been described from the north-south lineament, between the Valea Sării Brook and the locality of Andreiaşu. All over they consist of intraformational gypsite elements, varying in size from blocks to centimetric fragments, with a small amount of extrabasinal elements. The blocks occur in a quasinormal stratigraphic position, so that the deposits generally display a stratiform geometry with no lateral shifting. The texture is clast-supported, in places matrix-supported when the matrix forms a common body with the elements, as a result of the polyphase diagenetic by recementation and compaction of the deposit.

The mineralogical analiyses of heavy mineral concentrates, obtained both from gypsite elements and matrix, evidenced for the first time an association of authigenic minerals which included celestite, sulphides, fluorite and clear blende. Celestite has all crystallographic parameters closed to those of celestite encountered in other similar formations in Romania and its refractive indices correspond to the amounts of 26.25% Sr and 0.10% Ba.

The genetic model of the celestite (sulphate) diamictites formation as collapse breccia, which made possible the deciphering, to some extent, of the complex geology of the region, admits several premises, as follows: major tectonic control connected with the Subcarpathian nappe; tectonic-structural control connected with the Caşin-Bisoca fault and Rotileşti-Andreiaşu anticline and, last but not least, control of the halokinetic and seismic processes, the Vrancea region being the seismic centre of the country.

FLEXURAL LITHOSPHERIC STUDIES RELATING TO THE FORE-ARC REGION OF THE HELLENIC ARC

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The Hellenic Subduction System is characterised by a well-determined Benioff zone related to a dense dipping plate. On the basis of the newly formed gravity and topographic data banks of the broader area of Greece (Lagios et al., 1996) a recompilation of the gravity anomaly map of Greece was made, and the first isostatic anomaly map of Greece was constructed (Chailas et al., 1993; Lagios et al., 1995). By modelling the estimated isostatic response function for the area of Greece, it was possible to determine an Airy isostatic model, which was able to fit the data, with a mean Moho-depth of about 25km. Although it became possible to successfully isolate the gravity signal of the dipping plate in the isostatic anomaly map, the determined Airy model failed to fully predict the observed gravity field in the fore-arc region (which is mainly controlled by the flexure of the lithosphere due to the dipping part of the plate in the back-arc region), resulting thus in large amplitude isostatic anomalies.

A study of the flexure of the lithosphere in the fore-arc region of the Hellenic Arc is attempted here. The observed gravity anomaly field, and the deep seismicity taking place in the area of Greece (focal depths > 60 km), are used as controlling parameters in the applied modelling procedure. The finite element method is used to model the flexure of the lithosphere, which is treated as an elastic plate with spatially varying flexural rigidity and density, lying on a fluid foundation, with an end-part of the plate dipping into the fluid. At the same time, the effect of the topographic load on the flexure of the plate is also calculated. The finally produced model of the plate should therefore be consistent to:

(i) As far as it concerns the back-arc region:
  the spatial distribution of the earthquake hypocentres,
  a realistic geometry and density contrast between the dipping part of the plate and the surrounding mantle material.

(ii) As far as it concerns the fore-arc region: The produced flexure, due to the above-mentioned dipping part of the plate, to be able to predict the observed gravity anomaly field in that area.

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SUSTAINABLE TOWN PLANNING AND GEOLOGICAL CONTRIBUTIONS IN THE PLANNING PROCESS

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Following the Earth Summit Conference in Rio de Janeiro in 1992, the concept of Sustainable Development has gained world-wide acceptance as a means by which economic activities may enjoy "duration" without causing irreversible environmental damage. Principal contention of Sustainable Development is the notion that economic development and environmental protection are not necessarily antagonistic concepts but rather complementary to one-another.

Since the principles and requirements of Sustainable Development affect, directly or indirectly, the entire spectrum of socioeconomic development, they undoubtedly influence city planning and the planning process.

Responding to the challenge of taking positive action towards sustainability, the Commission of the European Union has issued, since 1993, its Fifth Environmental Action Programme. This Action Programme concentrates, among other things, on ten sensitive environmental themes or problems which require immediate action and the use of more effective methods for their solution and future management.

A substantial number of these themes/problems directly relate to city planning. It is also quite evident that proper management of most of these problems requires the contribution of geology since elements directly related to geology are profoundly inherent in them.

Listed below are some of the themes/problems and requirements of the Fifth Environmental Action Programme which cannot be properly managed without the use of geological disciplines:

- The requirement that development plans and projects "...must be consistent with the carrying capacity of the environment"
- The need for developing environmental indexes for planning purposes.
- The need to address issues related to "climate change" phenomena.
- The requirement for more effective solid and liquid waste disposal (particularly toxic wastes).
- The management of water resources.
- Coastal Zone management.
- Plans and activities related to management of Risks, Accidents and Natural Disasters.
- Etc.

OLIGOCENE FLYSH DEPOSITS WITH ASSOCIATED OLISTOSTROMS IN THE INNER ZONE OF THE SILESIAN NAPPE (NORTH OUTER CARPATHIANS, POLAND)*

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The Silesian Nappe is one of the biggest tectonic units in the Polish part of the Outer Carpathians. Within this nappe, between Skawa and Dunajec rivers extends an anticlinal structure called Lanckorona-Zegocina tectonic zone. It is formed of the Silesian and the Sub-Silesian nappes overthrusted one on another and folded both togather. After later erosion the Sub-Silesian had appeared on surface in several tectonic windows.The southern limb of the discussed structure in its eastern part has been examined by present authors between Raba and Dunajec rivers. This limb consists mainly of the Silesian deposits, Cretaceous and Palaeogene in age. There the Silesian Nappe is covered by the Magura Nappe overthrust on south and to north it tectonically joins to the Sub-Silesian Nape that occurs in the adjacent tectonic windows. In the studied area the Early Oligocene of the Silesian sedimentary succesion is represented by the Menilite beds, Cergowa sandstones and Krosno beds. The Menilite beds are developed as dark brown, silicified shales with chert level. Shales are partly interbedded by carbonate-less sandstones. The pebbly-mudstones and coarse conglomerates filling occasional depositional channals also occure. Pebbles are composed of quartz, gneisses and other metamorphic rocks, granitoids and sedimentary siliciclastic and carbonate deposits of the Late Paleozoic and Mesozoic age as well as Palaeogene shelf detritic limestones and sandstones with large foraminifera, lithothamnia and other organic remnants. Large size shally clasts very are frequent there. The thick-bedded Cergowa sandstones passes up the section to medium- and thin bedded shaly-sandstone turbidites of the Krosno beds. In the basal part of the Cergowa sandstones and close of the lithostratigraphic boundary between Cergowa sandstones and Krosno beds large olistostroms occurs. Olistostroms are composed mainly of the Lower Cretaceous flysch deposites which represent Upper Cieszyn beds, Hradiste beds and Verovice beds. Minor frequency of Upper Cretaceous flysch as well as Eocene non-turbiditic grey, grey-greenish or red marls and clayey shales have been noticed there. Also small-scale submarine slumpings are frequent within the Cergowa sandstones and Krosno beds. Occurences of the Oligocene deposits with olistostroms are known from innermost zone of the Silesian nappe, east of Dunajec river in Fore-Dukla zone in Poland, however especially well developed are in the Bitla zone in Ukraine.

Composition of pebbles and olistostroms allow to reconstruct, the history of a part of the Outer Carpathians basin which has been mostly colapsed and consumed by subduction during the Miocene folding and thrusting of the Outer Carpathian nappes. Presence of the conglomerates and olistostroms indicates the vincinity of southeren, active slope of the Silesian Basin which was conected with Silesian Ridge (= Silesian Cordillera). This ridge was an elevated geoanticlinal structure that was uplifted at the end of Early Cretaceous time during the basin inversion and next compression stage. During the Late Cretaceous and Palaeogene the ridge bounded the Silesian Basin from south and separated it of the Dukla - Fore-Magura and Magura basins. Its northern margin has been activ intensive during the Late Cretaceous and Palaeogene time. It reflected there in the type of the deposits sedimented on southern part of the Silesian Basin. At the Eocene-Oligocene boundary the Silesian Ridge has been partly colapsed and then wide connection between the Silesian and Dukla - Fore-Magura basins was opened. Therefore, during the whole Oligocene time in the sedimentary areas on the both sides of this ridge common unification of flysch facies (Menilite and Krosno beds) took place.

Presence of the discussed olistostroms within the Early Oligocene deposits of Menilite and Krosno beds suggests existance of an acretionary prism in the nearest vincinity. This prism could be formed when the consistituted basinal basement plate has been underthrust the southly situated Silesian Ridge (*cf.* Pescatore & Slaczka 1984 *Tectonophysics, 106: 49-70*). The prism has been consisted of flysch deposed during Early Cretaceous rifting time and later slope marly facies which overplaced flysch after uplifting of the Silesian Ridge. During sedimentation of the Menilite and Krosno beds, Lower Cretaceous flysch deposits and Upper Cretacous - Pleocene and Eocene marls have been sliced from the slope to the basin as olistostroms. Then the pebbles of rocks composing the Silesian Ridge and sorrounding it shelf were transported to the Silesian Basin by the high density flows.

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SOME PARTICULAR MINERALS RELATED TO THE OPHIOLITES OF ALBANIA

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Abstract.
The Ophiolite complex of Albania, set on between the Dinarides in the North and the Helenides in the south, is known as Mirdita ophiolite. It is composed of two parallel belts running from SE (Leskoviku area) to NW (Gomsiqe-Shkoder area)and they both show curve-shape extension toward NE in Tropoja-Gjakova area. This complex covering a surface of 4200 km^2 is constituted of the different mantle rocks ,transitory zone ones and cumulate associations (fig. 1). Sheeted dike complex ,volcanic basaltic and intermediary-acid rocks are also the main compound parts of this complex. In accordance to the ophiolite lithologic composition, chromite and copper-ore deposits are the most important mineralbearing potential of this complex. However, some other deposits or rare occurences of PGM, Ni- sulphide, Fe-Cu-Ni-Co sulphide and sulphoarsenide as well as Cu+Zn+Pb±Au±Ag mineralizations are also present in it. Related to these mineralizations, some particular and rare minerals are made known. These minierals are determinated by reflected light microscopy and by microprobe analyses in the BRGM, France.

The chromite of PGM-bearing chromitite mineralization is well distinguished from its accentuated ferrous character in comparison with the common chromite (MF=46,2 towards the MF= 65 to 75) (site 1). Two different types of chromite generations are evidenced: The first one is Cr-rich nodular chromitite and the second one the Al-rich and Ti-rich veinous chromitite (site 2). In the transitory ultramafite-mafite contact, a special mineral belonging to the spinel group is identified as a Ti-magnetite-chromite transitory mineral (site 3). The other particular chromite different from common one are present too: Al and Mg-rich chromite related to less depleted mantle (Cr/Cr+Al=59,3 and $Mg/Mg+Fe^{2+}$ =78,1) (site 4); Al and Mg-rich chromite related to transitory zone (site 5); Al and Mg-rich chromite related to troctolite-cumulate sequence (Cr/Cr+Al=42,8 and $Mg/Mg+Fe^{2+}$=74,3) (site 6); Al and Fe-rich chromite situated within volcano-sedimentary series nearby the ultramafite massif (site 7).

The complex mineral assemblages and particular minerals of sulphide and arsenide mineralizations are determinated also: Pyrrhotite+pentlandite+cubanite+chalcopyrite; magnetite+neodigenite+native cooper; mackinawite+valeriite assemblage within ultramafite rocks (site 8); the particular cobaltite (9.2%wt. Ni) and hedleyite (6.49%wt.Au) related to BMS mineralization (site 9); a network polysynteticaly twineed intergrowth of alloclasite+cobaltite related to quartz-sulphide mineralization (site 10); spots of maucherite related to the hydrothermal secondary Cr-chlorite-serpentine rocks (site 11); a particular member of linaeite group minerals, siegenite sceletal crystals within chalcopyrite+pyrrhotite mineralization (site 12); the spots composed by niccolite+macherite intergrowth related to chlorite+serpentine+chromite rocks (site 13); a particular PGE (Pd+Rh+Ir=0.58% wt.) and Co-bearing pentlandite variety of BMS magmatic mineralization related to dunite chromite rocks of main dunite sequence (site 14).

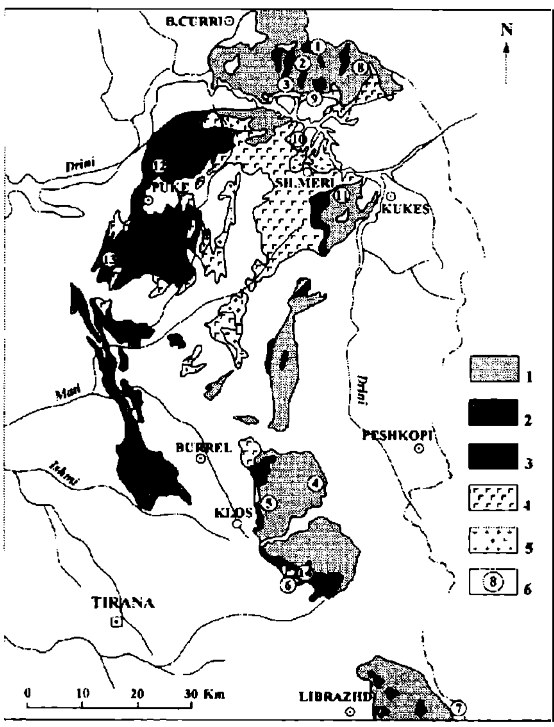

Fig. 1. Sites of some particular minmerals related to Albanian Ophiolite Complex.
1. Mantle harzburgites of the HOT-type, Eastern Belt; 2. Mantle harzburgites, Cpx-harzburgites and lherzolites of The HOT-LOT-type, Weastern Belt; 3. Massive dunites and transition zone rocks (Pl and Cpx-harzburigtes, wherlites, lehrzolites and pyroxenites); 4. Gabbros; 5. Plagiogranites and diorites; 6. Site number.

NEW KARST BAUXITE OCCURRENCE IN SLOVAKIA [MALÉ KARPATY MTS.]

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Geological setting:

The new bauxite occurrence is restricted to the northern part of the Malé Karpaty Mts.[northern part of the Brezovské Karpaty Mts. near to the city Brezová pod Bradlom]. The bauxit fills up the basal parts of pre-Gosauian canyon like paleokarst depressions in the Upper Triassic Hauptdolomite. The covering formation of the bauxit forms the basal Valchov conglomerate [Coniacian] of the Upper Cretaceous Gosau group. The bauxite is fnely granular to massive, soft to consolidated, eventually earthy to clayey, red to dark red with homogeneous matrix only with a few signs of pisolites [about 5 per cent].

Mineralogical composition:

The presence of individual mineral phases - boehmite, kaolinite and chlorite - in the samples was determined by X-ray diffraction [Šucha, oral communication]. The results of semiquantitative analysis show that boehmite is the main alumina mineral of the bauxite. Its average content ranges between 53-68%. The content of kaolinite varies from 12-15%. The relataively high average content of chlorite [19-37%] is striking.

Chemical composition and trace elements:

The alumina content of individual samples varies from 39 to 42%. The silica content varies from 22 to 25%. The range of total iron content varies in idividual bauxite samples from 15 to 16%. The titanium content varies from 1.8 to 2.0%. The loss on ignition of single bauxite samples is 11-12%. Trace elements indicate that the geology of the source area was a complex one, probably built not only of basic rocks, but also of metamorphic rocks or granitoids [Puskelova, oral communication]

Classification:

All Western Carpathian bauxite occurences belong to the group of karst bauxites and are close connected with the longest and most important paleokarst period Paleoalpine karst period - in the Western Carpathians.

Genetic ideas:

The environment of the bauxitization process was determined mainly by following factors: 1. The position of the Western Carpathian space in the realm of the northern Tethys. 2. Subaequatorial warm, probably seasonal climate with monsoonal features during the pre - Gosauian period - the most important factor which controlled the vegetation cover, hydrology, soils and the general geomorphological development of the Western Carpathian mainland. 3. Tectonics - the occurrence is situated in an orogenic belt which showed signs of the beginning quasiplatform development, with a relativ tectonic stability aproximate for 20 My 4. The "pre-bauxitic" material was most probably an iron rich silt clay, transported during the dry season by wind, or washed onto the carbonate karst surface by areal waterflows during the wet season.

TRACE ELEMENTS DISTRIBUTION IN QUATERNARY [?]TERRAE CALCIS [?]

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In the early sixties red paleosoils or soil sediments, overlying different limestones and travertines were considered also as Upper Pliocene and Quaternary "terrae calcis" - which originated from insoluble remnants of limestones and travertines. This opinion was presented also later. Other authors considered the red silt clays as mainly Neogenous weathering products, especially of crystalline schists, granitoids and neovolcanic rocks, which were after their formation transported to smaller or greater distances.

Besides the relic occurrences which due to their positions suggest a younger age [Upper Pliocene or Quaternary], also older "terrae calcis" were found: 1. Red ferruginous silt clays - "terrae calcis" - form the matrix of coarse to medium grained Valchov conglomerates, the basal member of the Upper Cretaceous sediments of the Gosau group in Western Slovakia, and sometimes occur as the infillling of paleokarst sinkhole-like depressions. Their clay fraction consists of chlorite, kaolinite, illite and illite/smectite and does not significantly differ from results obtained from relic red silt clays in neighbourhood. 2. In strongly fissured Annabergian limestones of Middle Triassic age the fissures are filled with red clays penetrating into a depth exceeding 15 m. The overlying formation is formed of organodetrital limestones of Paleogene age. Both examples show that, the often supposed Upper Pliocene or Quaternary age of relic "terra rossa" soils - accompanied in the neighbourhood by occurrences locally overlain by Upper Cretaceous or Paleogene sediments - should be substantially higher than the Upper Pliocene or Quaternary.

The average contents of most of the trace elements studied, diametrally differ in the underlying limestones and the red infilling of their fissures or overlying red silt clays. However, there are also significant differences, especially in the quantitative representation of some trace elements within the red clays. The trace elements in the underlying limestones, with the exception of strontium, are present in very low amount or below detection limit. High values of zirconium, nickel, chromium and vanadium may indicate that in the source area of the red silt clays were also alkaline rocks. In the source area metamorphic and granitoid rocks were probably also present. Weathering products were transported from the place of origin by water and partly by wind. In the area of occurrence of karstified carbonate complexes, they were washed into sinkhole - like ground depressions or fissures, representing sedimentary traps. The red silt clays of karstified travertines do not record the time of their origin but the phase of their washing into the fissures.

Should we consider "terrae calcis" to be exclusively a product formed only from insoluble residues of limestones, then this term would not be adequate for red silt clays of pre-Tertiary, or also of pre-Upper Cretaceous age, which were by misunderstanding taken as products of Upper Pliocene and Quaternary weathering products of limestones or travertines.

ALKALINE VOLCANISM IN TETHYSIAN BASIN: EVIDENCE FROM ANALCIME BEARING LAVA IN SOUTH APUSENI MOUNTAINS OPHIOLITES, ROMANIA

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Recent research in the central part of Capilnas Techereu Unit. South Apuseni Mountains. showed that the layered lava structure from the top of Mesozoic ophiolites includes an alkali-basic term (~300m thickness)-Barasti Median Unit (BMU). placed between a tholeiitic one-Podele Lower Unit (PLU) and a calco-alkaline one-Ciuciuveia Top Unit (CTU). Ciobanu & Gheuca(1997). The last mentioned two terms are interpreted either as the products of an unitary magmatic arc. Nicolae (1995). or as island arc volcanic over mid ocean ridge basalt. Savu (1996).

BMU volcanic consists in bedded block-lava flows interlayer by thin black sheets of residual decrepited lava, suggesting pulsatory short episode replenishment from magma chamber. Generally the bottom of the pile is formed by alkali-basalt. The entire sequence is characterized by the widespread presence of analcime. High vesicularity is characteristic for most evolved rocks. mugearites and benmorites. Abundant phenocrysts are represented by Ca-rich pyroxene ($Wo_{44-38}En_{54-61}Fs_{2-1}$). feldspar (plagioclase. anorthoclase) and analcime. Decrepited rocks contain similar pyroxene and plagioclase phenocrysts floating in residual acidic glasses/calcite cementation veins. Analcime is altered to calcite or silica richer zeolites such as clinoptilolite and mordenite. High alteration appears also in the tholeiites from PLU. especially as zeolitization. but analcime is not present in this association.

Alkaline suite has silica content in the wide range 45-60wt%. alkalis range: 4-11wt%, generally $Na_2O>2+K_2O$. mg # = 0.70-0.40. low TiO_2(0.6-1.15wt%). showing a transitory character from mafic alkali-basic to felsic-intermediate evolved volcanic. The rocks are classified according to alkalis vs. silica diagram (Le Bas et al. 1986). The array of plots begins from the corner of alkali basalt and hawaiites. cluster mugearite-benmoreite fields and show a tendency to span towards tephri-phonolitic field in the range 52-55wt% SiO_2 vs. >8wt% alkalis (up to 20% *ne* norm). The majority of alkaline lava are low to moderately *ne*±*ol* normative with *ne* ratios in the range=0.5-15wt%. Among alkali basalt and hawaiites appear *ol-hy* (low alkalis <5wt%). while among mugearites and benmoreites appear *q-hy* normative types (0.5-7% *q*). in silica-high (55-60wt%)/medium alkalis (5-7wt%) varieties. Transitory alkaline-subalkaline BMU volcanic character is reflected in the *Ne'Ol'Q* diagram (Irvine & Baragar. 1976) where the alkaline suite cross from Ne'corner of alkali field *through Ol'-Ab line* into subalkaline median field. near the *Opx-Ab* line. Better fitting with modal composition of alkali basalt and hawaiites appears in the *Cl-AN high Na* diagram and also the sodic character of volcanic suite is marked in *Ab An'Or* diagram (Irvine & Baragar. 1976). Global chemical composition of residual decrepited lava is characterized by low SiO_2 content (35-49wt%). high CaO (11-22wt%)/ high CO_2 (6.5-21.5wt%). low Al_2O_3 (10.3-14.5wt%). low alkalis (≤4.5wt%), wide MgO range (2.5-9wt%). comparable to carbonatitic residua related to alkali volcanism. The subunitar H_2O contents is in good agreement with the very fresh behaviour of the however friable rocks. By extracting CO_2 content as calcite from the global rock composition. SiO_2 and Al_2O_3 get to high ratios according to refractive indices of the acidic glasses and plagioclase phenocrysts abundance.

REE and incompatible trace elements of selected relative fresh samples from intermediate evolved lava show similar OIB's patterns. Differences among the group appear in steep to moderate slopes (La/Tb =50-18) correlated to slight increment of silica saturation. higher dispersion of LREE enrichment to narrow range of HREE depletion. kinked at Eu. Ranges of LREE (La=9-15.3 ppm. Eu=0.5-23 ppm). and HFSE (Th=4-15.6 ppm. U=1-3.7 ppm. Hf=0.85-4.7 ppm) are comparable to similar contents in OIB's from Pacific (Loihi-Hawaii. Tubuai. Eiao-Marquesas). while Ce (7-23 ppm). MREE (Gd=0.4-1.23 ppm) and HREE (Tb=0.15-0.43 ppm. Yb=0.2-0.55 ppm) are decreased by factors from 4 to10. comparative to the mentioned lava contents. Sharp Ce (-) and Hf (-) anomalies are related to residual fluids extraction. where these elements concentrate.

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CORRELATIONS OF METAMORPHIC INDEXES IN CLAY-RICH ROCKS AND VOLCANIC - VOLCANICLASTIC ROCKS IN MESOZOIC DEPOSITS OF THE SOUTH CARPATHIANS

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An attempt to correlate the very-low grade Alpine metamorphism of pelitic and volcanic - volcaniclastic rocks of the South Carpathians is based on recent studies of the mineralogy of the Mesozoic cover sequences (Severin and Cosustea Nappes).

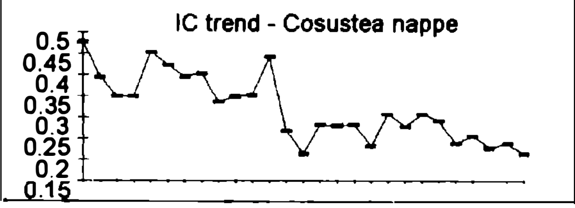
In various formations of the Severin Nappe the illite 'cristallinity' varies between diagenesis and anchizone-epizone boundary, with a maximum number of values clustered at the diagenesis-anchizone limit ($0.19\ \Delta^{0}2\theta$<anchizone<$0.32\Delta^{0}2\theta$). The values of IC for various siliceous slates are not greater than for Sinaia beds (turbidites), as it would have been expected considering that in siliceous rocks the illite aggradation is retarded because of K deficiency; K supply during metamorphism seems a reasonable explanation for this. Siliceous slates show good IC–ChC correlation; similar correlation is obvious for the Sinaia beds if only samples from the anchizone are considered.

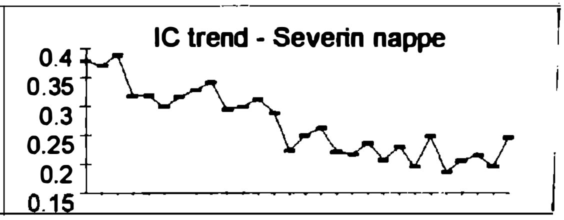
Jurassic basalts from the Severin Nappe show prehnite-pumpellyite and pumpellyite-actinolite facies metamorphism.

IC for the Upper Cretaceous deposits of the Cosustea Nappe (terrigenous turbidites and melanges) varies from 0.19 to 0.48 (anchizone-epizone boundary to diagenesis). The correlation between illite and chlorite 'crystallinities' is weak; a large amount of detrital chlorite must have been present to mask (conceal) the relations between authigenic chlorite and illite.

Late Cretaceous volcaniclastic turbidites of the Cosustea Nappe show a prehnite-pumpellyite facies metamorphism.

An increase in metamorphic grade from South-West to North-East is obvious in the case of Mesozoic formations of the Severin and Cosustea Nappes. In the Mehedinti Plateau (West of the Danubian bend) the IC values for Severin nappe formations are characteristic for lower anchizone-diagenesis, while eastward of the bend they are characteristic to the upper anchizone-epizone; there is a good correlation between the IC trend of pelitic rocks and mineral assemblages in associated volcanic rocks.The Upper Cretaceous samples give IC values typical for upper diagenesis west of Danubian bend and characteristic for anchizone in the South Vâlcan Mountains. There is no apparent eastward increase in metamorphic grade of the Upper Cretaceous volcaniclatic rocks; the lack of suitable samples in the Parâng Mountains is probably the explanation.





CHARACTERISTICS OF ENVIRONMENTAL DISRUPTION CAUSED BY EXPLOITATION AND PROCESSING OF MAGMATA AND CARBONATE ROCKS

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The exploitation and processing of building stones contribute to disruptions of environment and establishment of natural balance which are reflected in the following: natural resources of quality stone materials are lost irretrievably; the relief is changed permanently; fertile farming soil is lost and degraded; air, surface and ground waters are polluted; vegetation is annihilated; terrain instability is increased with occurrence of landslides and rockfalls; erosions are intensified; changes in the oecologic system are obvious and visible, etc.

Within igneous rocks of Serbia there have been registered 178 quarries of which as of now only 10 are operative. Quarries within igneous rocks have been opened prevailingly in andesites and dacites (100 quarries), and in granites and granodiorites (56 quarries).

Carbonate rocks form 9.6% of territory of the Republic of Serbia. Surfaces with occurrences of carbonate rocks are very heterogeneous and encompass the areas from few to several hundreds of squares km. As concerns carbonate rocks, i.e. limestone's, dolomites and marbles there are 250 quarries of which only 80 have regular production.

Next to roads some 35% of carbonate rocks quarries have been opened whereby there is an immediate menace to traffic flow and safety. In the close vicinity of settlements 25% of quarries are located and this is endangering the nearby population and property. Noise and air-pollution emerge with negative impact on people, flora and fauna. Changes to relief are considerable at the exploitation of carbonate rocks, since 60% of quarries have a length between 50 and 250m. On many locations there are quarries one after another in a series whereby the relief is substantially changed.

Opened areas on excavations and stocks piles of barren soil materials and finished products are close to one another thus provoking changes in the landscape of surrounding area.

THE IMPACT OF ALTERATION PROCESSES ONTO THE TECHNICAL PROPERTIES OF ANDESITES WITHIN CERTAIN DEPOSITS OF SERBIA

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Andesite and dacite rocks in the Republic of Serbia compose three quarters of all volcanic rocks. Frequent occurrence and rather good physical-mechanical properties are the basic reasons that within these rocks, in the last eighty years, there were 83 active quarries.

Geologic investigations have established that there are no new and unaltered andesites on the territory of the Republic of Serbia, and that all of them have been seized more or less by alteration processes. Alterations may be subdivided into two genetically different types, as follows:

- auto metamorphic propylization, originating within final stages of creation of andesites;
- hidrothermal alterations linked with later creation of deep granitoid rocks.

Propylitic alterations are characteristic for subvolcanic indurated andesites. Changes are visible on colored constituent components, whereas bright minerals remain unaltered. In these alteration processes the rock is attaining characteristic bright green color. Gradual alterations cannot be carried out distinctly and these changes do not exert an essential influence onto physical and mechanical properties of a rock.

Hydrothermal alterations change basically all constituent components within a rock, and thus exert an essential influence in altering physical and mechanical properties of andesites. Amongst hydrothermally altered andesites, three degrees of alterations have been singled out. Each degree of alteration is defined on the basis mineral composition changes being distinctly visible within the framework of microscopic investigations. All hydrothermal alterations in a quarry show distinct zonal structure which is very important for selective operation.

STRATIGRAPHY AND SEDIMENTOLOGY OF MIDDLE TO UPPER JURASSIC SILICICLASTIC DEPOSITS OF THE PIATRA CRAIULUI MOUNTAINS, EASTERN CARPATHIANS, ROMANIA

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A section reflecting the Jurassic formation of a passive continental margin at the southeastern end of the Dacide microcontinent was investigated. The stratigraphic profile is located on the western limb of the Piatra Craiului syncline, in the transition between the westernmost Eastern Carpathians and the South Carpathian basement. The western limb of the strongly asymmetrical syncline builds up a hogback with a relief of more than 1300 metres, falling nearly vertical to the Bârsa Valley in the northwest. On this part three geological units are present: (i) the generally low grade metamorphic basement, mainly composed of greenschists and micaschists belonging to the Leaota Series, (ii) the transgressive Middle to Upper Jurassic siliciclastic deposits, and (iii) the more than 700 m thick carbonate sequence of Tithonian age. The first two units are almost covered by dense forests and thus outcrops are to be found only in the steep, branching gullies of this flank. The massive carbonates of the third unit, however, are well exposed on the whole west-northwest side of the syncline.
The relatively accessible Ciorânguţa gully exposes the complete, relatively tectonic undisturbed section. Up to now there is no high resolution stratigraphic work on the siliciclastic unit available so that the presented profile could be seen as a new record of a poorly known sequence.

The Middle to Upper Jurassic epiclastic deposits start in the Ciorânguţa gully at the base of 1235 metres altitude and are building up a succession of 160 m thickness wich generally shows a fining upward sequence. It is a classic transgressive sequence with at least two clear regressive cycles of 5 m thickness each, establishing a sawtooth subsidence pattern. Two distinct lithofacies are developed: (1) a coarser, immature, shallow water facies of 64 metres thickness and (2) a finer, cherty and marly, deeper water facies. From the basis to the top the sequence is composed of:

(1) a basal imbricated microconglomerate bearing principally metamorphic clasts of the nearby basement and different algae and benthic foraminifera grading into
(2) a fine-sand lithic arkose (mainly plagioclase) with wavy lamination and abundant plant imprints and fragments beside brachiopods and bivalves,
(3) a fining upward orthoconglomerate bed with no fossils,
(4) medium sand-sized arkoses, intensively bioturbated and containing crinoid fragments,
(5) a fine sand-sized subarkose layer with coarsening upwards structure and tool marks,
(6) wavy glauconitic phosphorite (coated grain texture) with an abundant faunal assemblage (ammonoidea, belemnitida, crinoidea),
(7) marl and siltstone bedsets with initial parallel lamination but grading upwards into
(8) sandy and marly limestones with distinct lenticular bedding and
(9) cherty limestones, strongly bioturbated with burrows and belemnites on the bedding planes.

This stratigraphic record shows a synsedimentary tectonic control on the depositional environment from the beginning of the extensional phase of the basin in Early Bajocian. There is evidence of continuous subsidence until Oxfordian expressed by the facies change from litoral to pelagic conditions. Because of the abundant unaltered feldspars in the basal arkoses we may say that the source area was near the shoreline and has featured a steep, rocky relief. Up to the glauconitic phosphorite bed the composition of the conglomerates and sandstones points to the same provenance area. The phosphorite development indicates for at least the presence of upwelling currents in an outer shelf environment. From there on the terrigeneous influence diminishes more and more and a carbonatic facies develops. We also may say that at this point of the ancient continental margin the deepest level of deposition was above the CCD as we can see from the development of the cherty limestones at the top of the profile. We therefore conclude, that the investigated section represents the rift and subsequent post-rift development on a tilted basement block.

ZEIDAE AND CAPROIDAE (TELEOSTEI) IN THE OLIGOCENE FORMATIONS FROM ROMANIAN CARPATHIANS

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Among the six Recent families of the Zeiformes (Greenwood et al., 1966), only Zeidae and Caproidae have fossil representatives, present in the Oligocene formations from Romanian Carpathians as well. A review of the so far mentioned specimens in Romania from different collections and a study of the newly found ones from Fieni and Sucevita Valley Bassin have been accomplished.

Zeidae: represented by few specimens in Romanian East Carpathians *Zeus hörnesi* (Kramberger) described by Paucă (1938) from Ulmetu, and *Zeus* aff. *Hörnesi* (Kramberger) described by Jonet (1958) from Homorâciu (both from Oligocene Pucioasa-Fusaru Lithofacies; Tarcău Nappe; Rupelian) are assigned to *Zenopsis* sp. (poorly preserved; thus impossible to be assigned to a certain species). Two very well- preserved (double impression), well developed specimens (SL=76 mm; SL=102 mm) showing osteological characteristics typical for *Zenopsis clarus* Danilcenko have been recently found in Sucevita Valley Bassin (Tarcău Nappe; Bituminous Lithofacies with Kliwa Sandstone; Lower Dysodilic Shales; Rupelian).

Caproidae: represented by plenty specimens, differently termed in time. All the so far mentioned specimens (Paucă, 1933; Jonet, 1958; Ciobanu, 1977) and those recently found by us (Fieni; Valea Caselor Lithofacies; Rupelian) can be assigned to *Capros rodobojanus* (Kramberger) on the basis of their common osteological characteristics. Standard length/body depth ratio study displays in many specimens an inconstancy (remarked by other authors as well) but which can be placed within the species variability.

Therefore, only *Zenopsis clarus*, *Zenopsis* sp. (Zeidae) and *Capros rodobojanus* (Caproidae) have been found so far in several Oligocene lithofacies from Romanian Carpathians.

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ZONAL MINERALIZATION CREATED BY METALLOGENETIC AND TECTONO-STRUCTURAL PROCESS. CAVNIC-ROMANIA

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The Cavnic ore deposit is situated in the eastern part of neogene eruptive Gutai Mountain (north Romania).

The parallel NNE-SSW Cavnic sistem veins bear a poliascendent polimetalic mineralization. The macroscopic and microscopic study and tectono-structural processing show a single mineralization mechanism.

All the different complex mineralization aspects are a simple explanation. We have found some parameters (number of faults, symmetric or nonsymmetric opening vein type, deposit or nondeposit of a different polimetalic phase, time factor, etc.) which define a unique mechanism.

The numerous graphic interpretation show the zonal mineralization evolution in time and the space, creating an expressive image.

MIDDLE MIOCENE FORAMINIFERA BETWEEN THE PRAHOVA VALLEY AND THE TELEAJEN VALLEY (SOUTHERN SUBCARPATHIANS, ROMANIA)

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The Middle Miocene deposits from the studied region make up the filling of some small synclines, on the back of the Tarcau Nappe of the Eastern Carpathians Moldavides (Sandulescu, 1984). They are represented by Badenian and Sarmatian (Volhynian and Basarabian) deposits.

The Badenian normal marine deposits from the Southern Subcarpathians are classically divided into four, rather informal, litho-biostratigraphic units, which from bottom to top are: the **Slanic Tuff,** which in the planktonic foraminifera zonation established by Popescu (1987), belongs to the Candorbulina universa/Globorotalia bykovae and to the Globoturborotalita druryi/Globigerinopsis grilli zones; the **Evaporitic Formation,** belonging to the Globoturborotalita druryi/Globigerinopsis grilli Zone; the **Radiolarian Shales** and the **"Spiratella" Marls**. The last two units belong to the Velapertina Zone, established by the same author as above. As regards the Sarmatian brackish deposits, their lithology changes rather rapidly both laterally and vertically, so that no large scale lithostratigraphical units were established.

Within these deposits 11 foraminiferal assemblages were identified, as follows: **assemblage A,** characteristic for the lowermost part of the Slanic Tuff, represented by planktonic foraminifera mainly of the genera *Globigerinoides, Candorbulina* and *Globoquadrina*, with less than 1% benthonic foraminifera; **assemblage B**, in the middle part of the Slanic Tuff, characterized by a higher content in benthonic foraminifera and the eruption of the species *Globoturborotalita druryi* (Akers) and *Globorotalia (Obandyella) transsylvanica* Pps.; **assemblage C**, in the uppermost part of the Slanic Tuff, characterized by the disparition of the warm water genera and the predominance of the genera *Globigerina, Globorotalia* and *Globigerinita;* **assemblage D**, within the Evaporitic Formation, made up of *Globigerina* spp., *Globorotalia (O.) transsylvanica* Pps. and some agglutinated foraminifera; **assemblage E**, characteristic for the upper part of the Radiolarian Shales and for the lower part of the "Spiratella" Marls, made up of predominantly benthonic foraminifera of the genera *Caucasina, Bolivina* and *Uvigerina*; **assemblage F**, in the "Spiratella" Marls, characterized by the predominance of the species *Velapertina indigena* (Lucz.); **assemblage G,** in the upper part of the "Spiratella" Marls, made up of agglutinated foraminifera, miliolids and *Globigerina* spp.; **assemblage H,** in the lowermost Volhynian deposits, made up of *Varridentella* spp. and *Lobatula dividens* (Lucz.); **assemblage I,** in which species of the genus *Articulina* predominates; **assemblage J,** very characteristic for a short moment within the Upper Volhynian deposits, characterized by the species *Ammobaculites* sp., *Sinzowella* cf. *crustaformis* (Bogd.), *Glabratella imperatoria* (d'Orb.) and *Elphidium reginum* (d'Orb.); **assemblage K,** in the Basarabian deposits, characterized by *Porosononion* spp.

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SEDIMENTARY ENVIRONMENTS AND PALAEOGEOGRAPHY OF THE URGONIAN FORMATIONS OF HUNGARY

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According to Rat (1966) the Urgon is a biosedimentary system. Accepting this the paper gives an overview of the Lower Cretaceous rudistid formations in both the Tisza and the Pelso tectonic units of Hungary.

In the Pelso unit three Urgonian formation are known. The Köszörukobánya Conglomerate Member of the Lábatlan Sandstone Formation contains scattered limestone cobbles and two breccia beds of prevailingly limestone composition of carbonate platform (including reef) origin. The HST megabreccsa contains fossils as follows: corals, stromatoporoids, rudists, other bivalves, orbitolina, etc. The Köszörukobánya Member is deposited on the slope of the southern or southwestern side of the closed and obducted Vardar ocean.

The lower member of the Környe Limestone Formation is an organodetrital hemipelagic, allochtonous limestone of carbonate platform origin. The narrow zone is situated between a semi-restricted basin and a fresh to brackish-water lagoon. It is also found as a basin floor fan in the Vértessomló Siltstone Formation. The upper member of the formation is a typical platform carbonate with rudists (mainly *Toucasia carinata*), *Chondrodonta* sp., coral and stromatopora colonies and orbitolinas [O. *(M.) texana* és *O. (M.) subconcava*]. The cessation of the carbonate platform is caused by an increased siliciclastic production of a nearby delta.

The Zirc Limestone Formation in the Transdanubian Range is subdivided into a northeastern and a south-western successions. The lower member of the first one is characterized by rudists in rock-forming quantity (*Agriopleura blumenbachi*, *A. marticensis*, *Pseudotoucasia santanderensis*, etc.). The middle member is a pelletal, microfossiliferous limestone with frequent orbitolinas (O. *(M.) aperta*, *O. (Conicorbitolina) baconica* and *O. (O.) sefini)*. The upper member is hemipelagic biodetrital and sandy limestone. The south-western succession consists of rudistid (mainly *Eoradiolites* species) and gastropoda-bearing limestones (*Nerinea, Nerinella, Ampullina, Ceritella, Metacerithium, Pseudomelania*, etc. sp.) with bauxitic clay intercalations. The sedimentation of the platform carbonate is stopped by a set of subsequent world-wide events: short time sea level drops and sea level rises (glauconitic and phosphatic marl) in the Dispar Zone.

The formation of the Nagyharsány Limestone in the Villány Zone (Tisza unit) started in freshwater lagoon continued in marine inner and outer lagoons. Its lower member is characterized by some Lofer cycle elements (black pebbles, algal mat and fenestral fabrics) and root structures. The upper part of the formation is rich in rudists (*Toucasia carinata, Requienia* sp), green algae, *Bacinella, Lithocodium* and *Orbitolina.*

Corals, Chaetetopsis, rudists etc. occur together with pelagic and bathial fossils in the Magyaregregy Conglomerate and Hidasivölgy Marl in the Mecsek Zone. These particular sediments are products of an atoll-like feature fragments of which were gravitationally transported on the slope of the volcanoes and into the basin.

The paper outlines the palaeogeographic relations between the formations above and some Urgonian formations within the Alpine-Carpathian Realm.

STRUCTURAL EVOLUTION OF NE HUNGARY

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Analysis of NE Hungarian maps and sections helps to describe two areas with complex tectonic superpositions: the Aggtelek area and the Szendrő-Bükk area. Original tectonic superposition is based on metamorphic degree, actual superpositions and other geological considerations. The sequences can be grouped into three structural units: the lowermost Torna-Bükk unit, the overriding oceanic Darnó-Szarvaskő unit and the topmost Aggtelek-Bódva (Szilice) unit. These are covered by Tertiary strata. We measured structural elements in main outcrops, caves and quarries near the Hungarian-Slovakian border. Dating of the structures is relative and sometimes questionable.

A first ductile shear phase was recorded in the lower Torna, Bükk and Darnó-Szarvaskő units. This comprises SE striking stretching lineations with top to SE rotated clasts, southvergent synschistose folds. The proposed age for this deformation is Late Jurassic (160 Ma), coeval with high-medium pressure metamorphism. This phase is thought to record south(west)wards directed obduction of the Darnó-Szarvaskő accretionary prism on a Dinaric margin.

Another ductile phase is recorded in the Szendrő-Uppony Paleozoic massifs. Layer-parallel flattening, synschistose northvergent folds record a northwards transport, the age of which is thought to be around 120 Ma. The next phase is measured in the Szilice units with reactivated faults, flat south-dipping thrust faults and folds, giving a north-vergent overthrust. Based on simiiar structures across the border, the age of the deformation is inferred to be Albian (100 Ma). These two phases are speculatively related to the closure of the Vardar ocean and nortward emplacement and propagation of Dinaric elements over the already obducted Darnó-Szarvaskő suite and Dinaric (Bükk) margin (and farther north over the Austroalpine-Gemer margin).

A major ductile strike slip event occurred along the Darnó lineament. This sheared and offset all previously formed structures. This lineament fits in the NE-SW left lateral system of the Capathians, thought to be pre-Paleogene. We tentatively correlate this event with the unroofing of the metamorphic complex and with the formation of a Gosau basin in the Campanian (around 90 Ma).

Two ductile-brittle phases follow, both giving spectacular structures. Depending on lithology they are characterized by folds or strike slip faults. A supposedly first phase has NE-SW fold axes and mostly SE vergence, while the second has NW-SE fold axes and a NE vergence. Both might be related to Paleogene-Early Miocene deformations and their relative positions or successions might be explained by large rotations during the Early Miocene. These rotations affect large areas in N Hungary-SE Slovakia.

A brittle NE-SW left lateral strike slip acitvity is recorded by early Middle Miocene rocks around the Darnó zone. This is followed by NE-SW extension and NW-SE extension. The former might be Late Miocene in age, while the latter might be recent, because of the structures on cavity fillings in the caves.

INVESTIGATION OF SOME Tl – AND As – BEARING SULPHIDES FROM ALLCHAR (MACEDONIA)

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The epithermal Tl-As-Sb-(Au) ore deposit Allchar (Macedonia) is a unique one in the world because of its high Tl-content, especially expressed at the Crven Dol ore body which is localized in the northern part of the deposit. It is also a type –locality of a numerous Tl-minerals of As, Sb, Hg, and Fe, among which picotpaulite ($TlFe_2S_3$) and raguinite ($TlFeS_2$), occur as a unique natural phases.

The ore consists of dominant As- and Fe-sulphides as realgar, less orpiment, pyrite and marcasite, followed by lorandite ($TlAsS_2$) as the most frequent Tl-mineral and much less by picotpaulite and raguinite Sulphides of As usually occur in a coarse-grained aggregates, lorandite in single grains and crystals, picotpaulite and raguinite generaly as relics of different sizes, while pyrite and marcasite exibit a great diversity in sizes and shapes of their grains and aggregates, appearing in crystals, globulae, spherolites, veinlets. Besides this, the specific aggregates of pyrite, represented by the prismatic forms occur in the ore, developing its pseudomorphs over picotpaulite. In these cases a very fine-grained mixture of pyrite, raguinite and lorandite often remains, as well as a thin rims of raguinite, replacing picotpaulite.

By the previous ore-microscopic investigation a selection for tht EDS and EPMA analysing of the zonal and spongy pyrites, relics of pyrrhotite and super fine grains of the yet unknown phase was made. The analyses were perfomed with the Philips SEM XL-30 with EDS (1,4) and ARL SEMQ with WDS (2.3), operating at 20 kV and 20 nA of the beam current for the both instruments.

The obtained results confirmed the presence of pyrrhotite, arsenian pyrite with and without Tl and the obviously unknown phase, what makes a new base for the much complete explanation of the genesis of the Allchar ore-deposit.

Element	1	2	3	4
Tl	-	-	2.36	39.35
As	-	10.53	8.59	15.62
Fe	60.55	50.53	41.45	15.91
S	39.45	38.50	46.47	29.11
Total	**100.00**	**99.56**	**98.97**	**99,99**

Table.1. Analyses of Pyrrhotite (1), arsenian pyrite (2,3), and unknown phase (4)

INVESTIGATION OF GOLD FROM THE ST. BARBARA (EASTERN SERBIA) DEPOSIT

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Northern part of Eastern Serbia is the region where there are several gold-, gold-silver- and scheelite-bearing ore deposits. The precious metals are present as native gold and very often as natural alloy electrum (Au, Ag), occurring in the quartz veins which intersect the pre-Cambrian "green schists" formation, as a country rock. Two types of ore veins appear: one, which consists of "milky-white" quartz with pyrite and the other, which contains the Pb-Zn ore with pyrite, galena, sphalerite, chalcopyrite, etc., accompanied by silicifying quartz (later generation) and carbonates as gangue minerals. The precious metals occur in both types of veins.

The investigated material was taken from the St. Barbara deposit located in the central part of the region. It was represented by the fragments of quartz with impregnations of sulfide minerals and to a lower degree by the single pyrite grains, ranging in size from 2 to 6 mm.

Ore-microscopy and investigations by means of Scanning Electron Microscopy (SEM) were carried out on random samples described above. The pyrite grains are hypidiomorphic and exhibit the cataclastic and cleavage cracks, usually filled up wi h galena. In addition to these minerals, some quantities of chalcopyrite intergrown with sphalerite, tetrahedrite and traces of what appears to be argentite also occur.

The natural alloy electrum shows a significant diversit of occurrence. According to the frequency of its occurrence, the rarest are single electrum grains in quartz. It occurs as an inclusion in chalcopyrite much more often than in pyrite. Commonly, the largest amounts of the alloy are found embedded in and with galena, in the form of single grains or as intergrowths. Electrum exhibits either irregular, hypidiomorphic and deformed crystal forms, or occurs in irregular masses intergrown with galena. In some cases, thin rims of electrum surround the pyrite grains.

Investigation of the chemical composition of gold was carried out by means of SEM equipped with a fully automated x-ray Energy Dispersive Spectrometer (EDS), type XL-30 DX4i, manufactured by Philips. The investigation was carried out in the Centre for Microanalysis and Surface Studies, Ins itute for Nuclear Sciences, Beograd - Vinča. The working condition were the following: 20 kV excitation voltage, 20 nA bem current. The results are presented in tabular form.

Chemical composition of Au from Santa Barbara

	1	2	3
Ag	16.31	28.74	29.02
Fe	-	-	1.25
Au	83.69	72.26	68.83
Total	**100.00**	**100.00**	**100.00**

PETROLOGY OF LAMPROPHYRIC ROCKS OF THE MIOCENE BORAČ ERUPTIVE COMPLEX (CENTRAL SERBIA, YUGOSLAVIA)

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The Borač eruptive complex is a volcanic area in southern Šumadija (the central part of Yugoslavia), which is situated within a tectonically complicated part of the Vardar zone. Recent data have revealed the presence of coherent and volcaniclastic facies of dacites, trachytoids of lamprophyric character, quartz latites and andesites, as well as quartz latite-rhyodacite primary and resedimented pyroclastic rocks.

The largest occurrences of the lamprophyric rocks crop out as hypoabysal bodies, however coherent lava flows and primary and redeposited autoclastic deposits have also been observed. There are holocrystalline to hypocrystalline porphyritic phlogopite trachyte, phlogopite-leucite melaphonolite, phlogopite-feldspar leucitite and olivine melaleucitite varieties, composed respectively of diopside (Wo_{45-49}), phlogopite (> 0.5 % Cr_2O_3), sanidine ($Or_{54.6-54.9}$), leucite, ± oligoclase ($An_{28.8}$), ± altered olivine, apatite and opaques, as well as of quartz and zoned plagioclase ($An_{47.3}$) of xenocrystic origin. K/Ar radiometric data, obtained on phlogopites (22.78+/-0.88 and 22.65+/-0.89 Ma) as well as on a whole rock sample (22.72+/-0.86 Ma), showed that hypoabysal lamprophyres formed during the first volcanic phase of the Borač area. when calc-alkaline dacitic effusives originated. However, some stratigraphical relationships indicate that the formation of these rocks have multiphase character, but this statement has to be improved by new radiometric data.

The Borač lamprophyric rocks correspond to potassic/ultrapotassic series displaying high content of K_2O, MgO, TiO_2, incompatible trace elements (Ba, Sr, Zr, Y, Nb, Th and REE), as well as compatible elements which characterise primary mantle melts (Cr, Ni, Co, V, Ir and Sc). Comparing to the calc-alkaline rocks of the Borač complex they show lower Zr/Nb and respectively higher K/Rb ratio.

In terms of petrochemical and isotopic data of the Borač volcanic rocks the presence of two different magmas - alkaline (potassic to ultrapotassic) and calc-alkaline - became apparent. Their parental melts probably originated within the subcontinental mantle i.e. by melting of the parts previously enriched by the subduction component. Trachytoids of lamprophyric character lack europium anomaly and display evidences of residual fractionation and negligible contribution of crustal material. Comparing the Borač lamprophyres with the similar volcanics of the Roman Province it can be concluded that the Miocene Borač eruptive complex as a whole developed in a continental environment during post-collisional geotectonic conditions.

FACIES PATTERN VERSUS HYDROCARBONS MIGRATION IN THE MIOCENE COMPLEX OF NORTHERN CARPATHIAN FOREDEEP (POLAND)

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The Middle Miocene (Badenian-Sarmatian) marine infill of the Polish part of Carpathian Foredeep, up to 3.5 km thick in SE area, consists of three main lithostratigraphic units: clastic Skawina and Machów Formations, divided by evaporitic Wieliczka Formation (sulphates and rock salts). In the southern part of the foredeep, within sandy interbeds of both clastic formations, were discovered numerous economic hydrocarbons plays and in the northern area the famous native sulphur deposits occur within sulphates of evaporitic unit. Facies analysis of clastic Miocene deposits in the northern-central part of foredeep showed that coarse (gravelly-sandy and organogenic-detritic limestones) more permeable sediments (Baranów Beds of Skawina Fm and Chmielnik Beds of Machów Fm) continue only along the northern margin. Toward the basin centre, they form isolated bodies within generally impermeable pelites (marls, silts and clays). Similar facies relations are observed in the southern basin margin where coarse clastics of submarine fans wedge out toward the basin axis. Evaporites create also impermeable horizon within the whole foredeep.

Described facies pattern of the Miocene complex argues against unlimited migration of hydrocarbons - both the squeezed from folded Carpathian flysh and the original Miocene ones (Glogoczowski, 1976; Kotarba et al., 1988) - in the foredeep from the south to the north along porous clastic pathways was impossible due to lack of such ones. Most of economic plays (gas and oil) occur in the clastic belt developed along the Carpathians margin and much less (gas dominated) plays were found within isolated traps in the basin axis (Karnkowski, 1993). They are absent in the northern foredeep margin.

Thus, a large-scale hydrocarbons migration could take place along system of regional dislocation zones. Currently, the multi-coverage geological interpretation of satellite imagery enabled to detect such zones in this area (Karnkowski, Ozimkowski, 1998). Faults are very difficult to map both in horizontal and vertical sections in the homogenous Miocene deposits of foredeep. Thus, the analysis of lineaments pattern interpreted from satellite imagery, distinctly reflecting the subsurface dislocation zones, may better explain possibility of hydrocarbons migration through impermeable Miocene deposits than results of facies study and facilitates prospecting of hydrocarbon concentrations in the Carpathian Foredeep.

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VARISCAN AND ALPINE TECTONIC PROCESSES IN THE EASTERN CARPATHIAN OROGEN: EVIDENCE FROM $^{40}AR/^{39}AR$ MINERAL AGES AND STRUCTURAL ANALYSIS

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Three hornblende and eleven muscovite concentrates from sample collected within basement rocks of various Alpine and pre-Alpine nappes along a E-W section in the Eastern Carpathian orogen have been studied with $^{40}Ar/^{39}Ar$ techniques in order to constrain pre-Alpine and Alpine tectonic processes. The study area comprises in structural upward order the Infra-Bucovinian, Sub-Bucovinian, and Bucovinian nappe complexes. The new $^{40}Ar/^{39}Ar$ mineral ages combined with microfabrics and textural observations suggest that rocks within the Infra-Bucovinian nappe complex exposed within western sectors of the Rodna window were penetratively rejuvenated during Alpine orogeny. A muscovite concentrate (from the Bretila gneiss) yielded a plateau age of 116.1 ± 0.1 Ma that is overprinted by a low grade thermal event at c. 100 Ma. Western sectors of the structurally overlying Sub-Bucovinian nappe complex are non-retrogressed record muscovite plateau ages between 98.1 ± 0.1 Ma and 94.1 ± 0.1 Ma, and hornblende plateau ages of 117.0 ± 0.3 Ma and 266.7 ± 0.6 Ma (the latter close to the basal nappe contact). We interpret these ages to date cooling following the culmination of Alpine metamorphism that partly exceeded c. 500°C. This interpretation is in line with metamorphic mineral assemblages that include new grown garnet with normal prograde chemical zonation within meta-pelites.

The penetratively retrogressed Bretila gneiss of the Infra-Bucovinian nappe complex exposed within the Rusaia structural window (central study area) yielded a hornblende plateau age of 374.5 ± 0.3 Ma, and muscovite plateau ages 270.4 ± 0.2 Ma and 268.1 ± 0.2 Ma where low grade experimental increments display a staircase patterns with ages down to < 200 Ma. The muscovite ages are interpreted to reflect penetrative retrogression associated with ductile shearing, perhaps during phases of low angle, Permian extension.

Sectors of the Sub-Bucovinian and Bucovinian nappe complexes exposed east of the Rusaia/Iacobeni structural culmination display only minor effects of the Alpine metamorphism and pre-Alpine fabrics are well-preserved. Kinematic details of Variscan nappe assembly may therefore be resolved. Muscovite from the low grade metamorphic Tulghes Group sediments and metavolcanics yielded both in the Sub-Bucovinian (307.1 ± 0.2 Ma) and Bucovinian nappe complexes (303.5 ± 0.2 Ma) similar ages that are interpreted to represent muscovite formation ages during Variscan ductile shearing within low-grade metamorphic conditions. Muscovite from a low grade metavolcanic phyllite from the Variscan Pietrosul nappe (beneath the Tulghes Group within the Sub-Bucovinian nappe complex) yielded a 283.2 ± 0.1 Ma age that may record shearing during Early Permian extension as within the Infra-Bucovinian nappe complex of the Rusaia window. Furthermore, a muscovite concentrate from an amphibolite-grade sample of Bretila gneiss within tectonically highest basement levels of the Bucovinian nappe complex yielded a 330.9 ± 0.2 Ma age.

In summary, the new $^{40}Ar/^{39}Ar$ mineral ages suggest the following tectonothermal evolution of eastern segments of the Carpathian orogen: (1) the Bretila Group was metamorphosed during early phases of Variscan orogenesis (hornblende: 374 Ma) and slowly cooled through muscovite argon retention temperatures at c. 330 Ma. (2) Variscan nappe assembly occurred at c. 305 Ma within low grade metamorphic conditions was likely related to continuing extension within the Bucovinian microplate. (3) Localized Early Permian retrogression and shearing within low-grade metamorphic conditions is explained to relate to ongoing extension of the Bucovinian continental microplate, formation of horst and graben structures, and deposition of intramontane molasse sediments. (4) There is a strong gradient of peak P-T conditions of the Alpine metamorphic overprint from W (close to amphibolite facies conditions) and E (c. 300°C) both within Alpine Infra-Bucovinian and Bucovinian nappe complexes. These relationships argue for a ramp origin of these nappes, and cooling after peak metamorphic conditions during nappe emplacement. (5) Final cooling and exhumation of Alpine metamorphic units in the western Rodna mountains was apparently synchronous with formation of a Cenomanian-Late Cretaceous sedimentary basins. In comparison to Alps and Western Carpathians, Alpine tectonic processes (burial, nappe stacking, and subsequent exhumation of previously metamorphosed and buried units) occurred earlier as in Alps and Western Carpathians, and show, therefore, diachroniety during Cretaceous tectonic processes in the Alpine-Carpathian realm.

TAXONOMICAL CONTENT AND MOLLUSCS PALEOECOLOGY IN THE LOVECH URGONIAN GROUP (CENTRAL FORE-BALKAN)

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Urgonian sediments in the Central Fore-Balkan form an unique sedimentological and biogenic complex built up of terrigenous and carbonate bodies (Khrischev, 1966; Nikolov et al., 1991). The terrigenous bodies are characterized by its great lithological and fossil diversity. The material studied derives from the Barremian terrigenous rocks marls, sandstones and sandy limestones of Balgarene and Smochan Formations. Taxonomic study has resulted in determination of 50 species (29 genera and 21 families) of bivalves and 27 species (23 genera and 9 families) of gastropodes (Damianova, 1996; 1997).

All fossil accumulations recovered are considered to represent assemblages, regardless of their taxonomic content or preservational state. Depending of the substrate type, taphonomic peculiarity of the fossils and paleoecology af the species, the assemblages are arranged in zones from the coast to the open sea basin (Damianova, 1997). In the tidal zone, an assemblage of bivalve species *Pterinella petersi* is detected in the sandstones of Balgarene Fm (Lower Barremian). Within the subtidal zone, the following assemblages are recognized: *Pterinella petersi, Pterinella petersi Isognomon ricordeanus* (bivalves) and *Gymnentome, Paraglauconia, Neoptyxis astrahanica* (gastropodes) in the marls of Lower Barremian (Balgarene Fm.) (Ivanov, Damianova, 1996). Assemblages in the fore-reef are represented by *Pterinella petersi, Pterinella petersi Isognomon ricordeanus* in the Lower Barremian (marls and sandstones of Balgarene Fm.). Mixed bivalves gastropodes assemblages dominated by the representatives of Nerineidae, Cassiopidae and *Uchauxia phillipsi - "Nerinea" foeterlei* are registered in the Upper Barremian (Smochan Fm.). In the open sea basin several assemblages are separated: *Astarte numismalis* (Upper Barremian, Balgarene Fm..); gastropodes assemblages of *Cirsocerithium subspinosum Metacerithium turriculatum, Bathraspira tecta* (Upper Barremian, Smochan Fm..).

Occurrence of tidal assemblages is very rare due to the specific conditions required for their preservation: rapid sediment accumulation and death of the organisms. In the supratidal zone the assemblages are monospecific and homogenous. Fore-reef assemblages are usually mixed, with different state of preservation of the fossils, part of them being transported. Open-sea assemblages are monospecific too, but the specimens are very small-sized (below 5 mm).

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FOSSIL WEATHERING CRUST ON PANNONIAN CLAYEY-MARL SEDIMENTS AT THE SOUTH-EASTERN RIMS OF THE PANNONIAN BASIN AND ITS GEOCHEMISTRY

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In a belt covering the south-eastern rim of the Pannonian Basin, in which Belgrade, the capital of Yugoslavia, is situated, Pannonian sediments appear at a number of localities and are represented by several facies. One of them, a clayey-marl facies, is relative widespread and appears in the town of Belgrade and some other localiti-es. Here, it was found that Pannonian clayey-marl sediments are partly intensively and specifically altered which were determined as a product of an ancient weathering process, i.e., as a fossil weathering crust.

In the broader area of Belgrade, the Pannonian sedimentary formation containing clayey-marl facies is locally widespread. Belgrade is situated on the southeastern rim of the Pannonian Basin, at the inflow of the Sava River into the Danube River, and Neogene formations appear on the South of these rivers. The Pannonian formation, covering Sarmatian. Badennian and pre-Miocene formations, is represented by diverse facies: marl-limestone, marl-clayey and sandy ones. Pannonian clayey-marl sediments built up the ground of the central urban part of the town but occur also at numerous other localities. Due to several geotechnical problems in these sediments, they were intense but mostly only geotechnically investigated. The mineralogical-geochemical studies in the central urban part of the town indicated that in upper parts of this formation appear a fossil weathering crust (Dangić, 1985-86; Dangić & Ocokoljić, 1992). Covered by Upper Pleistocene loess, it is determined to be of Pliocene age. The fossil weathering crust on Pannonian clayey-marl sediments was found also on other localities, as at the town of Umka, situated on Sava river bank, 17 km SW from the Belgrade town core. At Umka, in this weathering crust a large and complex landslide (twins 1,3-1,6 km long) was formed (Dangić et al., 1997).

In the central urban part of the town Pannonian clayey-marl formation is up to 60 m thick, and its weathered part is 3-25 m thick. The profile is characterized by following zones (from top to down, Table 1): 1- limonite-carbonate, 2- with limonite and clayey-carbonate "veins", 3- of weaker limonitization, with gypsum, 4- transition, and 5- unaltered sediments. Zone-1 consists of brown-yellowish clayey and clayey-marl material with (mm-size) carbonate and limonite concretions; zone-2 of yellow-brown marly clay with gray parts, limonite concretions and Mn-oxide films; zone-3 of gray-yellow marly to marly-clayey material, locally limonitized, with veins of whitish clayey material and gypsum; zone-4 of gray/dark gray marls with limonite concretions and limonitization around fissures. Original Pannonian rocks are gray marls with scarce vegetation and fossil remains. Montmorillonite, illite and chlorite appear in whole profile, and mixed-layer mineral (montmorillonite-illite) and kaolinite, only in upper parts of the profile. Calcite appears in whole profile (30-50%), gypsum in its lower parts, and pyrite in original rocks. Main geochemical features of the weathering profile are (Table 1): a general depletion of FeO, sulfide-S, and Sr, and enrichment of Fe_2O_3 and SO_3, and increasing of both pH and Eh towards the top parts of the profile. Other components show less regular distribution.

Table 1. Profile of fossil weathering crust in the old core of town of Belgrade (FeO-SO_3 in %, B-V in ppm).

Materials-Zones	Thickness	FeO	Fe_2O_3	S	SO_3	B	Sr	V	pH	Eh (V)
1 limonite-carbonate	2.5 m	0.61	3.20		0.11	18	230	60	7.89	0.388
2 with clayey-carbonate veins	8 m	0.73	4.04		0.50	81	443	79	7.70	0.394
3 with gypsum	9.5 m	0.74	3.17		0.83	100	580	99	7.63	0.379
4 transition zone	3.5 m	2.97	0.69	0.54		32	480	60	7.70	0.350
5 unaltered rock		1.92	2.76	0.77	-	30	510	75	7.58	0.369

Mineralogy and geochemistry of weathering crust indicate that weathering appeared under semi-arid conditions. The similar fossil weathering crusts are expected to be discovered at other rims and broader areas around the Pannonian Basin, in Carpatho-Balkanian and adjoining regions.

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SELENIUM GEOCHEMISTRY OF DIVERSE GEOLOGICAL-GEOCHEMICAL MEDIA IN SERBIA AND ITS HEALTH IMPLICATIONS

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Geological composition of Serbia is complex - as situated in central parts of the Balkan Peninsula, it covers parts of a few large geotectonic-structural units: Carpatho-Balkanides, Serbo-Macedonian Mass, Vardar Zone, Dinarides, and Pannonian Basin. Accordingly, Serbia is characterized by a diversity in geologic-geochemical features. However, almost geological-geochemical media in Serbia are generally low-selenium, or Se-deficient. A Se-deficiency was found also in human/animal population. Extensive studies on relationship between selenium environmental geochemistry and human/animal health, last years numerous over the world, shown that both Se-deficiency and Se-enrichment cause "geochemical epi-demiological" health problems.

For the territory of Serbia, selenium content was studied in diverse geological-geochemical media: magmatic, sedimentary, and metamorphic rocks, sulfide ores (ore minerals), soils, river sediments, river-, ground-, and mineral waters, and plants. Selenium content and distribution for each of these media, compiled from published and some unpublished data are presented in Table 1.

Table 1. Selenium content in geological-geochemical media in Serbia and its Carpatho-Balkanides.[1]

Media		*Magmatic rocks (ppb)*					*Sedimentary rocks (ppb)*				*Sulfide ore minerals (ppm)*				
		all	*UB*	*B*	*IM*	*AC*	*all*	*Sands*	*Loess*	*CLM*	*Sp*	*Gal*	*Ch*	*Py*	*CB*
Serbia	n	265	32	58	61	119	35	3	27	5				5	2
	range	<8-257	15-218	8-257	<8-130	<8-92	<5-200	<5	<5-56	<5-200	1-6	2-500	-320	113-439	358-374
	mean	46	80±57	86±62	24±23	24±19	33±42	<5	26±18	87±90	2.1			292±139	366
Carp.	n	48		22	18	8								5	2
Balk.	range	<8-205		21-205	<8-33	<8-44								113-439	358-374
area	mean	50		79	26	17								292±139	366

Media		*Metamorphic rocks (ppb)*				*Soils (ppb)*			*River sediments (ppb)*		
		all	*SH*	*M*	*CM*	*all*	*alluvial*	*BF*	*COMP*	*f.<50 μm*	*f.<2 μm*
Serbia	n	89	67	8	14	199	18	14	33	45	17
	range	<5-206	<5-164	<5-6	<5-206		120-440	140-320	9-177	114-427	335-2600
	mean	28±42	24±34	<5	63±67	203	250	200	72±48	229	984±553

Media		*River & ground waters (ppb)*			*Mineral waters (ppb)*			*Plants (grain) (ppb)*			
		all	*river w.*	*ground w.*	*all*	*common*	*high-Se*	*all*	*wheat*	*corn*	*MB*
Serbia	n	27	11	16	28	26	2	161	69	88	4
	range	0.09-2.00	0.09-0.36	0.09-2.00	0.50-1100	0.50-15.0	20-1100				4.0-21
	mean	0.52	0.20±0.09	0.75±0.62		3.7±3.6		16.6	19.9	14.1	14±8

UB-ultrabasic; B-basic; IM-intermediar; AC-acidic; SH-schists, gneisses, etc.; M-marbles; CM-contact-metamorphic; Sp-sphalerite; G-galena; Ch-chalcopyrite; Py-pyrite; CB-covellite, bornite; CLM-clays, marls; BF-brown forest; COMP-complete material of samples; f< 50, f<2 μm- fine grain fractions of samples; MB-maize and beans.

All rocks' types of Serbia, magmatic, sedimentary and metamorphic, soils, and important plants (grains) are Se-poor, compared to related world averages. There are no significant differences between magmatic rocks of the Carpatho-Balkanide area (NE part of Serbia) and other areas. River sediments are also generally Se-poor but their clay-fraction locally appears to be strongly Se-enriched. Very strong Se-enrichments appear only in some sulfide ore minerals. River and (shallow) ground waters are Se-poor, but mineral waters are characterized by relative high or, locally, very high, Se-contents. In the case of Se-deficiency, improvement of health status of human/animal populations is possible by 2 approaches: (a) usage of artificial Se-enriched foods/food supplements, and (b) treatments of natural system with Se (Se-enriched fertilizers, etc.) and biological Se-enrichment in food products. In both approaches, and especially in the last one, for optimal results and control of unwilling effects, such as Se-toxicity, selenium status and geochemistry of relevant geological-geochemical media need to be known. Also, any Se-treatment in Serbia need to be advised/controlled by geochemists.

[1]-Compiled mostly from: Arsenijević (1992; 1995); Dangić, Dangić, Prelević (1994; 1995); Dangić, Komatina, Kijanović (1995); Dangić, Maksimović, Jović, Ršumović (1989); Dangić, Prelević, Dangić, Potkonjak, Matić (1995); Dangić, Rakočević, Dangić, Ocokoljić (1995);); Jakovljević, Stevanović, Blagojević, Kostić, Martinović (1995); Janjić (1982; 1983); Janković (1990); Jović, Milić, Popadić (1995); Maksimović, Dangić, Jović, Ršumović (1992); Maksimović, Djujić, Jović, Ršumović (1992); Maksimović, Nikolić, Jorga, Ršumović, Radošević (1995).

TRACE ELEMENT GEOCHEMISTRY OF OIL-BEARING SEDIMENTARY SEQUENCES IN THE SE EXTREMITY OF THE PANNONIAN BASIN

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The southeastern part of the Pannonian Basin, the Banat depression, is situated between Carpatho-Balkanides on east, Serbo-Macedonian mass on south, and Dinarides on southwest. It continues towards the South into a large subdepression, the Danubian-Moravian one, which was a very south-eastern golf of the Pannonian Basin. This subdepression covers a part of territory of the Southern Banat and flats around the Danube and the Morava rivers. Structurally, it is characterized by 4 local depressions: Drmno (Kostolac), Smederevo, Markovac, and Mlava. The Drmno local depression is with highest oil-generating potential and is only one in which oil fields were discovered and are in exploitation.

The Drmno local depression covers an area of 1500 km^2 and its sedimentary complex is as tick as more than 5000 m. It is characterized by 4 geological-structural units: the metamorphic basement, and sedimentary Pre-Badenian, Badenian-Upper Miocene, and Pliocene-Quaternary formations. The Pre-Badenian is terrigenous-limnic, with lower part (thick up to 2500 m) of clastites (conglomeratic to finer grain), middle (thick up to 350 m) of red shales and tuffites, and uppermost (thick up to 130 m) of sands,clays, and limestones. Badenian (200-1000 m) consists of a marine clayey-marl-sandy complex (Lower) and a marine-brackish clayey-marl-limestone-sandy complex (Upper). Sarmatian (400-835 m) is represented by a brackish-marine clayey-marly-sandy-gravel complex and Pannonian (200-350m) by a brackish clayey-sandy-marly-sandstone complex. Pliocene is represented by Pontian (600 m) brackish a clayey-marly (Lower) and a marly-clayey-sandy lignite-bearing (Upper) complex. A part of the later might be of Upper Pliocene age. Quaternary, represented by diverse facies, is as thick as more than 100 m.

Geological-geophysical studies indicated in the local depression a few local structures, prospective for oil-gas accumulation: Babušinac, Sirakovo, Bradarac, Maljurevac. By more detail investigations and drilling, oil-gas fields of Sirakovo, Kurjače, and Bradarac-Maljurevac were discovered. The paper presents trace element geochemical studies of sedimentary sequences in two borehole profiles of the oil field Bradarac-Maljurevac (boreholes #2 and #3). The distance between boreholes is around 960 m. In the oil-field, oils appear at a depth around 2200 m. In the borehole #2 profile, 11 samples representing 4 sequences were studied: (a) hanging-wall one, comprising Pannonian, Badenian and uppermost part of the Pre-Badenian sediments; (b) oil-bearing one (an upper part of pre-Badenian Tertiary); (c) footwall one, comprising middle-lower parts of pre-Badenian Tertiary; and (d) pre-Tertiary metamorphic basement. In the borehole #3 profile, 11 samples represented first three (a-c) sequences were studied. Elemental analyses were made using spectrochemical and atomic absorption spectrophotometric methods. Samples from oil-bearing sequences were sandstones, marls and shales, from hangingwall sandstones, alevrolites, marls, and shales, from footwall shales and alevrolites, and from pre-Tertiary a sericite-chlorite schist.

Table 1. Average element contents (Ca-Fe in %, Li-Sr in ppm) in clay fraction, samples from the borehole #2.

Sequences	n	cl.f.%	Ca	Na	K	Fe	Li	Mn	Cr	Ni	Cu	B	Ba	Sr
Hangingwall	3	2.8-20	1.9	1.7	2.9	4.8	56	514	130	80	58	<8	183	270
Oil-bearing	5	1.3-6.8	2.3	1.9	3.9	6.5	44	373	94	83	46	80	300	136
Footwall	2	5.7-8.9	0.1	1.6	2.9	9.4	44	415	145	63	66	*	*	*
Pre-Tertiary	1	12	2.7	2.7	1.6	7.7	25	1402	46	46	131	<8	350	270

n= number of samples; cl.f.= content of clay fraction; *= not analyzed.

Table 2. Element contents (Ca-Fe in %, Li-Cu in ppm) in clay fraction, samples from the borehole #3.

Sequences	n	cl.f.%	Ca	Na	K	Fe	Li	Mn	Cr	Ni	Cu
Hangingwall	2	14-10	0.36-0.59	1.7-1.9	2.1-3.9	4.6-5.9	71-78	505-907	81-209	56-69	32-62
Oil-bearing	6	1.6-9.4	0.004-2.5	1.7-2.7	2.7-5.2	4.3-9.7	29-67	212-5000	52-235	56-150	37-94
Footwall	3	4.5-25	0.003-0..6	1.5-2.7	2.9-4.4	4.8-7.2	41-131	312-987	24-145	80-150	37-56

Study of element distribution in particular samples shown that most of main and trace elements appear to be concentrated in clay fraction(s). Content and distribution of selected elements in clay fractions representing diverse sequences of profiles are shown in Tables 1-2. They indicate some interesting geochemical features. Oil-bearing sequence appears to be enriched in boron and barium, and depleted in strontium, but also some other elements show less regular tendencies to be either enriched or depleted in this sequence.

MINERALOGICAL AND SOME GEOCHEMICAL CHARACTERISTICS OF BOTTOM AND BANK SEDIMENTS OF THE DANUBE RIVER IN YUGOSLAVIA

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The Danube, European's second largest river appears to be a main drainage system of the Middle-Southeastern Europe, including the Carpatho-Balkanian Region and the Pannonian Basin. In Yugoslavia, it crosses the southeastern part of the Pannonian Basin and the Carpatho-Balkanian belt. Here, it receives several tributaries, some its largest ones, which drain either the Pannonian Basin (Drava, Tisa, Tamish), its rims (Velika Morava, Pek), or both (Sava). Thus, its catchment areas, especially right-hand one, are composed by diverse geological formations which appear to be sources of river sediment materials. These materials appear to be important regulators of river water composition, related geochemical processes, and river ecological system (Dangić, 1989). As their composition may depend on both formations in a wider catshment area and those forming river banks, we studied in same section samples of both bottom and bank sediments.

The mineralogical-geochemical study involved 8 sections of the bottom-bank sediments situated on the right bank of the Danube, 3 in the Pannonian Basin (upstream from Belgrade) and 5 on its southern rim. Their locations are, from the north to the southeast: 1-Beočin (upstream from Novi Sad), 2-Čortanovci (between Novi Sad and the Tisa inflow), 3-Belegiš (between Tisa and Sava inflows), 4-Vinča (downstream from Belgrade), 5-Kulič (upstream from the Velika Morava inflow), 6-Kostolac (between Velika Morava and Mlava inflows), 7-Novo Gradište (between Mlava and Pek inflows), and 8-Golubac (between the Pek inflow and the Djerdap lake). In each section, from both bottom and bank sediments more than one sample was taken. In mineralogical studies optical microscopic, DTA-TG, and X-ray diffraction analyses were applied. By extensive X-ray investigations of both integral material and clay fractions of samples several minerals were determined (Table 1). In elemental analyses (tables 1-2) AAS and emission spectrochemical analyses were applied.

Table 1. Mineralogical and some geochemical features of sediments in studied sections.

Section	Q	Fel	Ill	Ch	M	M-C	Ka	Cal	D	Mgs	Fe	pH	Eh
	b bn	b bn	b bn	b bn	b bn	b bn	b bn	b bn	b bn	b bn	(%)		(mV)
1	+ +	+ +	+ +	+ +	+ +			+ +	+ +		3.2	7.6-7.8	254-280
2	+ +	+ +	+ +	+ +	+ +			+ +	+ +		1.3-3.7	7.4-7.8	273-308
3	+ +	+ +	+ +	+ +	+ +			+ +	+ +	+	2.8-3.7	7.6-7.9	296-410
4	+ +	+ +	+ +	+ +	+ +	+ +		+ +	+ +		3.3-3.7	7.3-7.7	284-380
5	+ +	+ +	+ +	+ +	+ +			+ +	+ +		1.2-2.4	7.7-7.8	355-388
6	+ +	+ +	+ +	+ +	+ +		+ +	+ +	+ +	+	1.1-4.2	7.8-7.9	370-402
7	+ +	+ +	+ +	+ +	+ +			+ +	+ +		2.0-2.6	8.0-8.4	359-383
8	+ +	+ +	+ +	+ +	+ +	+		+ +	+ +		1.6	7.5-8.3	375-415

Q=quartz; Fel=feldspar; Ill=illite (mica); Ch=chlorite; M=montmorillonite; M-C=regular mixed layer montmorillonite-chlorite; Ka=kaolinite; Cal=calcite; D=dolomite; Mgs=magnesite; b=bottom sediments; bn=bank sediments.

Table 2. Contents of Fe, Mn, Zn, and Se in bottom and bank sediments and their clay fractions.

Material	n	range Fe%	mean	range Mn(ppm)	mean	range Zn(ppm)	mean	range Se(ppb)[1]	mean	n
Sediments	32	1.12-3.96	2.89±0.90	451-1119	750±204	28-412	121±101	9-177	72±48	33
Clay fraction	20	3.67-6.62	5.36±1.05	511-2551	946±443	131-762	326±185	335-2600	984±185	17

n= number of samples; [1]- from Dangić et al. (1995).

Mineral composition of bottom and bank sediments is characterized by presence of following minerals in all sections (Table 1): quartz, feldspar, calcite, dolomite, than in clay fraction chlorite, illite and montmorillonite. Sporadically, regularly mixed layer montmorillonite-chlorite, kaolinite, and other carbonates appear also. Sediments are characterized by relative small variation of iron content and pH and Eh in all sections, but iron and some other elements, especially selenium, appear to be enriched in clay fraction (Table 2).

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CORUNDUM-KYANITE AND KYANITE OCCURRENCES IN A CRYSTALLINE COMPLEX OF EASTERN SERBIAN CARPATHO-BALKANIDES

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A relative large belt of the eastern Serbia belongs to the Carpatho-Balkanides. Its easternmost part is built up by a complex nape Geticum, to which a crystalline clipe - Tekia crystalline zone belongs. This zone covers 100 km^2 and is built up by Proterozoic-Cambrian schists, lower metamorphic Ordovician and Silurian rocks, Devonian flysch, and Permian-Mesozoic sediments. In Serbia, occurrences of corundum, kyanite, silimanite, and andalusite are scarce, were known only for a few localities. One of them was the kyanite occurrence in northernmost part of the Tekia zone. Recently, in the southern part of this zone it was discovered an occurrence, named Bobolosh, of a new mineral raw material - corundum-kyanite ore (Dangić, Ilić, 1995). This discovery made the Tekia zone to be very prospective for exploration for corundum-kyanite and kyanite occurrences. Due to that, in this zone a regional geological exploration, covered 50 km^2, and a schlich exploration, covered 200 km^2 (the zone and adjacent areas; 0.45 schlich/km^2) were made. Also, some advanced studies of the corundum-kyanite ore occurrence Bobolosh and/or its ore materials were made (Dangić, Ilić, 1998) .

The ore occurrence Bobolosh appears in the southern part of the Tekia crystalline zone, in an area built up by crystalline complex and Miocene sediments. The crystalline complex here consists of gneisses (most abundant), amphibolites, amphibole and chlorite-sericite schists, granites, gabbros, and contact metamorphics. The corundum-kyanite rock appears as blocks, a bigger one (5x4x3 m) and a number of smaller (<2-3 m^3) ones, on the gneiss complex and a few smaller on the Miocene sediments. All the blocks are of same composition, but only the biggest one seems to be *in situ*. However, a zonation between corundum-kyanite mass (ore) and host gneiss-micaschist was identified (Fig. 1). The ore is poor in Fe, Mg, Na, and K (Table 1).

corundum- kyanite mass ⇒	transition zone (with tourmaline) ⇒	andalusite schist ⇒	kyanite schist ⇒	gneiss-micaschist (with garnet)

Fig. 1. Zonation in the corundum-kyanite ore occurrence Boblosh.

By the geological exploration, occurrences of rocks with high content of kyanite, as high as up to 12%, were discovered at a few localities. In exploration by schlich method, kyanite concentrations were found at that and some other localities. At a few localities, in schlich concentrations both corundum and kyanite appeared. This may indictor of new occurrences of the Bobolosh type (corundum-kyanite) ore. The Bobolosh ore, micaschists with kyanite, and kyanite from other localities show some geochemical similarities (Table 2).

Table 1. Chemical composition of the corundum-kyanite raw ore from the Bobolosh occurrence[1].

%	SiO_2	$Al_2O_3+TiO_2$	Fe_2O_3	CaO	MgO	Na_2O	K_2O	Ign. loss	Sum
Range	23,97-36,42	60,43-70,87	0,70-1,55	0,42-2,24	-0.06	0,12-0,37	-0.41	0,68-1,36	99,47-100,21
Mean	30,67±4,34	64.83±3.77	1.08±0.25	1.52±0.50	0.04±0.21	0.24±0.11	0.27±0.2	0.92±0.21	99.86±0.45

[1]- **chemical composition of 11 lots of raw ore, each of cca 18 t.**

Table 2. Average trace element contents in corundum-kyanite ore, micaschist with kyanite and kyanite (in ppm).

Material	n	Ba	Cr	Cu	Ga	Mn	Ni	Sr	V	Y	Zr	Th	U
Corundum-kyanite ore	8	30	1200	4	17	880	30	120	300	23	120	52	9
Micaschist with kyanite	3	197	62	60	7	362	10	12	90	27	147		
Kyanite	1	10	170	-	25	-	-	-	200	-	-		

Geological, petrological, and geochemical characteristics of the Tekia crystalline and results of geological and schlich exploration works indicate that this area is highly potential for discovering new corundum-kyanite and kyanite resources. Similar potentials are expected for other crystalline belts of the Carpatho-Balkanides.

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OPPORTUNITY OF COMPUTER DIAGNOSTICS OF STRATIGRAPHIC UNITS WITH USE OF BASE OF PARAMETERS OF CRETACEOUS AND PALEOGENE DEPOSITS OF THE UKRAINIAN CARPATHIANS.

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As a result of long-term study of geology of the Ukrainian Carpathians, for the first time for this territory, the base of parameters of Cretaceous and Paleogene deposits is made. By main basis for its, have served authorized in 1984 and 1989 regional stratigraphic outline of Cretaceous and Paleogene, as well as detailed descriptions multiple stratas and basic geological sections all of structure-facial zones of cover-folding mountain building. Whole in base 102 stratigraphic units (suites, undresuites, layers, horizons) are characterized and on each of them adduces the appropriate parametrical parameters.

The principle of Base formation method will be in details described in journal "The Geology and Geochemistry of combustible mineral" (Lviv) for 1998 year. They justify the order of summary and account of field expeditionary materials on such characteristic for sedimentology layers parameters as: 1. Position in geological section [SEC], 2. Thickness [THI], 3. Set of rock types [ROK], 4. Character of rhythm [RHY], 5. Phaneromerous and pelitic rock ratio [PHA], 6. Colour [COL], 7. Carbonate index [CAR], 8. Silica index [SIL], 9. Mike index [MIK], 10. Siderite content [SID], 11. Mechanoglifs [MHG], as well as 12. Bioglifs [BIO], 13. Marking horizons [MAR], 14. Find of fossiles [FOS] and 15. Age [AGE]. From here the peculiar formula of suite (or its part) proceeds, appropriate characteristic of which consists of particular characteristics of above-mentioned parameters ($\alpha\beta\chi$suite = $\Sigma\alpha\beta\chi$parameters). They can be complemented by another parameters. If there is appropriate volume of actual statistics, for developed by technique can be the parametrical bases of sedimental deposits are generated for any region.

With use of fifteen listed parameters is developed samples of uniform passports of stratigraphic unit with ciphergrame and radial diagram of twelve main parametrical indexes. This sample is used for creation bank of passports suites, undersuites, layers and the horizons of five age ranges of geological sections: Jurassic-Lower Cretaceous, Upper Cretaceous, Paleocene-Lower Eocene, Middle-Upper Eocene and Oligocene-Lower Miocene. The difference of characteristics parameters and each suite as a whole rather is precisely allocated in passports at graphic constructions.

Offered Base of parameters of Cretaceous and Paleogene deposits of the Ukrainian Carpathians is basement of computer informatic and searching system for reveals of particular stratigraphic units or its component for descriptions fragments of geological sections on outcrops or foreholes core. The gear of recognize is executed on computer by two ways: 1) cipher of actual given 12 main parameters and comparison made ciphergrame with similar to it in base of parameters, 2) construction of parametrical radial diagram and establishment its identity with such in bank of passports. In both cases the recognize is finished by determination the same stratigraphic of unit.

THE KINEMATICS OF OLIGOCENE-MIOCENE LATERAL EXTRUSION AND FORELAND IMBRICATION IN THE EASTERN ALPS AND THE OUTER WESTERN CARPATHIANS

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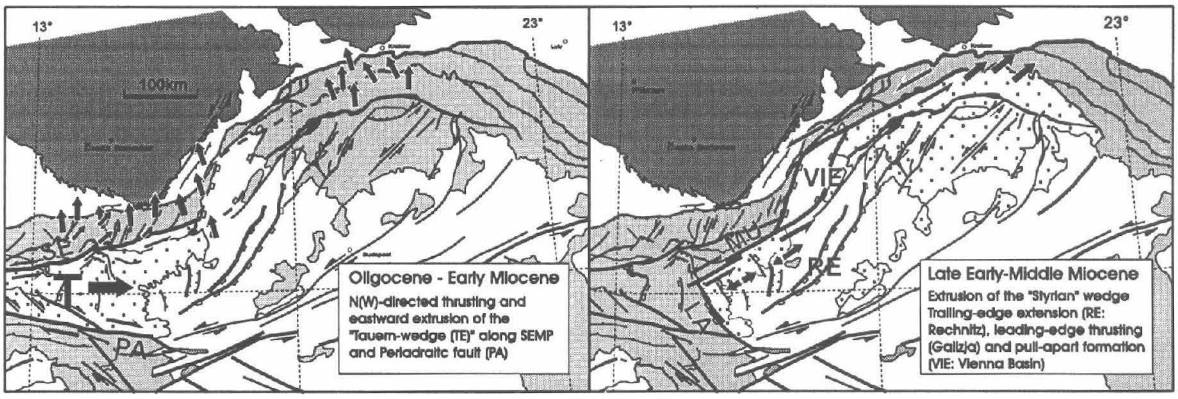
Oligocene-Miocene post-collisional shortening in the Eastern Alps and the adjacent Western Carpathians are characterized by contemporaneous foreland imbrication, east-directed lateral extrusion, crustal extension and the tectonic exhumation of metamorphic domes in the Central Eastern Alps. New tectonic data from the Polish Carpathians of Galicia, the Vienna Basin-Mur-Mürz transform fault, and from the western part of the Styrian Basin suggest that lateral extrusion evolved through two distinct stages:

Oligocene to Early Miocene shortening was compensated by the combination of NNW-directed thrusting in the Northern Eastern Alps/Outer Western Carpathinans and by the eastward motion of the Central Eastern Alpine „Tauern Wedge" between the SEMP- and the Periadriatic fault system. NNW-directed thrusting affected the nappes of the Calcareous Alps, the Rhenodanubic Flysch and the Molasse in the Northern Eastern Alps as well as the entire nappe pile of the Outer Western Carpathians. There, consistent thrust data come from the Andrychów Klippen, from the floor thrusts of the Subsilesian, Silesian, Fore-Magura, and Magura unit. Soft-sediment deformation structures in Oligocene flysch sediments and regional comparison indicate that NNW-directed thrusting lasted from the Eocene/Oligocene up to the Early Miocene.



Late Early Miocene to Middle Miocene tectonics were characterized by the termination of NNW-directed thrusting, the deactivation of the SEMP and the Periadriatic fault system, and by the initiation of a new extruding wedge which moved between the new-formed sinistral Mur-Mürz-Vienna Basin-transform system and the dextral Lavanttal system. These new-formed faults crosscut older extrusional structures like the SEMP and the Periadriatic fault. The initiation of the Mur-Mürz-Vienna Basin- and the Lavanttal fault system is dated by the subsidence of pull-apart basins along the faults which started during the Ottnangian/Karpatian. Deformation of the new-formed „Styrian wedge" combined trailing-edge extension and detachment faulting in the Styrian Basin area, strike-slip faulting along the Mur-Mürz-Vienna Basin transform system, and thrusting at its leading edge in the Outer Carpathians. The Mur-Mürz-Vienna Basin transform can be traced to the NE into the Western Outer Carpathians where it splits up into several NE-striking shear zones which overprint the nappe contacts between the Silesian and Magura nappe, and the floor thrust of the Bystrica nappe within the Magura unit. Sinistral faulting along the Silesian-Magura contact linked up with NE-directed out-of-sequence thrusts farther east. There, a number of Subsilesian windows crop out in front of the NE-directed floor thrust of the Magura nappe.

ENGINEERING GEOLOGICAL CONDITIONS OF TRANSPORT CONSTRUCTION IN UKRAINIAN CARPATHIANS

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The location East Carpathian in the centre of Europe significantly influence on life and economic relation of the countries of this continent and determines the extremely important meaning of transport routes running in mountains. In the nearest prospect further modernisation taking place in Carpathian railways and highways, construction of new ways, pipelines, power transmission lines sees. The realisation it is possible only on the basis of the maximum account of natural conditions Carpathian, first of all their geological structure and development as of mountain system. On the one hand it will allow to ensure reliability of structures and with other - to find the optimum decisions of the urgent environmental problems.

The mountain areas act first of all as serious barrier to the various communications ways, communication lines, power transmission lines, pipelines. Sharp dissection of the relief, its high dynamic, significant steepness of slopes, altitudinal climatic zonality and raised quantity of atmospheric precipitation basically determine human life and activity in Carpathian.

The high-altitude axis Ukrainian Carpathian watershed ridge precisely divides basins the Dniester (rivers Stryj, Opor, Sukel, Misunka, Svicha Lomnitza, Bystritza) and the Danube (Uz, Turja, Latoritza, Borzava, Rika, Terebla, Teresva, Kos'va, Black Tisa, White Tisa). On watershed ridge from north west for south east lowering are located, in which are situated passes of railways and highways - Uzok (889 m), Verez (839 m), Beskidy (974 m), Vyshky (930 m), Jablonez (931 m).

In mountains rather distinctly display connection of artificial objects with environment. The character mountain relief East Carpathian has largely determined a situation of the settlements and connection between them. The valleys of the mountain rivers act as settlements location and development and major lines of the communications, binding large settlements both the parties Carpathian, cross them with orientation to lowering watershed ridge. At present Svicha, Prut are as much as possible loaded by linear objects from the part south western slope valleys of the rivers Uz, Latoritza, Rika, Black Tisa- on the part of a north east slope - valleys of the Stryj. A part of ways in rivers valleys are laid on first over flood-plain terraces, is sometimes artificial broadened by cutting in slopes or in the part of a channel of the river by the arrangement coast protection with filling of a ground. Sharp stream channel inconstancy of the mountain rivers, the presence several flood peaks in their hydraulic regime imposes stringent requirements for reliability of road designs and hydraulic engineering structures -bridges, pipes, retaining walls, water overflow gutters and other.

Construction and the operation of lines of the communications is rather complicated in connection with development of the slopes gravitational processes. Creation of horizontal strips, cutting in slopes frequently result in disturbances of stability of the slopes with development of displacement loose deposits and block landslides with displacement them on inclined bedding planes of layers, cracks. Very frequently in result of linear construction on mountain slopes are made active ancient landslides. For protection of lines of the communications from landslides, the stabilisation of slopes were carried out and large work as a structure of the retaining walls, based on solid rocks, various types of drainages, hydraulic engineering structures for regulation of a superficial drain are carried out.

Engineering geological researches and the special researches on lines of the communications in Carpathian are directed mostly on revealing of the most adverse sites of slopes with possible development block landslides on cracks, related to tectonic disturbances, contacts inclined layers. Such sites, as a rule, are subject to detour. Stability and the reliability in operation of lines of the communications, laid in the valleys of the mountain rivers requires realisation of effective measures on coast protection.

Road and the hydraulic engineering structures on transport highways in mountain parts of the Dniester, Prut, Uz, Latoritza, Rika, Teresva basins on separate sites are subjected to the rivers mud flows. The danger of the mud flows grows on landslides slopes, on sites continuous deforestation. Prime problems of mud flows prevention in the valleys of the mountain rivers are the termination of the timber exploitation on abrupt slopes, forest planting on landslides and slide-prone slopes, dams creation on ways possible mud movements and other protection constructions. Examples of the decision particular engineering geological and environmental problems following from requirements of transport construction in Ukrainian Carpathian are mentioned.

LITHOSPHERIC THERMAL STRUCTURE IN THE TRANSYLVANIAN DEPRESSION - INSIGHTS FROM NEW GEOTHERMAL MEASUREMENTS AND MODELING RESULTS.

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The surface heat flow density pattern of the Transylvanian Depression (TD) represents a marked high amplitude short wavelength low in a region of generally elevated heat flow. Detailed temperature-depth profiles obtained by continuous temperature logging in 24 wells to a maximum depth of 1400 m combined with a finite element modelling of topographic and fluid flow effects support the conclusion that the observed thermal gradient in the TD truly represents the rate of heat loss of the subsurface. Modelling results show that the transient effects of sedimentation and erosion mean an overall 5-7 mWm^{-2} reduction in heat flow compared to the steady-state value and that a low mantle heat flow and a low crustal heat production rate in the TD are necessary to explain the heat flow anomaly. The effect of the Neogene evolution of the TD on the temperature field of the lithosphere is evaluated as well.

UPPER PLIOCENE VEGETATIONAL PHASES: SOUTH PERICARPATHIANS DEPRESSION ROMANIA

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A detailed scale of ten palynostratigraphic levels based upon a succession of pollen and spores assemblages is proposed (Fig. 1). The material has been delivered along the South pericarpathians depression during a period of time when the most of tardy Magnoliophyta families have started their developments.

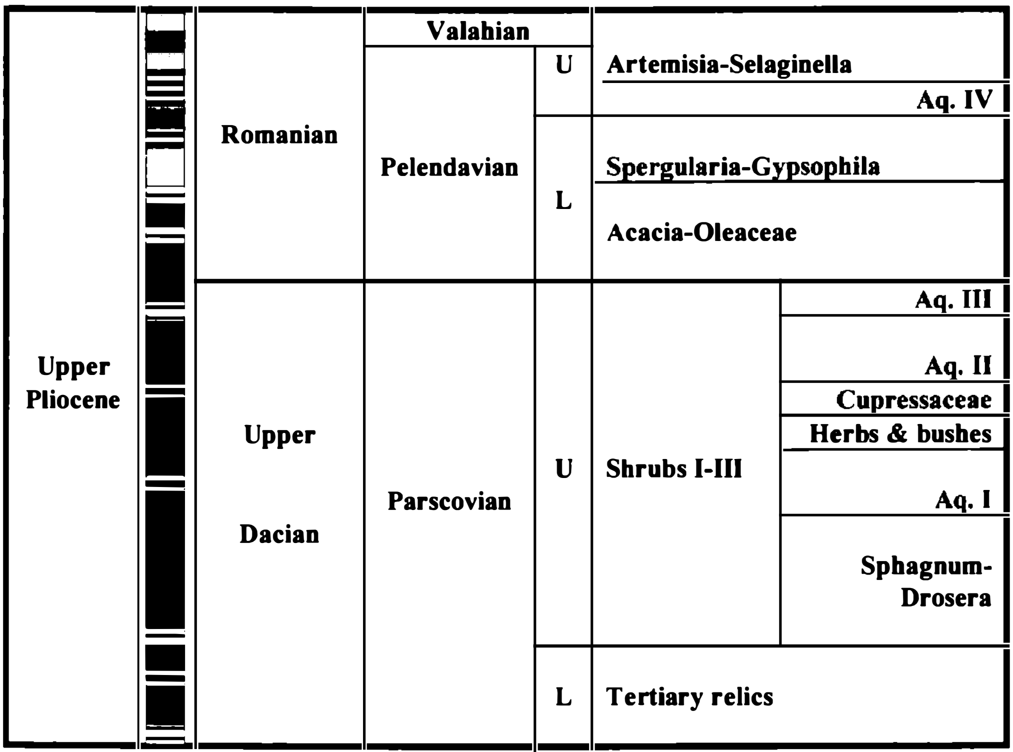

Fig. 1. Palynostratigraphic scheme illustrating the vegetation distribution during Pliocene.
Aq. = inter-phases of aquatic vegetation.

Some specimens of aquatics that release microorgans directly into the water have the non-arguable status of *in situ* stratigraphic markers which demonstrates their high stratigraphic resolution and a reliable accuracy in paleoenvironmental reconstructions as well.

All assemblages but three have only a local distribution and reflect specific paleoecological requirements. The others, *i. e.*, **Tertiary relics** and **Sphagnum-Drosera** and **Artemisia-Selaginella** groups cover the approximately the whole area and document a regional climatic control.

Some assemblages also suggest that, at certain times, the vegetation has suffered influences both of the Caspian and Mediterranean areas and further studies should be undertaken to disclose whatever connections have existed between this sector and other zones inside the Paratethys region.

ABOUT THE GENETICAL NATURE AND KATAGENETIC TRANSFORMATION OF THE ORGANIC MATTER IN MESOSOIC AUTOCHTHONE OF THE UKRAINIAN CARPATHIANS AND NORTH-WESTERN PART OF THE BLACK SEA COASTLINE REGION

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The geochemical investigation of the organic matter in Mesozoic deposits of Carpathians underthrust that are perspective for oil and gas is important and urgent for solving the problem of oil and gas-accumulation on whole.

The nature of organic matter (OM) and the grade of its transformation has been revealed.

The obtained IR-spectra are typical for OM subjected to katagenetic changes. Transformation expressed itself in the enrichment of organic matter by aromatic structures and partial loss of oxygenic groups.

The degree of catagenetic transformation corresponds to the following gradations: Mk_2-Mk_3 gradations of katagenesis stage (stages G-Z) for north-western part of the Black Sea coastline region and to MK1-MK2 (stages D-G) for OM in rocks of Carpathians regions.

The data of isotope composition of carbon of kerogene, chloroformic bituminoids and the results of IR-spectrometry show that OM has mostly sapropelic and humic-sapropelic origin. By methods of carbon isotopy it has been determined that $\delta^{13}C$ content of OM and chloroformic bitumoid ranges from $\delta^{13}C$ - -22,5- -25‰ for Carpathians and -30,2 - -31,6‰ of the Black Sea coastline region and corresponds to organic matter of mixed type, where the sapropel material prevails, and is close to the compostition of oil's carbon, which $\delta^{13}C$ ranges from -33 to -23‰.

CHANGES OF ISOTOPE EFFECTS IN MINERAL PHASES IN GEOLOGICAL CONDITIONS

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Mineral formations from different zones of the Carpathian region were studied and isotope compositions of rocks and minerals were fixed. Experimental investigations concerning the influence of various natural facktors on the isotope ratio change in minerals were carryed out. The conclusion was made that in natural conditions different outer influences such as irradiation and annealing leading to the isotope ratio change in Precambrian geological formations are superimposed on mineral phases. The isotope ratio change of elements in minerals are depended of irradiation conditions and exposition dose capacity as well as of mineral properties and of the afterradiate annealing character. Electronic irradiation generates surplus vacancies in minerals that leads to the sharp acceleration of diffusion processes. Recombination properties of minerals are very sensitive to irradiation. Unstructural admixtures depress the radiate-stimulated diffusion of alkaline ions.

The thermal annealing connected with metamorphism can provoke the redistribution of some elements between minerals, can cause the cleaning of paramagnetic centres and also can disturb the trackes stability. Stroncium redistribution between minerals connected with the superimposed annealing distorts an age interpretation. In these situations descending age meanings (discordantal age) are fixed as a rule. The heating under the superimposed metamorphic transformation assists argon diffusion in minerals. Therefore experimental data about the measure of the mineral stability to the loss of argon under the annealing must be taken into consideration under the application of the potassium - argon method. The K - O connections in biotite are easily disturbed under thermic influence and recrystallization, that favours to Ar isotope removal and age rejuvenation in comparison with muscovite.

The trustworthiness of age determination of geological objects was fixed by Rb - Sr microchrones of minerals on grains having <100 µm size. The analogous microanalysis can be used in combination with Sr redistribution madels for thermo-chronologic aims on a level with ^{40}Ar - ^{39}Ar method.

The incoherence of the meanings of age determinations are stipulated by ^{40}Ar and K mobility in the presence of surplus ^{40}Ar and by ^{39}Ar redistribution and its possible loss. Monazite can bear high radiation doses without of essential Pb loss. Radiogenic Pb/Pb_{b} are quickly accumulated in monazite owing to U and Th enrichment. Facts for age determination of monazite can be received by the way of U, Th, Pb synchronous measurement.

The age determination by ^{14}C method can be applied when rocks were not recrystallized. It may be take into consideration that the change of ^{14}C content in an atmosphere is caused by variations in intensity of the cosmic radiation of rocks.

The indexes of rubidium - strontium system ($^{87}Sr/^{86}Sr$ and $^{87}Rb/^{86}Rb$) can be disterbed in the result of influence of migrating solution at minerals (chemical exchange) and for annealing under metamorphism (strontium diffusion). Metamorphism can provoke the matter loss or addition in minerals and can change uranium - thorium - lead ratio. Therefore it should be analysed unchanged mineral individuals. The especial attential is turned to anomalous lead presence forming under rock transformation.

The samples must be unchanged for the determination of the temperatures of oxygen-bearing minarel formation (isotope - oxygen geothermometry). It is very important that isotopic ratio in phases (quartz - calcite) were "frozen" under the same temperature. In the result of this the $^{18}O/^{16}O$ ratio was invariabled during the geological time. The determination of temperature parameters for rock that are more ancient than Paleozoic ones is not well-founded.

So it is necessary to take into account the superimposed outer influences for interpritation of the trustworthiness of the isotope investigation data. The results of the isotope analysis must be confirmed by two or more independent other methods in some cases. Secondary ion mass spectrometry (SIMS) allows the unique capability of "in situ" isotopic measurements with minimal sample consumption and with the very high spatial resolution (< 1 µm), including mineral zonation investigation. Among offering methods a SIMS technique is fractionation effects brought from the physico-chemical processes of mineralization. Differences in mass and zero point energy make reaction rates and equilibrium constants if isotopes differented so that their pertition between phases at equilibrium or between reaction partners will be different.

STRAIN ANALYSIS AND IMPLICATIONS FOR DEFORMATION PATHS IN PALEOZOIC METACONGLOMERATES OF THE NORTHERN APUSENI MOUNTAINS

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Of the great number of nappes known in the Northern Apuseni Mountains, we dwelt only upon the Garda, Poiana, Biharia Nappes (and only for comparison, the Highis Nappe), in the constitution of which weakly metamorphosed conglomerates enter, of Late Carboniferous - Early Permian age. In all these tectonic units, stretching lineations of pebbles were measured; their strike is constantly NW - SE, showing the transport direction of the Alpine nappes during the Turonian.

The bi - dimensional analysis of the strain was undertaken by application of the classical Rf/Φ method in five observation points: Valea Negrii (Garda Nappe), Varciorog Waterfall (Poiana Nappe) and Siria Castle (Highis Nappe).The values of the strain rate (Rs) found by means of the χ^2 test vary between 1,62 (Garda Nappe) and 2,97 (Biharia Nappe). The diagrams of the initial distributions Ri/θ show the disposition of the long axes of the pebbles, from which, the absence of a preferential orientation in the primordial conglomerates can be deduced.

The first ascertainings concerning the deformation paths are the following: 1) the observation points plot in the Nadai diagram in the quadrant for which X>Y>Z, meaning that the principal axes of the strain ellipsoids did not interchange during the deformation, and: 2) in general, in the studied tectonic units, the strain had a plane character. Further, choosing the surfaces with measurements rigorously parallel to the principal planes of the deformation ellipsoid, the determination of the sectional strain type was made possible by means of the method proposed by Lisle (1986). This strain is coaxial in the Poiana, Biharia and Highis Nappes and non - coaxial in the Garda Nappe. The strain rate is also coaxial in the Biharia and Highis Nappes and non - coaxial in the other tectonic units. The deformation type was determined by another independent way, calculating the number of kinematic vorticity (w_k).

The plots of the observation points (with the exception of Piatra Molivisului) on the standard diagram proposed by Ghosh (1987) fall in the field of non - pulsatory deformations (for which $1>w_k\geq0$), confirming the former results.

By analysing the factors responsible for the geometry of the deformation ellipsoids we concluded that the overthrusts were accompanied by a homogeneous plain strain. The evaluation of the initial thickness of the nappes as well as of the mean rate of strain fall within the theoretical limits known for other similar zones with overthrusts in Europe (Kligfield et al., 1981)

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HOLOCENE AND RECENT CRUSTAL MOVEMENTS OF THE ZHELEZNITSA GRABEN, SOFIA DISTRICT, BULGARIA

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In contemporary aspect the Zheleznitsa graben is a Quaternary structure formed at the background of the periphery gravity blocks on Vitosha, Plana and Lozen mountains. The gravity blocks are formed as a result of the vault differentiated stage by stage uplift and abyss by fault structures for Vitosha and Plana and the block disintegration of the ply-fault structure of the Lozen mountain that has started in Late Pliocene. The tectonic development of the Zheleznitsa graben during the Pleistocene, Holocene and in the present-day stage is also in relation with the development of the complex Sofia graben. The contact between the two graben structures and the enumerated above horst structures presents one of the most activated in the present-day stage morphostrutural knots in Bulgaria.

The Holocene stage from the development of the Zheleznitsa graben is characterised by enforced vertical movements. In the peripheral parts, in the precontact zones with the Vitosha and Plana horst the total values of the vertical tectonic movements are within the range between +18 and +40 m. In the system of the Iskar fault zone the total value of the vertical tectonic movements is between +7 and +18 m. The Zheleznitsa fault is also active during the Holocene, the total value of the movements realised on it is of +5 to +12 m. As a result of the initial pre-Holocene tectonic impulse the Zheleznitsa graben is differentiated and a few smaller grabens are formed south of the village of Gherman and on the east of the village of Pancharevo, as well as the Pancharevo graben which is located in the wide basin of the river Iskar, between Pancharevo and Kokaliane, within the system of the Iskar fault. Its development is of practical interest as reservoir Pancharevo is in it.

The high natural seismicity of both the Pancharevo knot and the Sofia valley as well as the anthropogenic seismicity in the region of reservoir Iskar made necessary the carrying out of purposive geodetic measurements since 1982. Thus, the presence of contemporary activity along the fault structures was established. In the zone between Vitosha and Plana some strain of compression is observed which causes thrust movements. In the course of the geodetic monitoring a tendency of predominating strain of compression between Losen Mountain and Vitosha pluton has been observed. In the region under investigation the Iskar fault zone is related with compression as a result of which the Plana block thrusts on the Lozen block. Processes of active present day extension are found along the fault structures outlining the southern border of the Sofia graben.

The tectonic strains determined in the studied region are in good agreement with the results of the structural, geophysical and seismological investigations and give new elements concerning the geodynamics of the area.

FORAMINIFERAL ZONATION OF THE TURONIAN SANTONIAN DEPOSITS IN THE SREDNOGORIE ZONE, SOUTH BULGARIA

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The investigation of the foraminifera in the Upper Cretaceous deposits of the Srednogorie zone yielded well-diversified planctonic foraminiferal assemblages. Based on the stratigraphical ranges of the established planctonic species, the Turonian - Santonian successions are subdevided into 6 zones.

1. ***Praeglobotruncana imbricata*** **- Biointerval zone.** Definition: Interval from the first appearance (FA) of *Praeglobotruncana imbricata* (Mornod), the upper boundary is marced by the appearance of *Sigalitruncana sigali* (Reichel). Age: Early Turonian.

2. ***Sigalitruncana sigali*** **- Biointerval zone.** Definition: Interval from the FA of *Sigdlitruncana sigali* (Reichel) to the FA of *Sigalitruncana schneegansi* (Sigal). Age: Middle Turonian.

3. ***Sigalitruncana schneegansi*** **- Biointerval zone.** Definition: Interval from the FA of *Sigalitruncana schneegansi* (Sigal) to the FA of *Concavatotruncana primirtiva* (Dalbiez). Age: Late Turonian.

4. ***Concavatotruncana primitiva*** **Biointerval zone.** Definition: Interval from the FA of *Concavatotruncana primitiva* (Dalbiez) to the FA of *Concavatotruncana concavata* (Brotzen). Age: Early Coniacian.

5. ***Concavatotruncana concavata*** **Biointerval zone.** Definition: Interval from the FA of *Concavatotruncana concavata* (Brotzen) to the FA of *Concavatotruncana asymetrica* (Sigal). Age: Late Coniacian - Early Santonian.

6. ***Cocavatotruncana asymetrica*** **-Biointerval Zone.** Definition: Interval from the FA of *Concavatotruncana asymetrica* (Sigal) to the FA of *Globotruncanita elevata* (Brotzen). Age: Late Santonian.

WESTPHALIAN PALYNOLOGY OF THE NORTH-EAST (NE) BULGARIA, BASED ON CORED BOREHOLES

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The terrigeneus continental and nearshore sediments of late Carboniferous age from NE Bulgaria can be biostratigraphically determined on the basis of palynological investigations of sediment cores from Dobrudja Coal Basin.
In the Westphalian section can be distinquished six concurent range miospore zones on the basis of coinciding ranges of selected taxa: *Radiizonates aligerens, Dictyotriletes bireticulatus, Florinites junior, Torispora securis, Thymospora spp*. The subzones of this core interval resulted in more precise delimitation of biostratigraphic units within the Formations in the Basin. The palynological results have proved most convincingly Westphalian C and D (from Makedonka, Krupen and Gurkovo formations). The results from the miospore's studies from the Dobrudja Coal Basin make it possible the completing of local zonation of the Westphalian age for this region and the correlation withs the composite spore scheme in Western Europe.

ORE MINERALOGY OF A COPPER – GOLD MINERALIZATION IN THE AREA OF NIKISSIANI, PANGEON MOUNTAIN, NE GREECE.

by

Dimou Eleftheria * and Arvanitidis Nikos **

The Pangeon mountain makes a complex horst–graben structure of high–metamorphic rocks, developing in the southern extension of Rila – Rhodope belt. Since the time (around the 4^{th} century B.C.) of Philip the second, king of Macedonia, the Pangeon mountain became a prime target for gold exploitation. This is well demonstrated by remaining slags and adits, proving at the same time ancient Greeks' qualifications in mining and metallurgy.

In the area of Nikissiani copper–gold mineralized veins are controlled and developed in fractures cross–cutting basement qneisses, schists, amphibolites and marbles, as well as intrusive granites and pegmatites. The ore–mineral penagenesis comprises chalcopyrite, pyrite, pyrrhotite, tetradymite, native gold, mackinavite, cubanite, sphalerite, arsenopyrite and bismuthinite Imposed brittle deformation and supergene oxidation are expressed by the formation of malachite, azourite and limonite.

Native gold forms rounded grains of small size (some tens of μm to up to 0,5 cm) hosted in chalcopyrite, or mainly within its oxidation products, and contains 12–16 wt% silver. Whole–ore gold amounts range from 20 to 250 ppm.

Overall compositional and mineralogical characteristics of the Nikissiani copper–gold sulphide veins, are typical for middle to high temperature hydrothermal mineralizations. The origin and /or generation of the mineralizign solutions is more probably related to proximal hydrothermal activity of the Nikissiani granite and co–magnatic high–level intrusions.

The copper–gold vein mineralization in the area of Nikissiani makes a typical example of the uneconomic high–grade low-volume shear / vein controlled occurrences in Pangeon mountain. Except from their importance to understand metallogenic processes in western Rhodope and Rila, combined with historical evidences, the high–grade low–volume gold mineralizations can be efficient exploration tools for ore prospecting.

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DEVELOPMENT OF THE UPPER CRETACEOUS VOLCANISM IN THE TIMOK-SREDNJA GORA BELT SOUTHWARDLY FROM BOR MINE (EASTERN SERBIA)

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The Timok Eruptive Area (TEA) is a trench-syncline rift structure of Carpathian -Balkanian arch on the crust of continental type (Andric at al., 1972) which towards southeast continues into a planetary volcanic arch. The marine sedimentary basin is opened by Albian transgression and continues trough widening of the basin to the end of Cenomanian, when volcanic activity began.

Turonian volcanism is characterized by continental volcanic activity. Large volcanic areas are composed of andesitic and rarely dacitic pyroclastic and lava products. Intrusions of the subvolcanic andesite and diorite were formed in the final phase of the volcanic activity. In the Turonian time Cu deposits are formed: in channels of volcanic level-massive Cu ores, in subvolcanic-hypoabyssal level-porphyry Cu ores. Mineral association of the Turonian volcanites is presented by: plagioclase-andesine to acidic labradore (40-52% An, normativelly 46,80%), hornblende-Mg hastingsite to Mg hornblende and pargasite (Leake 1978). Biotite, augite and quartz as accessory minerals. Magma is calcalkaline, moderate acidic to neutral (SiO_2 - 54-65%, average in 24 analysis is 57,60%). At the base of diagrams Ba:La and Nb:La (Gill 1981), analyzed rocks plotted on orogenic andesite.

From Turonian/Sennonian boundary, the TEA is longitudinally devised into the eastern and western part. In the eastern part, in new formed shallows' conditions, begin resedimentation and easy deposition of epiclastic and clastic sediments till Maastrichtian age. In the western part, in slightly deeper sea conditions, volcanism is renewing several times with deposition of clastic sediments in mideruption pauses. The beginning of volcanism is characterized by presence of basatic-andesite products that forms smaller pyroclastic domes. Mineral association is presented by: plagioclase (49-70% An, normativelly An 54%), clinopyroxene - augit, very rare hornblende. Magma is calcalkaline, rarely toleitic, (SiO_2 - 48-55%, average in 12 analyses is 52,52%).The following basaltic-andesite products are forming wider volcanic areas. Mineral content is slightly different. Plagioclase has An value of 50-75%, extremely to 90%, normativelly An is 47%. Beside augit orthopyroxene also occur as regular constituent. Hornblende is rare or completely disappeared. Value of SiO_2 is 53-57%, average in 25 analyses, is 56,40%. Strong eruption that probably was happening in Campanian age, ejecting large amounts of material that built up volcanic islands, so at first volcanic activity took place in marine and later in continental conditions. Andesitic pyroclastic and lava products have been followed by injection of subvolcanic andesite, diorite and monconite. There are many Cu mineralization appearances and in the northern part of Bor vicinity there are Cu ore. According to their look, mineral and chemical composition they are very much alike the Turonian andesites. Chemical composition of magma that produce subvolcanic-hypoabisal rocks of Campanian age, is alkaline with potasic trend, while on Y:Nb and Y:Rb diagrams (Pearce, 1984) they are plotted on syn-collision granites and volcanic arc granites field.

Volcanism of the TEA ends on Campanian/Maastrichtian boundary appearing small amounts of basaltic-andesite products. Since that time whole the TEA have started to lift up and become shallow, so deposition of coarse- grained clastic sediments - sandstones and conglomerates and reef sediments begin. At the end of Maastrichtian deposition of brackish sediments taken place so the TEA stops to exist as a marine sedimentary basin.

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Abstract

MAPPING OF THE SPRINGS AND ARTESIAN WELLS OF THE CARPATHIAN BASIN IN THE 19TH CENTURY

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The inventory and the cartographic representation of mineral, medicinal and drinking waters is of high importance from several viewpoints, such as public health, tourism and the planning of water supplies.

The 19th century was characterised mainly by the description of occurrences. The in-depth investigation of the hydrological parameters of the waters of different type and temperature, and the utilisation of the results in water management, was the achievement of the 20th century.

In the Carpathian realm (except for the Transylvanian Basin) the first attempt to compile an inventory of mineral and medicinal water occurrences was made by **György Wernher**, castle captain of Sáros and Szepes. After several private initiatives of this kind, a systematic inventory was ordered by Queen **Maria** Theresa (1763, 1768). The result was a monograph of the mineral and medicinal waters of the Hapsburg Empire, by **Heinrich Johann Crantz** (1777, in German).

In those times, most of the authors were physicians or pharmacists. No wonder that they felt no need for representing the water occurrences and their characteristics on **a** map. **Vilmos Zsigmondy**, a mining engineer, who was a pioneer of the exploration of subsurface water in Hungary, proposed to produce for the Paris Exhibition in 1878 a map and a catalogue, which would provide a complete overview of the mineral and medicinal waters of the country. The three-sheet map was plotted by engineer **Géza Zsigmondy**, under the personal direction of **Vilmos Zsigmondy**. The Catalogue (Inventory) accompanying the map was compiled by a chemist, Professor **Béla Lengyel**. It was published under the title **"Les eaux minérales de la Hongrie"**.

Chemist **József Horváth** criticized the Catalogue, pointing out that it was incomplete, and from contradictory older analytical data the existence of in fact non-existing springs had been deduced. He himself produced an other map and introduced it to the Itinerant Meeting of Hungarian Physicians and Naturalists in 1879. This consists of a 1:300.000 scale map and an explanatory text. In 1881 it was printed (scale 1:792.000) with a legend in

colour, under the title "**Map of Mineral Waters and Spas of the Countries of the Hungarian Crown.**" This map showed 1.700 occurrences. they were grouped into six categories (alcaline, terrous, bitter-salty, rock-salty, ferrous, sulphurous). The thermal waters constituted a separate group.

For the General Industrial Exhibition in Budapest (1885) physician **Kornél Chyzer** wrote an explanatory note to the "**Map of Spas and Mineral Waters of Hungary.**" The map itself was published only one year later, in 1886. The explanatory note is much more detailed than the map, due to the constraint of the scale (1:1,440.000). The mineral waters of Hungary were subdivided into eight groups. Among the spas, the pine needle baths and cold water baths were also included. **Chyzer** achieved considerable success also with his work "**More Important Spas and Medicinal Springs of Hungary and the Adjacent Countries**", published in Stuttgart, 1889.

For the millennium of the Hungarian Conquest (1896), palaeontologist **Gyula Halaváts** compiled an "**Inventory of the Artesian Wells of Hungary**", while geologist **Tamás Szontágh** produced a manuscript map of springs, wells and the towns equipped with water pipe system. Mostly on this basis was published in 1908 a 1:900.000 scale coloured map "**Overview of the Urban Water Pipe Systems, Artesian and Drilled Wells on the Territory of the Countries of the Hungarian Crown.**"

This map distinguished drilled wells yielding mineral water and drinking water, respectively. Within both groups, artesian (sprouting) wells and simple drilled wells (with the static water table below the surface) were distinguished. Special signs indicate the localities which have more than one well, or wells of different depths, tapping different aquifers. The gas content of the waters and the dry wells have also been recorded. The very well printed, nicely coloured map reflected adequately the water supply level of Hungary at the beginning of this century. Its legend was kept in use for a long time.

SEDIMENTATION AND TECTONICS OF THE OUTER PART OF THE EASTERN CARPATHIANS (MOINESTI ZONE), ROMANIA.

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The median zone (Moinesti zone) of the Paleogene flysch in the Eastern Carpathians accommodates the most significant hydrocarbon accumulations in Moldavia, mainly at the Oligocene level of the Marginal Folds Nappe. This offered the best conditions for hydrocarbon genesis, accumulation and preservation.

Within this area, three major structural genetic units are outlined, fonned as a consequence of the Middle Miocene continental collision (Moldavian tectogenesis).

In order to diminish the geological risk in the hydrocarbon exploration, it was attempted to create a coherent tectonic sedimentary model. To this purpose, there has been used two methods of geological analysis on the formations belonging to study Paleogene basin.

The first method was based on the technique of balanced geological cross-sections, also used to restored the Paleogene basin studied at the null strain stage and estimation of its regional shortening

The second method, used for the first time in this area, consists of the complex sequence analysis of the Oligocene sedimentary deposits aiming to identify their depositional systems. There have been revealed several architectural models (electrofacies) characteristic to the shelf and deep sea areas. Likewise, there have been identified parts of source, transfer and deposition zones, specific to turbiditic system (E. Mutti, 1991).

For these methods, surface data as well as information on the drillings in the area were used, the seismic acquisition being unsatisfactory.

The correlation of the data obtained by these methods made possible to check up the accuracy of the used geological image. There have been established the stratigraphic units distribution, their position as well as the position of the key beds prior to deformation and depositional systems of the Oligocene deposits which may guide further hydrocarbon exploration.

^{40}Ar -^{39}Ar LASER PROBE DATING ON SINGLE CRYSTALS FROM TRONDHJEMITIC DIKES – SEBEŞ-CIBIN MTS. (SOUTH CARPATHIANS) – ROMANIA

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Single biotite, plagioclase and quartz crystals from porphyritic trondhjemites have been analysed for ^{40}Ar/^{39}Ar isotopes. The dike system occurs along and within a shearing belt of almost 90/8 km in the north Sebeş-Cibin Mts. (South Carpathians) which separates the Getic and the so-called Supragetic Realm. The tabular structures of the host Upper Proterozoic formations settled in the last pre-Alpine metamorphic event (M2) and the lithological boundaries between the main complexes seem to have behaved as shear zones (Stelea, 1994).

Structurally, the trondhjemitic dikes are variably deformed to undeformed, which suggests either a heterochronous emplacement or reflects a differential response to the brittle shearing associated with the Alpine metamorphic event (M3)

Laser step-heating ^{40}Ar/^{39}Ar age determinations on three different minerals (biotite, plagioclase and quartz) are discussed here. A plateau age of 108.4$\pm$0.5 Ma from biotite from an undeformed rock is identical to its integrated age, indicating negligible Ar loss since rapid cooling of the mineral through its closure temperature. Another biotite from a more deformed trondhjemitic dike shows small amounts of Ar loss in low temperature gas fractions. Its plateau age of 109.3$\pm$0.5 Ma is almost concordant with that from the undeformed rock. Consequently, the Ar/Ar data on biotite show the igneous cooling age of the trondhjemitic magma from two different dikes, meaning that this age represents the coeval intrusion of these bodies, after the brittle shearing stage, probably related to the Austrian phase.

The plagioclase phenocrysts are slightly altered and their age-spectra are problematic, indicating both excess Ar and younger ages relative to the biotite. These effects may be attributed to an event at 96 - 95 Ma.. Similar ages appear to be registered by inclusions within quartz crystals. Unpublished K-Ar ages of 87.4 and 90.5 Ma on biotite from dikes belonging to the same magmatic system may also reflect this post-magmatic event.

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A CONTRIBUTION TO KNOWLEDGE OF HYDROGEOLOGY OF BUJANOVAC SPA, YUGOSLAVIA

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Bujanovac spa is situated in Bujanovac depression, extreme south of Serbia. The depression is filled with Tertiary and Quarternary deposits. Its margin is built up of Precambrian crystaline schists with intruded granites. Thermomineral water accumulates in granites, particularly along faults which controlled the formation of the tectonic, Bujanovac depression.

Investigations of natural occurences of thermomineral water began in 1966. and, with interuptions, continued to the present day. A general inference, on the basis of the investigation results, is that the entire Bujanovac depression, Bujanovac spa area in particular (where the test results on water quality and withdrawal are the best), is an abundant natural water resource which has been only partly used in balneology and in table water bottling.

Hydrogeological investigations in 1996. and 1997., referred to withdrawal of thermomineral water at borehole BH-7, 555m deep, located 2 km north of Bujanovac spa. Water was abstracted from an artesian aquifer of granites, entered at depth below 480m from the surface. The investigations included:

-observations of yield variations over the year (October 1996. to October 1997.)
-hydrodinamic test of aquifer
-hydrochemical and sanitary tests.

Results:

- Extremely uniform annual discharge, from 1.09-1.14 l/s, as a result of the aquifer depth and balanced effect (small influence) of the anual hydrologic cycle.

-Hydrodinamic considerations are based on the measured water table recovery in the well after 50-hour discharge; the obtained values of transmissivity coefficient (T) are 7.57-8.71 m^2/day, depending on the method used.

-The type of abstracted water is hyperthermal sodium-hydrocarbonate mineral water. Principal quality parameters are:

temperature 42°C,
total dissolved solids 5.05 g/l and
free CO_2 content 1.22 g/l

-Continual sanitary analysis indicated full microbiological and chemical fitness for use of the abstracted thermomineral water

GEOFHYSICAL INVESTIGATIONS OF OIL-BEARING IN PROVADIA SYNCLINE

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The Middle Jurassic sediments from Provadia Syncline show considerable lithological, facies and physical variability. They are represented mainly by sandstones, siltstones, biodetrital and sandy limestones and shales. The very shallow-water sandstones and siltstones which are of relatively higher mineralogical maturity and sorting show better capacity and filtration properties. On the base of well-log investigations and core analyses in the wells a differentiation of terrigenous rocks' types is done. According to the mineral content and the quantity of cement 5 types have been defined. The following parameters are sensitive to the change of sandy, clayey and limy content: volume clayness (K_{cl}), interval transit times in the rock' matrix/skeleton/ (ΔT_{sk}). The porosity ($\varnothing$) and the relative clayness (η_{cl}) have been used as supplementary parameters. The range of variation of these parameters has been determined. Their combined using in a correlation scheme allows to outline the fields for the separation of reservoirs and non-reservoirs. The ratios of the coefficients of connate water and oil have been used to clarify the possibilities for getting of formation' flow. The above mentioned parameters characterise also the rocks which isolate the reservoirs above and beneath. The isolating rocks have been presented by siltstones and shales.

Fracture-pore and fracturereservoirs dominate in the region studed. The prolongation is necessary to study to the East and North East where have been devlloped similar facies and types of sediments. To the West, Noth and South their distribution is limitted due to the wash-outevents or paleoland existence.

GEOLOGICAL MAPPING OF THE BAIA MARE AREA (NW ROMANIA) BY REMOTE SENSING TECHNIQUE

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The sequential elucidations over the rich gold bearing and base metal ores in the Baia Mare area (NW Romania) related to the Neogene volcanic rocks, have motivated the geological mapping in this region. The goal of this study is to bring together new tectonic (including volcanologic), petrologic and metalogenetic data. A systematic fotogeological interpretation (sc. 1:100.000) on the area of about 1.200 km^2, superposed with satellite imageries (SPOT, 1-P 84/254; 84/253) have been performed. The criteria that allowed a GIS document elaborations have been used.

The main results obtained by remote sensing technique may be synthetically grouped as follows:

the majority of the contoured volcanic edifices forms: *calderas* with composite structures, mainly stratovolcanic, such as: Igniş, Stâmbu-Hârcea-Berdu, Pleşca-Prislop-Măgura Mare (S Jereapăn), Ursoi Peak-Bârlogele (Cămârzana); *major cones* ± *lava domes* ± *marginal volcanoclastics*, such as: Şatra, Măgura Focului, Higea, Piatra Şoimului, Şindilit, Negru Peak (Oraşu Nou), Jeleznic, Gărăţean (Negreşti), Măgura Târşolţ, Prislop Peak, Pleşcuşa Peak; *minor lava cones*, such as: Arşiţa, Măgura (Şuior), Ascuţitu, Coasta Chinezului, Minei Peak, Blidaru Peaks, Măgura (Chiuzbaia), Piciorul Herjei, Ostra, Purcăreţu, Muntele Mic, Oraşu Nou Vii, Grui Peak (Gherţa Mică), Dl. Mic (Turulung Vii) – of rhyolite-andezitic composition (the last one of dacitic tuff). The only one *cumulodome* we consider in the area is the Gutin Peak. The photogeological study contests the previous representation of the Mara and Săpânţa calderas. They look to be southward directed monoclinal stratovolcanic complexes (lava flow dominant). Their volcanic center could correspond to the northern - now erroded zones - Agrişului Peak, Peştilor Peak. A lot of *subvolcanic bodies* (most of them dikes and sills) mark tectonic alignments (active after the Jereapăn Pannonian phase);

- the discrimination between lava types, as well as between volcanoclastics and volcano-sedimentary deposits from different volcanic edifices, may be certainly mapped. Sometimes, the lava/piroclastics complexes are undifferentiated mapped;

- the Paleogene-Badenian sedimentary deposits of Băiuţ-Botiza area show a *suture melange structure* that contests the nappe structure (Botiza, Wildflysh nappes) previously mapped;

- the most important *tectonic alignments* (VNV-ESE Bogdan Vodă, E-W Dragoş Vodă) have recorded senestral strike-slipping dynamics related to the post-Jereapăn phase. Two secondary isoclinal fault systems (ENE-WSW and NE-SW respectively) have been described. Both categories (Băiuţ, Bixad-Corneasa and Jereapăn, Şuior, Baia Sprie respectively – for the main system; Băiuţ and Roata-Oanţa, Cavnic-Bolduţ, Herja, Dealul Crucii, Săsar respectively – for the secondary system) prove to owe an obvious metalogenetic value.

HYDROCARBON POTENTIAL OF THE TRIASSIC SEDIMENTS IN NORTHERN BULGARIA

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For more than 30 years the Triassic carbonate sediments have been outlined against the Phanerozoic section as a primary target for geological-geophysical works and deep prospecting-exploratory drilling.

Interest in the section[s] carbonate part of the Triassic system is supported by and grows owing to the fact that most criteria for evaluating its hydrocarbon potential are positive:

- in the Triassic carbonate sediments were discovered the gas-oil deposits of Goren and Dolen Dabnik, the gascondensate deposits of Chiren and Devetaki, the Aglen gas deposit;

- the Triassic carbonate sediments are characterized by a relative stability of oil and gas shows of various intensity;

-definite regularity in the nature of oil and gas shows is observed with regards to the geostructural units, and namely - predominantly oil ones within the boundaries of the Moesian platform, and gas ones in its continental margin;

-the Triassic carbonate section is characterized by varied carbonate rocks which represent reservoirs of various types and classes, mainly fracture-porous and fracture and in inferior quantity - cavernous-porous-fracture;

- peculiarities in the reservoir distribution dives grounds to divide the Triassic carbonate complex into two permeable bodies with heterogeneous characteristics;

the Triassic carbonate section is sealed by Upper Triassic Lover Jurassic regional impermeable complex.Its lithological peculiarities and the nature of alternation of almost impermeable rocks are diverse, and this makes its evaluation quite differentiated. Particularly promising, with good sealing properties are the anhydrite-saliferous sediments of the complex in the area of Elena-Omourtag-Preslav. The seal is also reliable in many zones of Northern Bulgaria when built up by Lower-Middle Jurassic terrigenous-clayey and carbonate-clayey sediments notable for their thickness;

- during the evaluation of structural-tectonic criteria difficulties are encountered in the establishment of the quantity, distribution and the size of local structures, no matter how well the Triassic carbonate complex is studied. Difficulties arise from the uncertain and insufficiently seismic data on separate areas of Northern Bulgaria, and on the other side - vast areas where the washout of the Triassic reached to the upper levels of Anisian, so that the structural models reflect the denudated surface of the Triassic carbonate section;

- spatial interaction between reservoirs and seals resulting from structural factors are favorable and suitable for the formation if natural reservoirs;

- the Triassic carbonate complex in Northern Bulgaria following an extension and a subsequent rift genesis which allowed the Tethys waters rush into these places. A strongly leveled shallow water shelf of an epicontinental marine basin is formed, wherein in two stages conditions were created for the formation of carbonate platforms.

MONAZITE AND RHABDOPHANE IN THE SOPRON HILLS, EASTERN ALPS (W-AUSTRIA)

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The crystalline rocks of the Sopron Hills represent the easternmost outcrop of the Austroalpine basement. Detailed investigations worked out the existence of two different lithological series within the Sopron Hills, whith different metamorphic history. 1) Lithologies with a relative well preserved pre-Alpine mineralogy comprise the Óbrennberg-Kaltes Bründl Series. In Bt-And-Sil Schists And shows Ky-overgrowth on its rims and in many samples the metastable co-existence of And, Sil, and Ky can be found. St only occurs as relicts within And. Bt-Ser-Cld-Grt-Schists are also frequent .2) The Sopron Series mainly consist of monotonous diaphtoritic mica schists with varying Qtz-contents and numerous rectangular to rhombic pseudomorphs after St. Characteristic coarse grained „Grobgneiss" was found only in the very southernmost part of the crystalline massif. Leucocratic, moderately foliated, medium-grained gneisses, which lack any transitions to the „Grobgneiss" are much more abundant.. The conditions of the pre-Alpine high-T metamorphism in the Óbrennberg-Kaltes Bründl Series are estimated at 650°C and 3-5 kbar. There is good evidence for an Alpine metamorphism in the Sopron Series, with peak-conditions at 550 ±30°C and 9,5 ± 1,5 kbar.

The occurrence and abundance of their accessory REE minerals were examined by EMPA. Monazite, xeno-time and rhabdophane [$CePO_4 \cdot nH_2O$, $n \geq 0.5$] arc rather widespread; allanite and florencite are scarce. Ap-prox. 150 quantitative analyses were done on Mnz and rhabdophane, the distinction between them based on the measured oxide totals. – In the *schists* of *Óbrennberg–Kaltes Bründl Series* Mnz over 10 µm grain size is abundant (40-150 grain/section, with one exception). It is sometimes idioblastic, often included in And or intercalated with Bt suggesting formation – at least partly – during pre-Alpine metamorphism. It may be transformed partly or totally to rhabdophane in some samples, originating grains with appearance and chemistry similar with Mnz but oxide totals below 97% ("Mnz-like rhabdophane"). Other type of rhabdo-phane, see below, may also be present. – *Gneisses of Sopron Series* are poor in Mnz: one medium-grained gneiss has small inclusions in apatite, another in garnet. Rhabdophane, on the other hand, is abundant in some gneisses, forming heaps of small (≈1 µm) grains, with chemical compositions different from Mnz: Ca>Th; Y- and other HREE-, often Th-contents are higher. This type of rhabdophane is also present in some of the schists and must have different origin from Mnz-like rhabdophane. – In the *schists* (and quartzite) of *Sopron Series* the abundance of Mnz (or Mnz-like rhabdophane in one sàmple) is changing from 0 and 1 to 80 grain/section or more. The rocks with high abundance contain Cl-apatite as well.

In Mnz compositions the following changes were observed: a) nearly parallel change of Ca and Th (Ca≈Th); b) variation of Y and other HREE, presumably with P-T conditions ; c) differences in Eu-anomaly (Eu/Eu*) among grains of different origin.

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GIS-AIDED INDUSTRIAL PRODUCTION OF GEOLOGICAL MAPS

By

INSTITUTE OF GEOLOGY AND MINERAL EXPLORATION
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V. TAKAS, M. SALACHORIS, P. RAGGOU

ABSTRACT

The Institute of Geology and Mineral Exploration of Greece with its experienced staff, traditionally produces high quality geological maps.
With the advent of the Geographical Information Systems (GIS), together with the Desk Top Publishing (DTP) Systems, the cartography has been reoriented and a new dialectic relation has been created.
The wedding of GIS and DTP in geological map production aims to
-The improvement of the productivity and the development of new or ameliorated production methods.
-The development of new or improved products with high additive value and possibilities of penetration into new markets.
-The high technology transport and adaptation into traditional branches and its critical overview.

The new trends of the Geographical Data Management technology focuses at the GIS technology adoption. These GIS packages primarily designed for the input, update, analysis and storing of geographical information disposed simple tools for map design, composition and creation.
Today, they are enriched with additional capabilities or they are compatible with commercial, at the self, more user- friendly products. Consequently, high quality map compositions can be created (letters, symbols, color models, color separation, etc.)
There are numerous parameters that should be defined for the production of high quality and concrete specifications geological maps.
The final product, the geological map, in digital form, can be afterwards be published by the modern publishing houses.

ENVIRONMENTAL AND CLIMATOLOGICAL SIGNIFICANCE OF THE MIOCENE CORALLINE ALGAL-BRYOZOAN FACIES (APOSTOLI BASIN, EASTERN CRETE, GREECE).

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The Apostoli Basin, in the central-west part of Crete, was formed as a fore-arc type basin related to the convergent plate boundary between the African and the Eurasian plates. Most of the Neogene sediments filling the basin were deposited in a terrestrial to shallow marine environment. Marine facies become more abundant upward in the succession and culminate with the overlying bioclastic limestones.

The studied bioclastic limestones are characterized by a Coralline Algal-Bryozoan facies, analogous to the "maerl" facies described for fossil and recent carbonate sediments. Coralline algae prevail towards bryozoan and occur mostly in fragments (poorly sorted biomicrudites). In places branching or encrusting coralline algae also occur (biolithites). Fauna includes also abundant echinoderms and in lesser amount benthonic and planktonic foraminifera.

The above facies consists principally of high and low Mg calcite shells, typical for a temperate sedimentation. Typical tropical carbonate elements generally lack (e.g. corals, calcareous green algae, ooids, grapestones).

Textural characteristics reflect deposition under low energy of sedimentation, in a protected marine environment. Such conditions are favoured in a very shallow shelf, "bay-like", environment, where scattered patch-reefs consisted of coralline algae and bryozoans develop. These build-ups suffer strong bioerosion providing abundant skeletal elements (bioclastic limestones).

The absence of reef-building corals (chlorozoan association) and the appearance of a highly calcareous facies, representing by the coralline algal-bryozoan facies (foramol/bryomol), association suggest the prevailance of cooler conditions. These conditions are developed due to the progressive closure and drainage of the marine connection between the western Tethys and the Indo-Pacific ocean, as Africa and Eurasia collided, ultimately leading to the Messinian salinity crisis (Drooger, 1979).

Calcareous nannofossil biostratigraphy has been carried out in the marly intervals of the bioclastic limestones. The calcareous nannoplankton assemblages are characterized by the presence of *Helicosphaera stalis* and *Discoaster pentaradiatus*. The combination of these species along with the absence of *Amaurolithus* spp. allows the assignement of the studied sediments to CN8b/CN9a biozones (Okada & Bukry, 1980), suggesting a Middle-Upper Tortonian age.

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CHANGING CONCEPTS. FROM THE MEDIAN MASS TO THE MICROPLATES

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The successive changes of the concepts about the tectonic character of the basement of the Pannonian Basin (s.l.) are briefly outlined.

The Median Mass Controversy

- Loczy, L. Sen. (1918) adopted and enlarged the paleogeographic concept of Mojsisovic, E. (1880) about an "Eastern Continent", later considered by Kober, L. (1921) to be an autochthonous craton. Princz, Gy. (1926) baptised it "Tisia". Telegdi-Roth, K. (1929) extended it as far as to the Carpathian flysch belt. Schmidt, E.R. (1957) tried to combine it with nappe tectonics.

- Pavai Vajna, F. (1931) considered the Pannonian Basin, in sharp contrast to the previous view, to be an active geosyncline. Rozlozsnik, O. (1936) assumed an inhomogeneous iuxtaposition of rigid and mobile belts. Horusitzky, F. (1961) developed the idea that these were in fact partly superposed nappes. These belts and the major lineaments separating them were represented, already on the basis of sound deep drilling evidence, on the map of Balogh K. & Körössy, L. (1966) and interpreted by Wein, Gy. (1967, 1969).

The Mantle Diapir Theory

Geophysical (mainly seismic) data revealed that the crust is relatively very thin beneath the Pannonian Basin. Szadeczky-Kardoss, E. (1968, 1969) explained this by partial destruction of the crust from below, due to magma currents which are active in the upper mantle, producing a "mantle diapir". Stegena, L. (1972) assumed even the existence of two such diapirs.

The Plate Tectonical Approach

After the first introduction to plate tectonics in Hungary given by Panto, G. (1970), an increasing number of Hungarian geologists, palaeontologists and geophysicists contributed to the application of plate tectonics to the geodynamic evolution of the Pannonian Basin: Szadeczky-Kardoss, E. (1971), Geczy, B. (1972, 1973), Stegena, L., Geczy, B., Horvath, F. (1975), Wein, Gy. (1978), Balla, Z. (1982), introducing a (sometimes amazing) number of microplates with subduction sutures between them. Balla, Z. & Dudko, A. recognised the importance of large-scale horizontal displacements as early as 1969. This line of thougt was further developed by Meszaros, J. (1983), Kazmer, M. (1984) and Kokay, J. (1985).

A fairly well established consensus seems to have been achieved about the point that the "Tisza Unit" microplate (what has been left of the "Tisia") has been detached from the European plate and moved to its present position along the so-called Central Hungarian Lineament.

During the past decade, the displacements of the individual microplates and the role of the main structural lines were widely debated. Palaeomagnetic evidence produced by Marton-Szalay, E. contributed considerably to the deciphering of rotational plate movements.

Recently much attention is paid to the post-Early Miocene (Badenian and younger) stages of basin evolution: pull-apart basin subsidence (Horvath, F. & Royden, L. 1983, etc.), Neo-Alpine block tectonism (Hamor, G. 1982, 1985 etc.)

UNDERTHRUST STRUCTURES OF MARMAROSH MASSIF OF THE UKRAINIAN CARPATHIANS AND THE PROBLEMS OF THEIR GAS-BEARING

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The structural-formational analysis of Marmarosh massif and adjacent territories shows that intensively deformed and pulled in north-eastern direction tectonical structures of internides and externides are developed in this region. The internides are composed by metamorphic formations of Proterozoic and also Paleozoic, Mesosoic and Cainozoic volcanogenic-sedimentary formations of before the flysch row. Externides are composed by flysch formations (Cretaceous, Paleogene), which are deformed into the fold-covering structures along the Alpine tectonogenetical cycle.

Regional thrust of internides on externides is proved by results of the geological syrvey, drilling and geophysical works. Within the internides there were revealed the regional underthrust structures, which were successively pulled one on another. Radomirska and Kamianopotitska structures are composed by intensively dislocated Mesosoic formations, which reflect the Cimmerian and the beginning of the Alpine tectonogenesis. Rakhivska underthrust structure is composed by Lower-Cretaceous serieses of flysch-like type and its belonging to internides is not evidenced enough. By data of the geological observations around Rakhiv the thrust surface of metamorphic rocks in Marmarosh crystalline massif has a tilt of 15-25° to southern west and has a folded character in longitudial and transverse directions. Last time there were revealed the complicated schuppen-nappe structure of metamorphic Baikalian, sedimentary Variscian and Cimmerian-Alpine complexes of Marmarosh massif, the latter looked like a packet of nappes with general displacement of mass from southern-west to northern-east. By now the presence of the regional nappes Dilovetsky and Bilopotitsky is determined.

On base of investigation of primary actual drilling data at this territory there were revealed the inflows of hydrocarbon gases. The depthes where the gases inflows have been obtained range from 80 to 620 m. Gas-bearing deposits belong to carboniferous or black-shale formations and stay on stratigraphical levels: Vendian -Lower-Cambrian, Paleozoic (not subdivided), Upper Carboniferous, Lower Jurassic, Oligocene. Lithological and petrological analyses and the investigation of core samples of gas-bearing deposits testify, that inflows of gas have been obtained from rocks subjected to significant tectonical reworking (cataclasites, mylonites, phyllonites. fault breccia). It means, that collectors are jointing and their formation is caused by tectonical reasons.

The gas composition is nitrogen-hydrocarbon-methane with nitrogencontent from first to 60%. The migration of such type of hydrocarbon fluid is testifyed by results of geochemical investigation of hydrocarbon inclusions in the main vein minerals of this region: in calcite and quartz as «marmarosh diamonds». Mass-spectrometry study of vein calcite from Paleozoic and Jurassic deposits shows the presence in gas component of CH_4-50-70%, CO_2-about 10%, N_2-11-34%. In «marmarosh diamonds» the gas-like hydrocarbon inclusions prevail with contents of CH_4-90-100%, N_2-from 0 to 10%. The temperatures of vein minerals formation are 140-220o and also testify the possible preserving of hydrocarbon deposits under the nappes of Marmarosh massif.

Thus, the gas-bearing of Marmarosh massif is in space-genetical connection with carboniferous formations of different age; the formation of collectors and traps is connected with tectonical processes and caused by nappe construction of the massif. It is possible that significant role in formation of the surface show of hydrocarbons belongs to their inflow from the deep, more thick deposits.

DEPOSITIONAL ARCHITECTURE OF THE SERRAVALLIAN DEPOSITS: SILOCOCLASTIC TURBIDITY FANS ZVERNEC OUTCROP IN ALBANIA

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The outcrop of Zverneci (Vlora region) which represents mollasic deposits of Serravallian has continuously attracted the attention of Albanian and foreign geologists. All this not only a result of a splendid outcrop but also the great sedimentologic richess: type facies, lithology, geometry and facies structure, the quality and variety of the sedimentarian figures, their sequence and hierarchy, the absence of macrofauna, the spectacular evidence of concretions of Burdigalian: both as "blocks" in the center of the channels and as a „nucleus" of the sandstone concretions: thinning or thickening up sequences, powerful erosive base channels or lobes with a very clear base, spectacular rhythmic inter-beding, thin centimetric coves of mudstone marls.

CRYSTALLINE BASEMENT DISTURBANCE AND ALLOCHTHONITY IN THE MALÉ KARPATY Mts. (PETROLOGICAL DATA)

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The pre-Alpine basement of the Western Carpathians is represented mainly by medium to high-grade paragneisses, orthogneisses, amphibolites and other metamorphic rock complexes which were later intruded by granitoidic rocks of Variscan age. Metamorphic zonation is connected with granitoid intrusive rocks. The spatial relationship and metamorphic zonality exists in some areas only as rudimentary remnants. In other places the complete metamorphic zonality was preserved. Due to the tectonic disturbances of the Variscan orogen, it is still unclear whether the crystalline complexes in some „core mountains“ are in an autochthonous position.

In some profiles of periplutonic zones the dehydration processes and volume changes represent the absence of continuity of these changes with respect to the distance from intrusive granitoidic contact. The extent of the fluid component production through the metamorphic reaction protolit is not always related to the distance from magmatic body. The main dehydration pulses, which depend on the overstepping of a particular mineral assemblage stability, are realised at lower P-T exposed zones. Dehydration features in particular periplutonic zones do not offer the metamorphic reaction arguments about continual dehydration caused by a particular granitoid rock body. Volume changes of these dehydration reaction processes have similar relations to the granitoid body contact within the frame of zonal development. This petrological observation, together with the index mineral appearance confirms disturbances of metamorphic zonality with respect to the metamorphic reaction sequence and the dehydration extent.

Calculated approximative P-T trajectories (in range of 570-650 °C and 3.5-6.1 Kbar) express first order tectonic motion and represent specific uplift conditions of the particular tectonic blocks. Some of the samples express uplift trajectories determined dominantly by decompression during cooling while the others may present more isothermal, probably rapid decompression during uplift period. The peak progressive conditions were different for samples with different geological position. These differences in samples P-T data are considered to be the further arguments for the tectonic disturbance of the crystalline metamorphic cover.

Garnet progressive growth analysis based on crystal size distribution (CSD) indicate a rapid cooling during uplift for samples where garnet mass fraction transfer (M/M_T = 0.10-0.53) has low calculated values. The calculated annealing estimates indicate that in some rock samples up to 50 % garnet mass fraction was transferred during the annealing process that lasted after the peak metamorphic conditions were completed. High nucleation rates occur during contact metamorphic conditions, whereas high-grade regional metamorphism is represented by slow rate of nucleation. CSD analyses of garnets lead to differences in average nucleation rate ($No/cm^3/s = 2.9*10^{-8} - 1.0*10^{-7}$) in individual tectonic blocks. These kinetic characteristics of garnet crystallization reflect however the regional metamorphic thermal histories (with heating rate ca. $4*10^{-5}$ °C/yr) for samples that have now the periplutonic tectonic position. The calculated estimation of garnet growth residence times based on garnet CSD may be bracketed within time span of ca. 1000 - 2000 years. The calculated residence time characteristics for particular samples differ no more than in one order of numerical magnitude. The regional recrystallization products are usually subjected to prolonged cooling after thermal culmination and CSD histograms are mostly significantly modified.

The retrograde recrystallization extent, retrograde mineral domains and mass transfer indicate slower cooling during exhumation, probably controlled by erosion, for some samples, but for the others, the tectonically controlled rapid uplift trajectories.

This is related to the different petrological data in individual tectonic blocks and their correspodence to their tectono-metamorphic development. The approximate trajectories thus verify different uplift conditions of individual tectonic blocks during final stages of the Variscan orogen events. Orogenic block transport and tectonic structuring occurred in Variscan era and later during Alpine movements which destroyed and displaced the polymetamorphic Tatric crystalline basement into new structural positions.

The data obtained form the arguments for the Tatricum crystalline basement disturbance and its allochthonity in the Malé Karpaty Mts.

These results strongly stimulate the revision of Variscan metamorphic zonation features in other Western Carpathian geological areas.

SEDIMENTARY ENVIRONMENTS OF THE MIOCENE MOLASSE (CARPATHIAN FOREDEEP, SE POLAND)

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Sedimentological research combined with analysis of well log curves made it possible to conclude that the Carpathian Foredeep basin in SE Poland (Fig.1) was filled, in Badenian and Sarmatian, with deposits typical for different sedimentary environments. Sedimentation began by transgressive depositst of the Baranów beds, formed at the time of relatively slow sea level rise, and a small delivery of clastic material. The sedimentation of the Baranów beds took place within three zones: external shelf zone, internal shelf zone and offshore environments. The deposits of the first zone are 25m of thick, at the latter zone 2.5m thick, and the deposits of the internal shelf zone have the intermediate thickness. In the upper part of the Baranów beds an extended condensed level with glauconite occurs. Above Baranów beds, there are anhydrite deposits ca. 20m thick. Their presence can be related to a sudden relative sea level fall. Above the chemical beds, internal shelf deposits (10-35m) accumulated. These deposits represent a sudden rise of relative sea level.

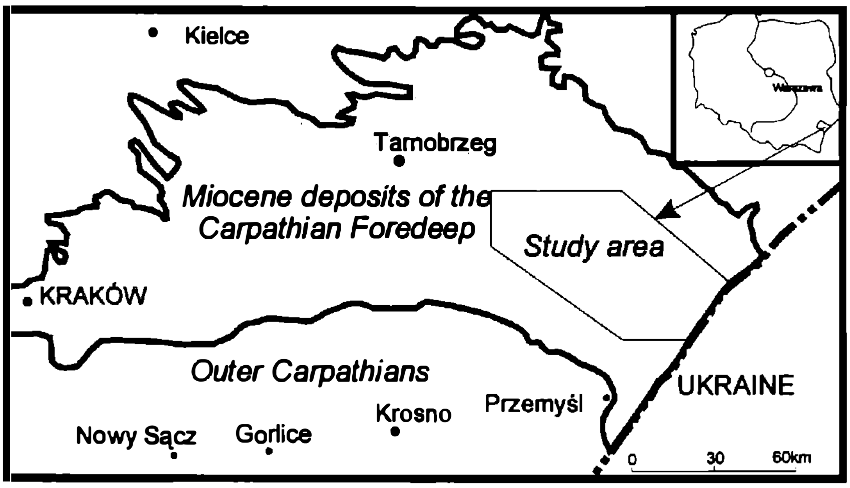

Fig.1

In the SE part of the studied area, there occur extended turbidite distal basin plain deposits (600 -800m thick) formed in conditions of relatively high sea level. Towards the NW and N, they form many onlaps on Upper Badenian deposits. Upwards there is a gradual levelling of the basin bottom. There is no basin plain deposits towards northen and western parts of the studied area. In these parts, the profile consists of several repeated coarsening-upwards sequences. The sequences have different thickness from 20 to over 100 metres. Many features show that they probably represent progradation sequences of the delta front, dominated may be by fluvial processes. Towards the SE, the sequences change into more fine-grained basin deposits and sequences are less solid and their well logs are egg shape. The complete profiles are 600 to almost 1,500 meters thick in the SE part, and they accumulated in the conditions of relative sea level fluctuations with a great volume of delivered clastic material. The uppermost part of Miocene deposits profile is ca. 300 m thick in the NW and about 500 m towards the SE, where it is represented by repeated parasequences. Sediment building the parasequences is typical for bay environment of a tidal flat. Within the whole area, the profile of Miocene products show a tendency of shallowing upwards.

DEPOSITIONAL ENVIRONMENT OF THE SACHRANG FORMATION (LOWER TOARCIUM, NORTHERN CALCAREOUS ALPS).

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The **Sachrang Fm**. is a product of the Toarcian Anoxic Event (TAE) and represents bituminous, finely laminated black shales with a thickness varying from 70 cm to more than 27 m. Due to geological setting and micropalentological content of the rocks under examination, 2 different members can be differentiated: The **Sachrang member** is intercalated in typical grey basinal sediments, therefore sedimentary thickness is highest (more than 27 m) and duration (*exaratum* to *bifrons*-zone) is longest. Microfacies comprises rocks rich in radiolaria. Resedimented intervals are rather common and represented by up to 1 m thick layers of densely packed Intra-Biomicrites, sometimes with low-angel cross-stratification. The **Unken member** is sandwiched between red limestones and represents a marginal facies of the Sachrang Formation. Thickness is max. 3,5 m, the sedimentation is restricted to the *bifrons*- zone. The shales are rich in bivalves and intercalations of resediments (turbidity currents, debris-flows), often exhibiting green colours and an extreme high content of calcareous nannoplancton and foraminifera. Due to the changing of thick (21-72µm) nannofossil-rich layers with thin clay-rich laminae (4-29µm) a seasonal variation in pelagic bioproductivity is documented. A superimposed cyclycity is recorded by the changing of general calcite-rich and -poor layers in the order of cms to dms. They represent intervalls of $5,7 \times 10^3$ to $17,1 \times 10^3$ years and are interpreted as climatically induced, the more calcareous layers representing times of warmer periods with a general higher bioproductivity of the calcareous nannoplancton. Elevated paleoproductivity of the photic zone is corellated with upwelling. The driving mechanism for this szenario is the downflowing of warm saline waters, generated in shallow shelf-seas, that replace the nutrient rich bottom waters. Furthermore at the sediment-water-interface mats built of sulfuroxidizing bacteria (Begotiaceae) existed. Together with the nearly omnipresent foraminifera they document the occurence of free O_2 in the overlying water. Because of the low diversity and density of foraminifera-faunas in the deep basinal sections, O_2 content was mostly low and is thought to represent dysaerobic or exaerobic conditions. Organic, inorganic and isotope geochemical investigations indicate an initial 2-3 fold increase of bioproductivity during a first stage of the TOA, followed by a slightly decrease of productivity.

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TERRANE MAPS OF THE ALPINE HIMALAYAN BELT (IGCP no. 276)

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After a five years period of cooperation within IGCP no. 276 (Paleozoic geodynamic domains and their alpidic evolution in the Tethys; leader: D. PAPANIKOLAOU) drafts of the terrane map of the Alpine-Mediterranean area (F. EBNER, F. NEUBAUER & G. RANTITSCH) and the Himalya (G. FUCHS & A. SINHA) were presented and discussed during the Special Symposium on Tectonostratigraphic Terranes at the XVth CBGA-Congress in Athens 1995. 1998 the maps were printed together with the terrane descriptions in Ann. Geologiques des Pays Helleniques, Vol. 37, Athens 1996. The mediterranean IGCP-terrane maps induced S. KOVACS to initiate a new progam „Maps showing the main evolutionary stages of the Circum-Pannonian Region". In our presentation the terrane maps are presented. Additionally in the lecture some aspects of terrane tectonics of SE-Europe are shortly outlined in the paper.

The tectonic structure of the Alpine belts of SE-Europe is composed of distinct terranes which can be attributed to different, Cadominan, Variscan, Cimmerian, and Alpine orogenic cycles.

1. Cadomian elements representing an old suture zone consisting of magmatic arc and ophiolitic sequences cropping out in a belt from the Eastern Alps to the Balcanides. These sequences were primary positioned along the northern margin of Gondwana.

2. Terranes formed within different tectonic settings were included in the Variscan (Carboniferous) continent-continent collisional orogen during which Gondwana collided with Laurussia. Most of these Paleozoic terranes (tectonostratigraphic units) represent passive continental margins and rift related environments, and subordinately some oceanic and active continental margin settings. The Variscan orogeny was accompanied by the intrusion of huge amounts of late- to post-orogenic granites.

3. The break up of the Variscan crust already began with the initiation of a molasse stage during the Late Carboniferous. In the Permian rifting is accompanied by until now less well known magmatic processes (e.g. in the Alps and Western Carpathians).

4. The Alpine (Mesozoic) cycle is dominated by the independent opening and closure of several oceanic domains. South of the present Pannonian basin two major oceanic domains (Dinaric and Vardar ocean) existed. These domains are interpreted as equivalents to Mirdita/Pindos and Axios oceans of Hellenides. The northern continuation of these oceanic tracts between the Apulian and Moesian microplates is strongly disrupted by Tertiary strike-slip faults. Thus correlation of Early Mesozoic oceans (Transsylvanian, Meliata ocean) in the basement of the Pannonian basin, the Eastern and Western Carpathians, and the Eastern Alps remains a largely controversal topic as well as the Jurassic (Cimmerian) closure of the Meliata-Vardar-Axios oceanic domains. Beside these Tethyan oceanic tracts some other ones (Penninic oceanic basins, Klippen belt, Civcin Severin rift) opened during Jurassic to Cretaceous times in a position much closer to the stable European continent. They split off some continental fragments (terranes) from the passive continental margin of Europe. Real exotic terranes are missing in the Alpine cycle.

5. After thrusting of the Alpine nappe systems (triggered by the subduction of the oceanic tracts) indentation of the Apulian plate into the European lithosphere induced lateral continental escape to the Pannonian realm along major strike-slip zones, generating the last group of disrupted „terranes"

UNESCO GEOPARKS - A NEW INITIATIVE FOR CONSERVATION AND DEVELOPMENT

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UNESCO is promoting a new concept to stimulate the integration, conservation and development of geological heritage. During recent years UNESCO has been confronted with a number of requests, showing the rising need for a global promotion of the geological heritage of the Earth. To serve this demand, the United Nations, Educational, Scientific and Cultural Organization (UNESCO), in co-operation with the International Union of Geological Sciences (IUGS) recently initiated the **Geoparks Programme**. This programme aims to facilitate and promote world wide the preservation and wise management of geological heritage and increase public awareness by attributing a special title as "seal of excellence" to selected geological sites.

Geoparks are defined as sites or areas of geological significance, rarity or beauty, in which geological features play a significant part, and where the geological heritage is protected and developed at the same time. They may also include other assets as for example: archaeological, ecological, historical or cultural values. Geoparks are sites of excellence, serving the conservation of geological heritage and socio-economic development that is culturally and environmentally sustainable. The management body of a Geopark shall take care of the logistic support for environmental education and training, research and monitoring, related to issues of conservation and sustainable development.

Applications for this seal of excellence are adddressed to the National Commission for UNESCO in the Member State concerned, following the procedure and nomination criteria set out by the operational guidelines of the programme. The Commission after consultation with appropriate governmental and other authorities will forward the application to the Geopark Secretariat. Each nomination will be systematically subjected to an evaluation by an independent international board of experts for inclusion in **"UNESCO Geoparks"**

Individual Geoparks remain under the sole jurisdiction of the State in which they are situated. It is in the submitting party's responsibility to ensure the necessary legal instruments for a management policy or plan for the area functioning as a Geopark.

We are all conscious of the need to preserve our geological heritage for present and future generations. A heritage which must become globally recognized and conserved for the sake of tradition, science, education, sustainable development and last but not least for its beauty. The UNESCO Geoparks Programme offers an opportunity to enhance the value of this heritage world wide, motivate and strengthen national capacities and trigger regional economic development on the basis of conservation and protection.

EARLY EOCENE BENTONITES FROM TWO SECTIONS OF THE EASTERN ALPS (AUSTRIA) AND THEIR CORRELATION WITH THE NORTH SEA REGION

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In thc vicinity of the town of Salzburg Paleogene deposits occur in the Northern Calcareous Alps (Untersberg section) as well as in the Rhenodanubian flysch (Anthering section). Around the Paleocene/Eocene- boundary in both sections a short interval with abundant bentonite layers was found. These bentonites occur within nannoplankton zone NP10 (*Tribrachiatus bramlettei*) in the classification of MARTINI 1971 and the vanish just before the first appearance date (FAD) of *Tribrachiatus contortus.*

In thc arca of Salzburg the Anthering formation (EGGER 1995) forms the youngest part of the Rhcnodanubian flysch. Within the Anthering-section turbiditic marls are the dominating rocks which alternate with hemipelagic claystones. The latter prove a depositon of this flysch below of the local CCD. In a 40 m thick part of the section 24 bentonite layers were found which are seen as tuffs of air-fall derivation.The bentonite layers display thicknesses from 2 mm to 3 cm.They are totally converted to smectitic clay. Immobile element concentrations point to a alkali basaltic composition of the original magma. A few of the thicker layers, however, show concentrations typical for highly evolved alkaline ashes. These chemical compositions and the age of the bentonites point to a correlation with bentonites of the North Sea region. According to HEILMANN-CLAUSEN (1997) at Anthering the dinoflagellate cyst *Apectodinium augustum* has its last appearance (LAD) approx. 25m below of the oldest bentonite layer x1. In the North Sea region the LAD of this species is within the "negative" ash series. Therefore the ash-bearing sequence of Anthcring may be synchronous with the upper part of the "negative" ash series and/or the "positive" ash series in the North Sea region. It might be possible that the first and thickest layer (x1) at Anthering is correlative to layer +19 in the North Sea region. According to first results by SCHMITZ (unpubl.) the $d^{13}C$ spike should be within outcrop J of the Anthering section, a few meters above of the FAD of *Rhomboaster cuspis* and approx. 40m below of the first bentonite layer x1.

In the Untcrsberg area usually the Paleogene deposits are formed by marls. Therefore it is remarkable that at the basc of the studied section 1.5m of red claystone occur.This claystone might represent the time of the bcnthic extinction event (BEE) within the nannoplankton-zone NP9 and therefore should be correlative to outcrop J at Anthering. At the top of the claystone 0.5m of clayey marls form a transition zone to nonturbiditic marls which are dominating the rest of the section. In the clayey marls coccoliths are rare (10% or less) and the nannoplankton assemblages mainly consist of *Rhomboaster cuspis* (up to 49%), *Discoaster multiradiatus* (up to 35%) and *Discoaster falcatus* (up to 17%). This composition of the strongly corroded nannoplankton assemblages is interpreted as an effect of carbonate solution which led to an secondary cnrichment of species less prone to dissolution. Approx. 25m above of the top of the basal claystone the first bcntonites appear. Within 5m of marls 15 bentonite layers were observed. These layers display the same immobile element concentrations as the coeval layers at Anthering. So there is little doubt that the bentonites of both sections belong to the same eruptive volcanic events.

THE 300-KM-LONG INNSBRUCK-SALZBURG-AMSTETTEN (ISAM) FAULT SYSTEM: A MAJOR DISPLACEMENT LINE IN THE NORTHERN EASTERN ALPS

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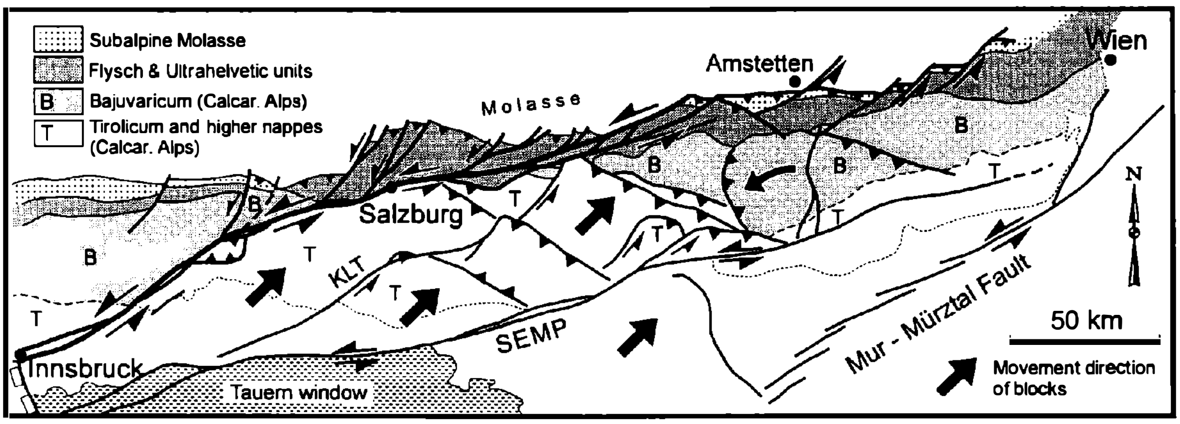
Detailed mapping and microtectonic surveys allow to trace a large scale shear zone in the northern Eastern Alps between Innsbruck and Amstetten (Lower Austria). This 300-km-long fault system is the eastward continuation of the well known Inntal fault and crosses the Northern Calcareous Alps (NCA), the Flysch zone, the Ultrahelvetic units and finally the Molasse zone. The ISAM-fault accommodated eastward movements during Oligo-Miocene lateral extrusion. Minimum cumulative sinistral offset in the Flysch and Molasse zone is 48 km.

The NE-striking ISAM-fault is kinematically linked with the N-S trending Brenner normal fault which merge together near Innsbruck. Normal displacement of the Brenner line during unroofing of the Tauern window was transferred to sinistral strike-slip faulting along the western segment of the ISAM-fault which follows the Inn valley east of Innsbruck. North of Kufstein the fault system bends 20° from a NE- to ENE-direction heading towards the city of Salzburg. North of the bend zone an array of NNE-trending sinistral faults branches off from the main system. East of the bend zone, the fault separates the Tirolic and Bajuvaric nappe system of the NCA. Near Salzburg, the fault reaches the northern margin of the NCA and follows the floor thrust of the NCA before entering the Flysch units. Deformation there is partitioned into sinistral faulting on ENE-trending strike-slip faults and NE-directed thrusting. A large part of the disappearance of the Bajuvaric nappe system can be attributed to oblique sinistral movement along the ISAM-fault which offsets the thrust boundary between the two nappe systems. The continuation of the fault system in the Flysch zone is locally covered by NE-directed out-of-sequence reactivations of the floor thrust of the NCA. Several off-branching splay faults offset the Flysch floor thrust onto the Molasse. Finally, the main fault segment offsets the Flysch/Molasse boundary SW of Steyr for at least 20 km. A part of the sinistral offset is accommodated by high-angle reverse faulting along older NW-SE striking faults in the NCA. East of Steyr, the sinistral ISAM-strike-slip fault merges into the thrusts of the subalpine Molasse causing NNE-directed movements.



SOURCE FOR FORMATION OF TERRIGENOUS SEDIMENTS IN THE SOUTH-EAST CRIMEA

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There are (from south to the north) the Planerska, Vidnenska, Juravnenska, and Tambovska areas in the southeast part of the Crimea peninsula. Some decides ago in these areas some respected holes were drilled for oil and gas. The holes found light inflow gas but the bed of terrigenous sediments was discovered under the Jurassic limestons in the Tambovska area and under clayey sediments in Planerska area. This bed in the Planerska area has the thickness from 300 to 500m. The loosely coupled clastic material presents the terrigenous sediments that is polymictic. There are the predominance of quartz, glass, limestone, tuffs and volcanic rocks clasts. Usually the clasts were not balling or well balling. In this layer the tuffites occur.

Both clasts of volcanic rocks and tuffs have the similar composition to volcanic rocks (pillow-lava of keratophyre; and spilite, andesite, andesite-basalt) and tuffaceous sediments of Karadag explosive volcanic massive that is located to the south direction from the Planerska area, on coast of the Black Sea. Also clasts of the jaspereal rocks were found. They cement the pillow in lava of Karadag keratophyre.

Clasts are cemented by siliceous dejection. The cement fills pores between clasts. Sometimes there is carbonatization of cement that as result of the recrystallization of limestons clasts. Chlorite, mica, and carbonates replace plagioclase and Fe-Mg minerals. The cement and the high-bedded clay have the similar composition. They were formed in the way of a sedimentation of volcanic ashes. The gradation observes between these terrigenous sediments and clay: the layer of frustulent sediments - the clay with interbeds of aleurolites, sandstons and conglomerates – clay. These clay and cement were subjected to carbonatization, chloritization and hydrousmicatization. Therefore the ashes clay is replaced by normal hydrousmicaceous clay.

Under the conglomerates layer the clay with interbeds of quartz aleurolites rest. The clastic material is sorted fine. These clay and aleurolites have the delta bedding.

The sediments in the Vidnenska and Juravnenska areas are mainly presented by limestons.

The above-described facts allow us to determine the conditions of the formation of these terrigenous sediments approximately. The formation of underlying sediments happened in complicated delta conditions. Then there was a lifting of the territory and volcanic eruptions in the south (the Karadag region). The eruptions, apparently, happened very heavily that has served to formation of the above-described layer of terrigenous material. Obviously, that the eruptions happened simultaneously with mountains formation. The presence of a numerous clasts of limestouns testifies to it. The volcanism ceased a gradually.

FORMATION OF SILVER ORES IN SULPHIDE BODIES OF THE BEREGOVO ORES FIELD (TRANSCARPATHIAN, UKRAINA)

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The Beregovo ores field is located in the Intercarpathian volcanic belt. In this field there are the Beregovo gold-base metal, Kuklanske gold-base metal, Muzievo gold-silver-base metal and Kvasovo silver deposits. The deposits are typical epithermal. The formation of the ores field is connected with the Miocene ryolite volcanism. The structure of the ores field is defined by position of the Beregovo explosive caldera. Ores bodies are found in clayey sediments, which were deposited on the Mesozoic basement. Some types of the ores bodies: veins, stockworks, veinlets and disseminated ores are divided there.

Silver ores are distributed both in sulphide ores and in quartz-barite bodies. Both types of the ores are sometimes observed together, however periods of their formation are different. Sulphide ores (pyrite, sphalerite and galena prevail) contain about 80% of the total volume of silver. The silver mineralization is presented as small shots of Ag-Sb sulfosalts (polybasite and pyrargyrite) and as native silver sometimes. Ones are mainly concentrated in galena. These minerals were formed during the completion of formation of the galena-sphalerite assemblage. Akantite, polybasite, mackinstryite, jalpaite and native silver were determined in quartz-barite ores. Also a little of silver is contained in Ag-bearing tetrahedrite (freibergite), Ag-Cu-Bi sulfosalts and electrum which have formed after the primary sulphide ores.

Formation of polybasite and pyrargyrite in sulphide ores was caused by the presence of the Pb-Sb sulfosalts mineralization and it was defined by primary permeability of the sulphide aggregates for thermal water solutions. Before formation of silver ores in sulphide aggregates there were dissolution of the sulphide minerals and replacement of this one by quartz. Thereat anglesite and cerussite were replacing galena. These processes have led to the destruction of the rich silver ores in the Beregovo ores field.

By the first of the Ag-containing minerals the emulsion shots of native silver was precipitated to natural faces of growing galena grains. Pyrargyrite and polybasite were formed in the way of replacement of boulangerite grains during Ag saturation of galena matrix. At the first stages this replacement was along the border of galena grains. Sb sulfosalts were crystallised as the sequence range of formation (from the early to the later): boulangerite bournonite pyrargyrite polybasite. We have discovered the Pb-Sb sulfosalts assemblage in the base metal ores for the first time. In the ores a common mineral is boulangerite that is often observed in galena as "chains" of small shots. Boulangerite was crystallised with galena simultaneously. Native silver became overgrown with boulangerite sometimes. Boulangerite was crystallised with galena simultaneously. The Pb-Sb mineralization was the major source of Sb for the formation of all the later Sb-sulfosalts. Ag-Sb sulfosalts are often observed as thorough pseudomorphoses of boulangerite and bournonite grains in the places of distribution of the Pb-Sb sulfosalts. Pyrargyrite grains are observed sparsely in other places of the Beregovo ores field. Polybasite is more distributed, but independent mineralization of this one occurs as separate local groups of grains which were subjected to selective recrystallization.

GALENA SEMICONDUCTING PROPERTIES OF THE MUZIEVO GOLD-SILVER-BASE METAL EPITHERMAL DEPOSIT (TRANSCARPATHIAN, UKRAINE)

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The Muzievo gold-silver-base metal deposit is located at the southeast of the Beregovo Neogene explosive caldera in the Intercarpathian volcanic belt. Galena was crystallised during formation of the pyrite-sphalerite-galena assemblage of base metal ores. It is the main carrier of Ag in these ores. Early generation of galena contained silver in solid solution. Ag was leaving galena during the formation of silver-containing sulfosalts (pyrargyrite and polybasite) in this one. As result of this process there were the recrystallization of galena grains with the disappearance of the growth zonation in the galena crystals and the grade decrease of thermoelectric power (Zeebeck coefficient α_n is in range from **-180...-450** μ**V/°C**) (Fig.1).

The last stages of the mineral formation caused the replacement of the sulphide ores by the quartz-barite aggregates. During this process the intensive dissolution and oxidation of galena (it is the reason of the anglesite formation) were accompanied by its recrystallization in the periphery zones of the quartz veins. Ag was taken out or, partially, it diffused into the galena and has created the solid solutions there. In consequence of it the semiconducting properties of galena was shifted. Usually p-conductivity are determined along grains boundary, cracks and holes in the galena compact aggregates (range of Zeebeck coefficient α_p is from **+140...+320** μ**V/°C**). The direct dependence between Ag content in galena and its thermoelectric power, α_p and α_n factors, (Fig.1) was determined. The lack between these decreasing and increasing trends may be testify concerning the different periods of the galena alterations during the formations of Ag-base metals ores.

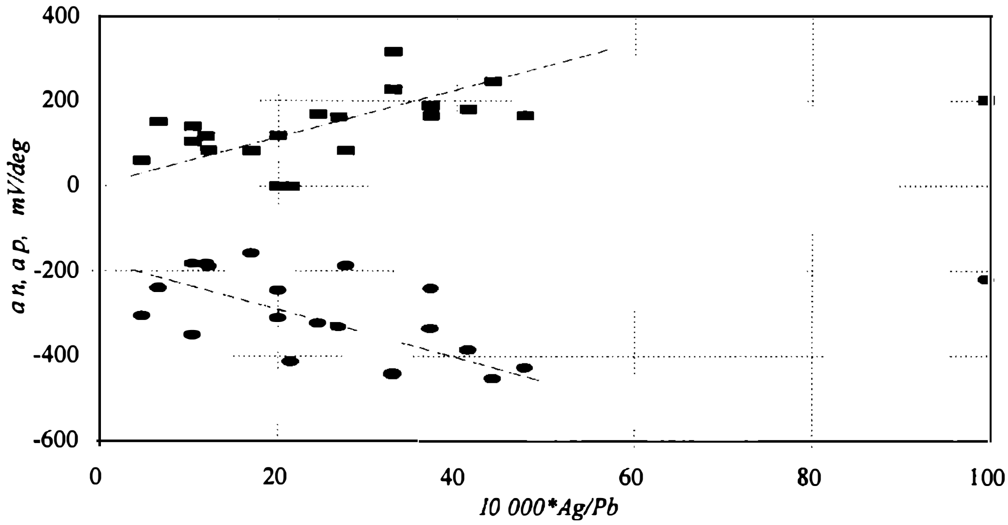

Fig.1. Correlation between the thermoelectric power, α_n ((sum $\alpha_n^{(n)}$)/n) and α_p ((sum $\alpha_p^{(n)}$)/n), and Ag/Pb for ores of the Muzievo deposit.

CONTRIBUTIONS TO THE HYDROGEOLOGY OF THE PLIOCENE-QUATERNARY FORMATIONS ALONG THE ROMANIAN-BULGARIAN BOUNDARY

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The knowledge of the vertical movements of the major uplifts and depressions,of the continuously changing deposition environment during Dacian-Middle Romanian time and of the development of the Danube Formations (in the Upper Romanian-Holocene interval) is of importance for the understanding of the groundwater's flow pattern etc.

For the south-western part of Moesian Platform,the existence of the south to north plunging:Vanju Mare-Prunisor depression,the Vidin-Strehaia uplift,the Lom-Filiasi depression,the Kozlodui-Zaval-Grecesti uplift etc. and its differential vertical movements are the main factors for the defining of the Pliocene-Quaternary hydrogeological basin.

After the interruption of the link between the Pannonian and Dacic Basins,the development of the radial convergent hydrographic network on the eastern slope of the Transdanubian Carpathians and the existence of the emerged sector of the Vidin-Strehaia uplift,favoured,during the Dacian,in the first western depression (Vanju Mare-Prunisor),the rapid refreshing and the extending of the river-dominated delta plain (the Berbesti Formation-ca 300 m thick parasequences with pebbles,sands,clays,coals).

To the east,in next N-S depression (Lom-Filiasi),during Early Dacian,an important south-north stream built up a great delta (ca 15o m thick sandy sheets having confined waters belonging to bicarbonate-chloride and bicarbonate-natrium types).Then,during the Upper Dacian-Middle Romanian interval,the upper delta plain and the alluvial floodplain environment phases followed,the last having south-north mixed load rivers (the actual semiconfined aquifers with bicarbonate-sulphate magnesium calcium and bicarbonate natrium waters types).

During the Upper Romanian-Lower Pleistocene,the Alluvial Fan of the Danube Formation was built up:up to 5-20 m unsorted gravels and sands (extending at ca 250 m above sea level,on the southern edge of the Getic Plateau).To the south of Getic Plateau,during the Middle Pleistocene-Holocene time,the Danube eroded in different measure the Pliocene-Lower Pleistocene formations and built up the system of the five terraces and its meadow.

For the Danube Valley,our researches allowed the delimitation of the deep formations and the estimation of the hydraulic relationships of those with phreatic aquifers (i.e.the Berbesti Formation has a radiate convergent character,the equipotential line being ordered concentrically around a hydrogeological window situated in the lower left terrace of the Danube, in the Romania country).

THE TEMPERATURE AND BURIAL HISTORY OF THE PANNONIAN BASIN - NUMERICAL SIMULATION STUDIES AND KEROGEN MATURITY IN THE DRMNO AND MARKOVAC DEPRESSIONS (SERBIA)

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Computer-aided simulation techniques have become a powerful tool in petroleum geology during the last decades. The basic concept of basin modelling is to quantify the complex dynamic processes in a given sedimentary basin. Geological-geochemical models have been developed to simulate the subsidence, thermal and maturation history, in order to determine position of the oil generation zone through time and calculate quantities of generated, expelled and migrated hydrocarbons in the Drmno and Markovac depressions in the SE part of the Pannonian basin (Serbia; Yugoslavia). Stratigraphic, lithofacial, structural, thermal and geochemical data[1] were used for the modelling of burial and thermal history of Neogene sediments in this area. The analyses included lithostratigraphic units located at depths of 5000 meters. The basic procedure included the evaluation of the present-day thermal regime, porosity study, backstripping models, calculation of the Time-temperature Indices (TTI) and Easy %Rr, measuring of vitrinite reflectance and the use of PDI-1D software [2,3]

The results of the microscopic study of present-day thermal maturity shows that the organic substance in the drilled sequence of Tertiary sediments in the Drmno and Markovac depressions is in the phase of late diagenesis and early catagenesis. Based on numerical modelling it could be shown that in general the source layers of the studied depressions have reached an initial stage of hydrocarbon generation. A significant generative potential for oil only was calculated for Pre-Badenian sediments, generally in depths bellow 2200 metres (central parts of the depressions). A considerable gas potential, however could not be modelled. Based on the constructed models, oil generation in the Drmno and Markovac depressions started about 16-17 Mabp, during late Karpatian and early Badenian. The peak of hydrocarbon generation in both depressions is reached today. This can easily be understood when regarding the thermal and subsidence history of the SE part of the Pannonian Basin with a recent maximum burial and strongly elevated present day heat flows of 90-110 mW/m².

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HIGH GRADE METAMORPHIC ROCKS OF TEKIJA (EASTERN SERBIA)

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Tekija area is the part of the Carpatho-Balkanides. It is situated near Kladovo in Eastern Serbia. The Proterozoic crystalline complex of Tekija is built mainly of gneisses and mica schists. Quartzites, amphibolites, amphibole schists, granite-gneisses and granites are much less common. This complex is connected with the Gethian nappe, which, like the belt 40 km long and 3-8 km wide, spreads from Tekija to the south. During the Laramian phase this complex of rocks was overthrusted upon autochthonous Palaeozoic rocks, Hercynian granites, Jurassic and Cretaceous sediments and volcanic rocks. In the east and northeast of Tekija, in its wider area, two dominant groups of rocks can be distinguished. They are gneisses and mica schists.

Gneisses are gray to dark gray rocks. Their structure is massive or schistose, and texture from granoblastic to lepidoblastic, grading to porphyroblastic. They are made of quartz (35-50%), feldspars (25-40%) (plagioclase, orthoclase and/or microcline), micas (10-30%) (biotite and/or muscovite), ± epidote and very rarely hornblende. Garnets, sometimes kyanite and staurolite, occur as porphyroblasts. Accessory minerals are titanite, leucoxene, zircon, apatite, tourmaline and metallic minerals, and secondary are sericite, chlorite, quartz and calcite.

Mica schists are markedly schistose, brownish gray rocks. Texture is porphyroblastic, with elements of granoblastic and lepidoblastic. They have porphyroblasts of garnets, kyanite and staurolite large form less than 1mm up to 7mm, rarely larger. Mica schists of Tekija are coarse-grained rocks with well developed foliation. The sheets of micas are often bended around the porphyroblasts. They are made of quartz (20-40%), plagioclase (5-15%), muscovite (15-20%), biotite - chlorite (10-15%), garnet - almandine-spessartine composition with a small amount of pyrope and grosular (5-25%), kyanite (2-5%), staurolite (0-3%) and accessory minerals - tourmaline, sphene, apatite, zircon, rutile and metallic minerals (1.5-3%).

Mica schists of Tekija are sometimes strongly altered. The alterations are (a) intensive or partial chloritization of biotite sheets; (b) partial, rarely complete sericitization of porphyroblast of staurolite and kyanite; (c) seldom and slight chloritization of garnets (on the rims as well as in the central parts of the grains; (d) post-kinematic growth of the large sheets of chlorite, biotite and muscovite without disturbing the foliation and (e) post-kinematic growth of the small sheets of muscovite at the right or some other angle to the foliation.

On the basis of mineral composition and relationship between minerals, it can be concluded that these rocks have been metamorphosed under the conditions of amphibolite facies. Relationships between minerals indicate synkinematic growth of crystals, but in several phases of regional metamorphism. Presumed temperature of metamorphism was about 580 - 630°C, and pressure from 3.4 to 5.8 kbar.

Correlation of metamorphic P-T conditions between basement rocks in the Austro-Alpine units east from the Tauern Window and in the eastern sector of the Western Carpathians

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To compare Pre-Alpine metamorphic evolution, metabasites from the Middle Austro-Alpine units in the Eastern Alps (Mugel area, Seckauer Tauern, Rottenmann Tauern, Wölzer Tauern, Seetaler Alpen) and from basement complexes in eastern Slovakia (Branisko, Cierna Hora, Zemplinicum and Gemericum) were selected for petrological investigation. Some of these metabasites are lithologically correlated with leptinite-amphibolite complexes in Variscan units of the Western Europe and they partly associate with ultramafic rocks. Metamorphosed mafic rocks form Hochgrößen in the Rottenmann Tauern are represented by amphibolized eclogites and amphibolites. The peak pressure and temperature minerals in eclogite are omphacite with maximum jadeite content of 40 mol %, garnet and edenitic amphibole. Results of garnet-clinopyroxene thermometry indicated average temperature of 700 °C for eclogite facies metamorphism. Minimum pressure of 1.5 GPa is given by jadeite content in clinopyroxene. Equilibrium reactions of end-member amphibole, garnet and clinopyroxene gave pressures of about 1.8 GPa. Retrograde phases in the eclogites are symplectites of diopsidic clinopyroxene, pargasite and albite. P-T conditions for symplectite formation were estimated around 1.0 GPa and 500 °C. Metabasites from the Mugel area, Seckauer Tauern and Wölzer Tauern are amphibolites that besides amphibole and plagioclase may contain also garnet. Amphibole-garnet-plagioclase-quartz thermobarometry indicate 0.8 - 1.0 at 580-630 °C for these rocks. Metabasites from the Seetaler Alpen are characterized by the presence of garnet, amphibole and clinopyroxene-amphibole-albite symplectites. The clinopyroxene is rich in diopside with a maximum of 15 mol % jadeite content. Amphibole-garnet-plagioclase thermobarometry gave pressure of 1.0-1.5 GPa at 600-700 °C for these rocks.

Relatively low-pressure, but close to that from Seckauer and Wölzer Tauern are inferred for amphibolites in the eastern part of the Western Carpathians. Garnet-amphibole-plagioclase thermobaromtery, used for amphibolites from gneiss-amphibolite complex in the Gemericum, Branisko and for upper tectonic units in the Cierna Hora, indicated pressures of 0.6-1.0 GPa at 600 - 700 °C. Pressure of 0.6-8.5 GPa at 600-700 oC were obtained for amphibolites in the Zemplinicum. Metamorphic structures and mineral zonation indicate mostly a retrograde P-T path for all investigated metamorphic complexes in the Western Carpathians.

Alpine metamorphic assemblage were studied in granitoid rocks from the Grobogneis Complex (Lower Austroalpine unit) in the Eastern Alps and from Gemericum in the Western Carpathians. Metamorphic minerals in the Grobogneis Complex rocks are garnet, phengite, albite, biotite and amphibole. As newly formed minerals, the Gemericum granites contain phengite, albite, chlorite and rarely garnet. In both cases phengite has relatively high-Si content of 3.3 a./f.u. Metamorphic pressure inferred for Alpine overprint are 0.9 - 1.0 GPa at 450-500 °C in the Grobogneis complex and 0.5-0.7 GPa at 300-350 °C in the Gemericum.

The preliminary results from this investigation indicate similar tectonometamorphic evolution in the Eastern Alps and Western Carpathians during Variscan time. Although the age of the Hochgrößen eclogites is not known, the present position of these rocks indicate pre-Alpine high-pressure metamorphism. In this case subduction of the Plankogel oceanic basin and subsequent collision of the European plate should be responsible for this event. Some evidences of Variscan northvergent subduction in the Western Carpathians units can be found in the northern sector of the Gemericum. Comparing the Alpine metamorphic assemblages a continuation of medium- to high-pressure metamorphism can be assumed from the Grobogneis Complex through the Sopron massive in the Eastern Alps, Southern Veporicum to Gemericum in the Western Carpathians.

Heavy mineral-based provenance studies in the Palaeogene flysch successions of the Pelagonian zone s. l. (Hellenides, Greece)

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The heavy mineral content of the Palaeogene flysch sediments of the Pelagonian zone s. l. was investigated in the Othrys Mountains; Pelion peninsula; on the islands of Evia and Skopelos; at several sites of the Argolis peninsula and on the island of Poros. The flysch successions of the Pelagonian zone, in general ranging stratigraphically from the Upper Maastrichtian to the Eocene, rest above the Mesoautochthon carbonate succession, mainly of Late Creataceous age. In some places, the flysch sediments developed transitionally from Maastrichtian-Paleocene pelagic limestones; in other places sedimentation commenced unconformably above reworked shallow-water carbonates of the Mesoautochthon cover. The onset of flysch facies, in general, youngs from the east towards the west.

Most of the flysch successions are characterized by highly stable heavy mineral assemblages consisting of zircon, tourmaline, rutile and apatite. With only few exceptions, chrome spinel, as well as garnet, are relatively rare components. The sandstones show an immature petrographic composition, especially rich in feldspar, so that the stable heavy mineral composition cannot be explained by intensive reworking processes or by interstratal solution. Therefore, these heavy minerals mirror the predominantly granitoid composition of the source terrain, with relatively few garnet-bearing rock complexes and ophiolite bodies. In only two regions is the heavy mineral composition of the flysch sediments in contrast to the predominant assemblages: (1) in the western part of the Othrys Mountains, near Domokos, and (2) near Lighourion (Argolis). These successions are characterized by very high garnet contents, accompanied by only low percentages of stable minerals and chrome spinel. In the western Othrys, additionally, blue amphiboles occur frequently, this has not been observed at other sites. This assemblage points to a source area which consisted of large complexes of mica schists and blueschists, whilst granitoid and ultramafic rocks played a subordinate role.

The Palaeogene flysch basin of the Pelagonian realm was supplied from two different provenance terrains. The garnet-rich sediment infill seems to be restricted to western parts of the basin. The main source, characterized by the stable mineral assemblages, had presumably an internal position. Ophiolite complexes, in both sources, were only exposed to a minor extent. Sporadically higher percentages of chrome spinel were only found together with the stable associations. An outstanding chrome spinel content has been observed in the formation underlying the flysch sediments on the island of Poros.

The major part of the Pelagonian flysch sediments supplied from granitoid sources can clearly be distinguished from terminal flysch successions of the External Hellenides, where sediments with such high contents of stable minerals are unkwon.

PREDICTION OF GROUNDWATER CHARACTERISTICS - METHODS AND APPLICATIONS

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Groundwater characteristics from the quantitative point of view are mainly divided into the groundwater level values (depth of the groundwater table under the surface or under the measuring point, high of groundwater level above the see level), spring yield values and groundwater runoff values. All of them can be characterized by statistical characteristics, which are more or less representative depending on many factors.

The aim of groundwater characteristics gaining is not only to describe them, but also find the pattern of their fluctuation in various time intervals and at last to predict their development in the near or far future. This step should be the final and the most important part of groundwater resources assessment, but often it is the most difficult part of it.

Groundwater is an important natural renewable resource, which is in Slovakia used for drinking water supply for more than 78 % of inhabitants. The importance of gaining representative prediction of any groundwater characteristics increases with ever increasing need of water and with affecting of natural groundwater regime by human activities.

Two groups of problems should be assessed during preparation of task solving: input data quality and forecasting method selection.

The following problems connected with the input data are most often taken into account:

- availability of data,
- the length of the time series,
- observation time step,
- technical quality of measurements,
- statistical quality of data,
- selection of representative data from the point of view of investigation aim,
- anthropogeneous interference with the environment.

All these specific features of the input data can influence their suitability for using in the selected method of groundwater characteristics forecasting.

The selection of prediction method is closely related to the aim of prediction. Following groups of prediction methods were assessed:

- probability methods, based on construction of a theoretical probability distribution curve. The disadvantage of such prediction is that the time of predicted value occurrence can not be exactly determined.
  methods of analytical expression of the interrelationship among groundwater characteristics and regime influencing factors, based mainly on by regression and correlation methods. These methods enable quite simple time fixed prediction which representativeness depends mainly on number of assessed values.
  methods of analysis and extrapolation of groundwater characteristics time series, represented by trend analyses, recession curves analyses, Box-Jenkins models, exponential smoothing and other methods. Depending on the selected method the seasonal fluctuation and trend (if exist) can be taken into account.

Concrete presentation on practical examples enables to show very clearly the advantages and disadvantages of single selected methods for prediction of groundwater characteristics.

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FACIAL DEVELOPMENT OF UPPER PERMIAN GYMNOCODIACEAN LIMESTONES OF CHIOS ISLAND (AEGEAN SEA, GREECE)

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The uppermost part of the "Nappe Unit" in the northeastern part of Chios contains Gymnocodiacean limestones, belonging to the *Neoschwagerina*-zone, are well exposed in the Marmaro Bay area.

At the cliff of eastern Mamaro Bay five lithostratigraphic units can be distinguished:

1. *Multithecopora* thickets
2. "Lower marl" horizon
3. Richthofeniid-Microbial-Sponge Buildup
4. "Upper marl" horizon
5. Gymnocodiacean meadows

The up to 30 m thick unit 5 will be discussed in detail. This unit starts with regulary bedded limestones containing numerous oncoids followed by horizons with scaphopodes and *Skolithos* ichnofossils and alternate with marl intercalations rich in foraminifera of *Glomospira* type. The limestones contain abundant miliolid foraminifera, whereas fusulinids are very rare.

The most striking fossils in the middle part of the sequence are large mollusks and bellerophontids. The uppermost part is dominated by Gymnocodiaceans.

Unit 5 represents a low energy lagoonal to coastal environment. The last one is indicacted by thin bedded calcrete intercalations.

LATE VARISCAN EVOLUTION OF THE JADAR AND BÜKKIUM TERRANES: A COMPARISON

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Comparison of Late Variscan evolution of the Jadar and Bükkium Terranes, showing close relationship, presently located on opposite margins of the Pannonian region due to strike-slip dispersion, is presented.

JADAR TERRANE - Variscan flysch was deposited in Jadar trough (*Vlašić Fm*) and in the same time on the Ub intrabasinal rise pelagic limestones of *Družetić Fm* were formed. The flysch development finished in Lower Bashkirian when in this arcas stopped marine sedimentation. New cycle started with deposition of molasses in Podolskian, in the lower part with products of gravity sliding (*Ivovik Fm*; siltstones with brachiopods, intercalated by limestones). Over it fusulinid limestone of Myachkovskian-Asselian age can be found (*Kriva reka Fm*).

Likodra Nappe consists of carbonate-terrigenous beds of Bashkirian and Vereian age (*Djulim Fm*, *Rudine Fm* and *Stolice Fm*) which gradually pass from Culm Flysch. Probably its emplacement took place before the Middle Permian transgression.

In Permian three formations were developed: *Middle Permian Clastics Fm*, which in lower parts is built of white and yellow quartz sandstones of marine origin (fragments of crinoids) with lenses of *Bobova breccias* (equivalents of Tarvisio breccias, Carnic Alps) and in upper part is built of purple or greenish coloured shales and siltstones (rarely sandstones) with appearance of gypsum and magnesite; *Dolovo Fm*, made of dolomite with intercalations of shales and siltstones beds and presence of rauhwackes, and very thick *Bituminous Limestones Fm* of Upper Permian age, dark gray to black coloured with abundant macro- and microfauna. Limestones of Upper Permian age are in continuity with Lower Triassic ooidal limestones with scarce foraminifers.

BÜKKIUM TERRANE - Variscan Flysch (*Szendrő Fm*) in the **Szendrő Unit** follows Visean to lowermost Bashkirian shallow water and basinal carbonates and partly interfinger with them. Contemporaneous basinal carbonate-shale formation of the **Uppony Unit** (*Lázbérc Fm*) reflect calm conditions without turbiditic activity. Post-flysch sediments are unknown. In the **Bükk Unit** the Variscan pre-flysch sediments are unknown. The flysch (*Szilvásvárad Fm*) is overlain by fossiliferous limestone - siliciclastic succession of the Auernig-type *Mályinka Fm* of Podolskian-Gzhelian age and representing the late Variscan molasse stage. There is no evidence for a deformational or metamorphic event between these two formations.

Lower Permian formations (equivalents of Rattendorf and Trogkofel groups) in Bükk Unit are not known, probably due to local uplift. The *Szentlélek Formation*, assigned to the Middle Permian, represents the beginning of the Alpine sedimentary cycle. It begins with coastal plain deposits: white sandstones with a limestone breccia horizon at the base, then brown-red sandstones – siltstones. The upper part is formed by sabkha deposits: green and purple shales – siltstones, anhydrite – gypsum and grey dolomites. The Upper Permian *Nagyvisnyó Limestone Fm* reflects shallow marine, ramp conditions, with dark grey dolomites at its lower part, followed by black, fossiliferous limestone ("Bellerophonkalk"). Black, silty-marly intercalations between its thick beds indicate cyclic siliciclastic input. The Permian-Triassic boundary, recognizable as *"boundary clay" event* in some sections, is followed by lowermost Triassic ooidal limestones.

The **conclusions** are as follows: 1. Pre-Podolskian hiatus preeceding the shallow marine molasse-type sedimentation is proven in Jadar terrane and could be possible in the Bükkium Terrane (*Kriva reka Fm* and *Mályinka Fm* are marine molasses of Auernig-type); unconformity between molasse and flysch formation, caused by Variscan orogenesis, is not established; 2. In the Early Permian probably an uplift took place in both terranes; 3. Similar lithologies of transgressive clastic–evaporitic formations of Middle Permian age; at the base in both terranes carbonate breccia horizons occur (probably equivalent of the Tarvisio breccia); 4. Both terranes show almost identical Middle-Upper Permian evolution and continuity in Lower Triassic, and 5. The Jadar and Bükkium terranes show much more similar evolution for the investigated period than to any other unit in the Circum-Pannonian region, what means that their present distant position (the Bükkium being entirely exotic in its present setting) is only the result of later dislocations, mainly of Tertiary strike-slipe dispersion.

PALEOECOLOGY OF RICHTHOFENIID BRACHIOPODS FROM CHIOS (GREECE)

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The Marmaro Bay section in the northeastern part of Chios Island (Greece), belonging to the *Neoschwagerina* zone, exposes a reef-like mass occurrence of Richthofeniid brachiopods (*Richthofenia* cf. *lawrenciana* (DE KONINCK), BESENECKER et al. 1968). The lowermost part of the section consists of thin-bedded dark shallow water limestones containing predominantly smaller foraminifera such as *Calcitornella* sp., *Climacammina* sp., *Cribrogenerina* sp., *Deckerella* sp., *Kamurana* sp., *Pachyphloia* sp. etc., abundant encrusters such as *Tubiphytes*, dasycladaceans and gymnocodiaceans as well as bryozoans, echinoderms, brachiopods and coral biostroms (*Multithecopora* sp.). Richthofeniids are rare and concentrated in intercalated lenses of massive limestones. Upsection their number increases significantly as one approaches a ca. 1 m thick marl bed. Above the marl bed follow up to 10 m thick massive reef limestones. The lowermost part of this reef contains an apparently monospecific association of abundant and densely packed Richthofeniids. Towards the top a gradual change in the organismic content leads to the formation of a microbial-sponge reef which is terminated by a second marl horizon (FLAJS et al. 1996). The excellent preservation of the Richthofeniids (in most cases with preserved dorsal valves; clusters of several individuals linked by connecting spines) as well as the the carbonate microfacies exclude transportation. We interprete the flat-lying clusters of individuals in hinge side-down position to be in living position. The clustering of the orientation of the specimens towards NW may indicate that their growth orientation was controlled by weak bottom currents as proposed e. g. for *Calceola* in the model of RICHTER 1929. These observations as well as the lightweight construction of the ventral valve, its ultrastructure and the high position of the center of gravity contradict in our opinion the „flapping valve model" of RUDWICK 1961. For these reasons we interprete the Chios Richthofeniids as recliners in a low energy and soft bottom environment. Their concentration just below, within and just above the marl horizon may indicate a r-strategic mode of life during special environmental conditions induced by a short term sea level fall.

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LATE MESOZOIC AND EARLY PALEOGENE TECTONICS OF THE TRANSDANUBIAN RANGE

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The Transdanubian Range is the southernmost part of the Tertiary Alcapa block. Its Mesozoic structural evolution and particularly its structural relation to West Carpathian units is controversial. This presentation will give a review of the structural evolution of the area in the light of new paleostress and other published structural data.

The Transdanubian Range unit is bounded by the Cretaceous Rába line to the west, by the Diósjenő-Hurbanovo line to the north, by the Tertiary Balaton-line to the south, while the eastern boundary toward the Bükk unit is questionable. It consists of three main geographic parts, these are from SW to NE the Bakony-Vértes-Balaton highland, the Gerecse, and the Buda-Pilis-Csővár hills. The strike of Permian-Lower Cretaceous formations and pre-Tertiary structures show a gradual change from NE-SW (Bakony) through E-W (Gerecse) to NW-SE (Buda-Pilis). This change was traditionally interpreted as a bending of the NE segment from an originally homogenous, NE-SW strike (Balla and Dudko, 1989). This model would imply a 90° CW rotation of the Buda segment with respect to the Bakony. New paleomagnetic data (Márton, in prep.) contradict to this theory and demonstrate that the different strikes are original features. New structural models (e.g., Tari, 1994) and paleostress data (Bada et al., 1996) show that the three sub-areas had different structural evolution.

The study area suffered a Middle Triassic rifting which was followed by passive margin subsidence during the Late Triassic. Early Jurassic renewed rifting resulted in differentiated paleotopography (Galácz and Vörös, 1972). Sinemurian to Pliensbachian neptunian dikes and synsedimentary faults suggest a NE-SW to NNE-SSW tension during this rifting.

Few Malmian neptunian dikes indicate a N-S contraction and E-W tension in the Gerecse. The change in stress field can be placed to the Callovian or Oxfordian and can be probably connected to the closure of the Meliata ocean to the north. The load of the obducted oceanic crust (Meliata? or Szarvaskő?) led to the formation of a flexural basin (Tari, 1994) beginning with the Berriasian. This resulted in the northward downbending of the Gerecse during the Early Cretaceous and the formation of a flexural bulge in the northern Bakony during the Albian (Mindszenty et al., 1994). Southward progradation of the deformational front is indicated by the southward shift of the coarsening upward sequence and the position of the bulge. The final episode is the middle-late Albian (to Cenomanian?) southvergent imbrication in the Gerecse and Pilis hills. All these processes occurred in a N-S to NE-SW compressional stress field.

Folding and imbrication of the Bakony could start during the Aptian but mainly occurred during the Early Albian. The characteristic stress field was NW-SE compression. Turonian and Senonian compression with similar axes also amplified the folds. The Aptian-Early Albian (or later?) folding was probably associated with nappe emplacement of the Bakony over Austroalpine units (Tari, 1994).

The whole Transdanubian range was affected by a NE-SW to ENE-WSW compressional stress field. This could amplify the folds in the Buda hills and form "cross structures" in the Balaton highland (Dudko, 1991). Because the Senonian seems to be affected by the stress field, its age is probably Paleocene. This phase can eventually be correlated with post-Senonian imbrication of the Csővár hills (Haas et al., 1997).

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COMBINATION OF PALEOMAGNETIC AND PALEOSTRESS DATA IN THE PANNONIAN BASIN AND SURROUNDING AREA

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During the last decade, a great number of paleomagnetic and paleostress data were obtained for the Pannonian basin and surrounding mountain chains. As it is well known, both methods are very important in the tectonic reconstructions. It is less widely recognised however, that the combination of the two types of data sets can lead to a more correct interpretation.

In our presentation, we give the first, basin-wide comparison of paleomagnetic and paleostress data using the method of Márton & Fodor (1995). The comparison of the two independent data sets is made within several sub-units of the two main microplates since Márton (1997) demonstrated a complicated rotational motion of microplates of the Pannonian area.

The data sets we are using are well constrained for the Northern Hungarian- South Slovakian Paleogene basin, for the Tokaj-Slanec volcanic chain- East Slovakian basin and for Slovenia, around the boundary of the Alcapa unit and the Dinarides. We have scattered data from western and central Slovakia.

We infer from the data sets that one of the most important Tertiary rotations occured within the Alcapa unit during the late Early Miocene (late Ottnangian- Karpatian). The large counterclockwise rotation is reflected by an apparent clockwise change in the paleostress axes. This deformation happened in a stable stress field (~N-S compression).

In addition to this microplate-like rotation, two other types of rotations can be demonstrated. A 30-40° CCW rotation affected the northeastern part of the Alcapa unit, from the Tokaj-Slanec hills to the Gutii Mts. This late Middle Miocene motion post-dates the rotation of the Alcapa. The rotation can be connected to the final thrusting of the Northeastern Carpatians and back-arc opening of the Transcarpatian basin, due to the roll-back of the subducting slab. Another type of rotation is connected to large shear zones, like we demonstrate it for the Periadriatic fault zone in Slovenia.

From the southern Tisza-Dacia unit we compaired new paleomagnetic and stress data from the Mecsek hills and published data from the northern Apuseni Mts. and Transylvanian basin (Pătraşcu et al., 1990; Györfi and Csontos, 1994). The general trend of change in the paleostress field corresponds to the CW rotation of the unit, however, the timing of the motion is not clear. Further complication is added by new observations on CCW rotation of the northern part of the Mecsek (also reflected by paleostress data) which shows that the microplate rotation was combined with other deformations, too.

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THE STRUCTURE OF THE RHENODANUBIAN FLYSCH ZONE IN THE ATTERSEE TO TRAUNSEE REGION (AUSTRIA)

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The structure and the structural development of the Rhenodanubian Flysch Zone (RFZ) in the Attersee to Traunsee region (Upper Austria) have been examined by structural analysis and 3D structural modelling. The structure of this particular sector is complicated due to effects of several superimposed deformation stages. The structure is dominated by thin-skinned tectonics mode of deformation of the infilling of the flysch basin, which took place between the northern front of the Northern Calcareous Alps, which acted as a buttress at the backside of the thrust wedge and the weak Ultrahelvetic successions, which were incorporated into a combined Ultrahelvetic/Rhenodanubian thrust wedge. Several major deformation stages can be distinguished. These include: (i) overthrusting of the Ultrahelvetic continental margin sequences by the Rhenodanubian Flysch Zone during Late Eocene, (ii) subsequent shortening of the combined Ultrahelvetic/Rhenodanubian thrust wedge, likely associated with the emplacement onto the southern margin of the Molasse Zone during Oligocene to Early Neogene, and (iii) disruption of the combined Ultrahelvetic/Rhenodanubian thrust wedge by strike-slip faults during the Neogene.

In detail, the up to 1,400 metres thick turbiditic deposits of the RFZ are organised in a sandwich-like manner and typical structures such as ca. E - W trending, kilometre-scale kink fold anticlines and synclines, blind thrust faults and splay thrusts. Associated outcrop-scale structures have been analysed in, e.g., the Gmunden quarry. Exposure of Ultrahelvetic units is along D2 stage, out-of-sequence thrusts. Palaeostress tensors were deduced using fault-slip data from more than fifty stations. A succession of superimposed palaeostress tensors by means of superimposed fault and striae can be deduced as follows:

1) Top-to-NNE nappe stacking led to the compound of RFZ units above the Ultrahelvetic Buntmergelserie. Mainly bedding plane striae yield reduced palaeostress tensors, which have been calculated from separated, homogeneous data sets with the orientations of the principal kinematic axes of $\mathbf{D_1}$ with σ_1=217/24, σ_2=122/24, σ_3=9/63.
2) Subsequent top-to-N thrusting is documented tectonically by different styles of splay thrusts, kink folds, and blind thrusts - all detectable on both outcrop- and map-scales. Data separation of bedding plane parallel slickensides and of E-trending faults led to a tensor group $\mathbf{D_2}$ with the orientations of principal stress axes σ_1=185/23, σ_2=277/32, and σ_3=12/57.
3) An anticlockwise rotation of the palaeostress field from N-S shortening $\mathbf{D_2}$ to a final top-to-NW thrusting tensor group finished the architecture of the Rhenodanubian fold and thrust belt. The calculation of bedding plane parallel E-W trending fault results in a palaeostress tensor group $\mathbf{D_3}$ with orientations of the main stress axis σ_1=160/31, σ_2=268/27, and σ_3=30/47.
4) Conjugate steep strike-slip, NNW- and ENE-trending, faults formed due to further, ca. N-S contraction respectively left-lateral wrenching. The orientations of the kinematic axes for this event have been calculated with σ_1=153/33, σ_2=357/55, and σ_3=255/12.
5) Dextral reactivation of D4 strike-slip fault patterns under transtensional E-W wrenching conditions ($\mathbf{D_5}$: σ_1=237/11, σ_2=137/42, σ_3=338/46).
6) East and westward directed normal faults (D_6), and reactivated D_4/D_5 fault patterns depict E-W stretching of northern sectors of the Alps even in this northern RFZ zone (σ_1=241/34, σ_3=89/53).
7) Subsequent E-W compression (D_7) due to the geomorphic shape of the basement in this area of the RFZ led to a tensor group with E-W compressional and subvertical extensional directions (σ_1=116/18, σ_3=314/71).
8) Finally, N-S extension (D_8) is related to final collapse of the RFZ during uplift (σ_1=109/69, σ_2=293/21, and σ_3=202/1).

The geological data were put into a 3-D working space with the GEOSEC3D© software in order to create a 3-D structural model. Modelling work focused on the elaboration of geometrically reasonable structures, fault-fold relationships, and evaluating the applicability and methodology of reconstruction of this complicated foreland fold and thrust belt on principle. In this way we obtained results on stratigraphic patterns, kinematics and geometric relationships for this sector of the RFZ, yielding a better understanding of Tertiary kinematic of the Ultrahelvetic/Rhenodanubian Flysch thrust wedge.

ABOUT TECTONIC MELANGE IN THE UKRAINIAN CARPATHIAN

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We have studied the mixtite zone about the Delyatin and Zarechje villages, which are located on right abrupt bank of the Prut River on a distance of 250 m. In this district there are the melange zone of crush movement of the folded Carpathian mountains on Pricarpathian sagging. The thickness of this basset is from 100m to 200m. It has polymictictic composition of terrigenous material that is presented by clasts of metabasites, carbonates, and terrigenous sediments. The cement is mainly presented by the argillaceous-calcareous polymictic composition. There are contact and basal types of the cementation. Often the rocks have the flow structure that is the evidence of its plastic deformation. In this mixtite zone the blocks of limestons occur. The limestons is marmorate often; their colour is grey or white. Size of the clasts varies from some santimeters to 2m. Also the marmors and gabbride clasts are observed. The long hubs of the metabasites and chloritic shale clasts are oriented towards the movement of frontal part of the nappies.

By petrographic characteristic these rocks and rocks of the Rachovskyj massif (Ukraine, Rumania) and the Apuseni mountains (Rumania) are the similar. The green-grey shales occur there. They are the fine-grained rocks by size of the clasts up to 0.1mm. They have the well-defined and finely bedding, silky glitter of the planes of schistosity. They are metamorphic.

The sericite-chlorite-biotite-muskovite-quartz shales (muskovite, biotite, chlorite, and sometimes epidote predominate) occur in the Saulyak deposit. The sericite-muskovite-chlorite-quartz shales predominate in geologic section of the Middle-Delovetzkaja age (the Tukallo deposit), the Late-Delovetzkaja age (the Jaseniv deposit). The structure of these shales is granoblastic. By the glide plane we determined the direction of the movement. The nappies move on northwest. The movement happened in situation of deep-sea sagging. After it these rocks were modified in zones of nappies development. As a result of it there were the appearance of limestone blocks and gabbrides clasts. The most closely the same limestone sediments are known in the Transcarpathian region only. The clasts of marmors were appeared as the process of movement of the overthrust masses on the autochtone. The frontal part of these overthrust masses was destroyed during this movement. Therefore this mixtite zone has the clasts of white marmors of structure of tectonites in base overriding mass, and the tectonic breccias, chlorite shales.

The represented study corroborates the model of geodynamic of this region: the obduction on passive border of continent for the Early Cretaceous, and the formation of nappe in rocks of neoautochthone for the Paleogene.

YOUNGER PALEOZOIC ROCKS OF WESTERN PART OF THE VARDAR ZONE –TAKOVO SURROUNDINGS

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Investigated area belongs to the part of western Serbia on boundary of Sumadija, near to Gornji Milanovac. In this relatively small area in tectonik contact are two tectonic units with completely different developments. They are: Dicina unit (rocks have similar characterstics as rocks in Drina-ivanjica paleozoic) and Brezna unit (eguivalental rocks as in Jadar block). It is considered so far that, thas area is presented by Paleozoic with characteristics and geological developement that belongs to Jadar block. Based on recent explorations, part of the area that belongs to tectonic unit Dicine, is presented by four formations: Formation of Drina, Formation of Golija, Formation of Kovilj conglomerate and Formation of Birac. Major evidence for such interpretation certanly is presence of metamorphisized magmatites which are absent in Jadar block. Paleopalynological investigations gave first paleontological evidences about age of this area. In intercalations if siltstones are found palynomophs remains: Punctatisporites glabar, P orbicularis, Tripartites cf. rugosus, Granulatisporites altus, Dictyotrilites fimbriatus i Knoxisporites literatus.

The rocks of Paleozoic age (carboniferous and permian) are widely distributed and they are represented by siltones, sandstones, metasandstones, limestones and metamorphosed magmats (first time determinated). Metamorphisized green rocks with concordant quartzite veins, 5 cm thick, is porphyry rock (porphyroid plagyogranite, equivalent to quartzkeratophyre) with gray-green coloure and schist texture. Also it can be occured in metasiltsone interbeds, with porphzroid structure and rare fenocrystalls of plagyoclase.

The rocks of Lower and Middle Triassic ege represented by dolomitic limestones, dolomites, porphiritic breccias and tuffs, porphyrites and carbonate-terrigenous series.

Composite tectonic features are formed in many phases, and caused by Hercynian and Alpine orogenesis. On the tectonic map are given the results using various modern methods.
Investigations concerned to this area helped to better understanding of geological development this territoty and make possible geological investigations in future.

TRANSREGIONAL ORE-BEARING ZONES OF ACTIVATION: PRE-CAMBRIAN - CENOZOIC (AS AN EXAMPLE ARE EAST EUROPEAN PLATFORM AND CARPATHIAN BALKAN REGION).

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Planetarium geodynamic system of long-living through transregional lineaments - megazones of activation where distinguished for the first time within the limits of East European platform, Carpathian-Balcan and Black Sea-Kaspian regions. Such megazones control placing of most large mining and oil-gas bearing areas. They are fixed by anomalous geophysical, geochemical and power fields, high exo- and endogenic activity and high seismic activity.

The sublatitudinal zones are the most marked and well investigated for the present time.

North-Ukrainian megazone is distinguished on the North of Ukraine (to the South from 52° of northern latitude) and traced to the East within Voronezh massif limits, to the West - on the Belarus and Poland territory.

The megazone controls metallization of rare metals (Perzhansky field of rare metal granites and metasomatites), apatite (Dubrovinsky field of carbonatites), gold in ferrum-flinty rocks assotiations of Kursk Magnetic Anomaly (KMA). Native-copper metallization of volyn traps is placed in the West (Lukov-Ratnov horst zone), and far there are famous silver-polymetallic fields of Silezia. Perspective kimberlite formations (Chartoriysky and Kukhotskovol'sky diatremes, numerous bodies of lamproite-kimberlites of Zhlobin depression) are displayed within zone's limits. Formation of ore- and gas-bering structures of Pripyat trough is connected with sublatitudinal disturbances activation too.

Central-Ukrainian megazone is traced along 48° of n.l. and distinguishes by unik ore-saturation. There is the main mining belt of Ukraine, represented by large deposits of gold, rare metals, uranium (Ukrainian shield); deposits of fluorite (marginal part of the shield), mercury, silver, gold, polymetalls (Donbass, Transcarpathians) within limits of the zone. In the West the zone controls placing of mining gold deposits (High Tauern in the Bohemian massiff area, etc.), number of mining objects in Kashper mountains, mining golden field of Ghellino-Mokrsko Prazhsky basin. Saturation of hydrocarbons is typical for basement of the zone (Northern Alfeld, Hungary).

South-Ukrainian megazone .is shown along southern limit of East European platform (48° 30' of n.l.). It controls oil and gas bearing structures of Black and Azov seas, in the East - Stavropolie and Near-Kaspian deposits, in the West - oil and gas accumulations of Foresouthcarpathian trough. The oil and gas bearing of crystalline basement is manifested on the South of Hungary.

Thus, the phenomenal geodynamic system of through megazones of activation, lengthy developed (from Pre-Cambrian till Cenozoic) is distinguished for the first time. The megazones are traced in different type and different age structures and have unik oil and gas bearing.

Tensions, created by changing of the Earth rotary regime, are one of energetic sources of periodical magma-tectonic activation. As a result, there is high gradient field of tensions in the zones distinguished, coinciding with «crucial parallels». Availability of the field of tensions is necessary condition for self-organization and functioning of ore-forming systems.

Further investigation of ore-concentrating megazones of activation distinguished will open new perspectives for large ore and oil-gas bearing deposits discovery. Increased seismic and exogeodynamic activity of the megazones demands investigation of anomalous dynamic knots within their limits with the aim of catastrofic phenomena preventing during large objects construction.

PECULIARITIES OF THE FORMATION OF THE PGE MINERALIZATION IN THE UKRAINIAN TERRITORY

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Several PGE deposits have recently been found within the NW area of the Ukrainian Shield in mafic and ultramafic rocks which consist of following main types:pyroxenite, peridotite, dunite, l herzolite, gabbro. The mineralization containing disseminated sulphides are controlled by shearing between Podolsk block and Volyno-Podolskaya zone. The geological peculiarities, prerequisites and prospecting indications of PGE deposits are: 1 - occurrence in the region of complex multiphase intrusions of mafic-ultramafic rocks of the peridotite-pyroxenite formation; 2 - distinct differentiation of rock masses, conditioning the formation of rock varieties with intensive layering; 3 - tectonic dislocation by shifting that contribute to the splitting of ultrabasites into separate blocks, presence of tectonites, shist-forming zones and gliding plane; 4 - the presence of elongated and persistent zones of fault (inside peridotite, olivinite norite strata and their contact zones) intruded by gabbro dikes were emplaced and through which mineral-forming solutions were penetrating; 5 - presence in rocks of zonal metasomatic bodies with amphibolic, chloritic and scurfy serpentinous fringes, iron-rich ultramafic pegmatiod.

Ores are hosted by both of ultramafic and mafic cumulates. PGE concentrations ranging up to 4.9 g/t (Pt + Pd) was determined. The contents of other PGE are low. PGM association with a predominance of Pt-Fe alloys in the former stages and Pt-Pd sulphides and tellurides in the latter ones were determined too. PGMs in sulphide bodies are mainly represented by metallic alloys, sulphides and various Pt-Pd-Te-Bi minerals (isoferroplatinum, tetraferroplatinum, braggite, cooperite, maslovite, merenskyite, frudite, moncheite, urvanchevite, insizvaite, sperrylite). The individual PGM species (many unnamed) were identified in this investigations and were grouped into the following categories: 1 - metallic alloys, e.g. isoferroplatinum, tetraferroplatinum; 2 - sulphides, e.g. braggite, cooperite; 3 - tellurides/bismuthides, e.g. maslovite, frudit, merenskyite, moncheite, urvanchevit, insizvait; 4 - others, e.g. sperrylite.

The combined geological, mineralogical and geochemical evidences indicate that PGE concentrations in the Ukrainian mafic-ultramafic intrusions have been formed by combinations of several processes. The PGE mineralization is the result of magmatic-hydrothermal systems that were being developed during the late crystallization and it was transported in the form of the incompatible residue probably as aqueous sulphide and / or chloride complexes. PGM sulphides with tellurides/bismuthides were minory dominated in ore bodies. The highest PGE content was in early generation of sulphides. After major magma influxes absolute levels and relative abundances of the PGEs were changed according to the encreasing of the fractionation degree of a residual liquid. PGE content has been revealed in the poster generation of amfibole, mica, in rocks with apatite. The small grains (they generally have 10μm in diameter) of Pt and Pd tellurides and bismuthotellurides (moncheite, michinerite) occur on grain boundaries between pentlandite and pyrrhotite. Grains closely assotiated with sulphide phases usually along grain boundaries have a micrometer size of Pt and Pd minerals. PGM grains are occured in the metamorphic silic mineral phases with high contents of Cl, F, OH. It is suggested that hydrothermal activity played an important role in the formation of these PGE enrichments during the transportation, segregation and precipitation of sulphide metals and PGE.

The study of significant PGM mobility in low-temperature environments has important genetic implications and the investigation of PGE mineralization have provided a good base for the theoretical and practical use. Detail investigation of mineral textures in supposedly unalterable layered rocks along the contact zones of mafic-ultramafic complexes was made. These complexes were a long time considered as ones having enigmatic features and now they have been emerged as the most impressive, large-scale results of fluid activity. The theoretical studies identified the following objects that had possible importance in the complexation with Pt and Pd in Ukrainian deposits: chloride, bisulfide, thiosulfate, polysulfide.The data of the field studies can be used as a model for the assessment of new bodies in known deposits. The preferential association of PGMs with pentlandite can be an important factor because this mineral have better flotation response than pyrrhotite has. The mineral assemblages represent different stages of magmatic crystallization and deposition from postmagmatic fluids and metamorphic recrystallization in retrograde magmatic processes and in different grades of regional metamorphism

Engineering- and Hydrogeology of Danube Hydropower plant in Austria: HPP-Freudenau compared with former construction sites at the Danube

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On the occasion of the termination of the construction work of the Danube hydropower station in Vienna (HPP Freudenau) this summer a brief review of the engineering geologic and hydrogeologic data are given. The results are compared with the geology of former completed hydropower plants at the Danube

General geologic situation

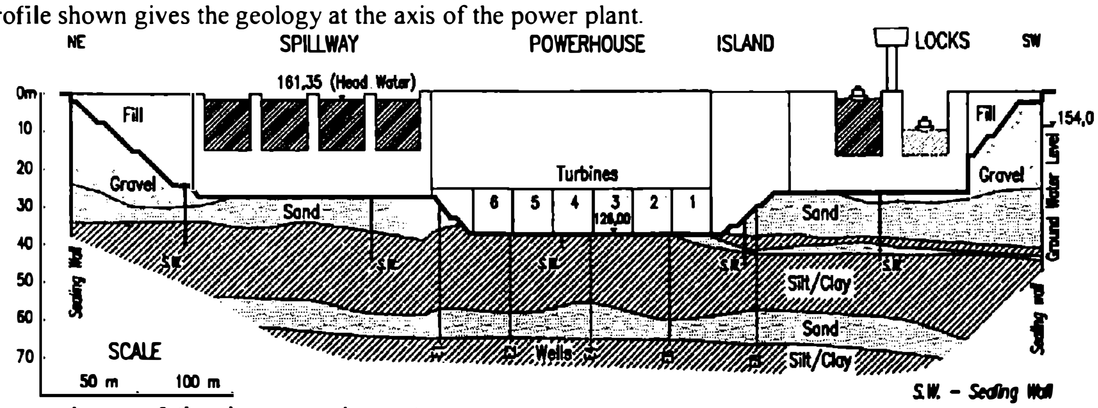
The Danube river crosses the Vienna Basin from west to east. In the west the Danube flows through the alpine Flysch zone, the basement fill of the tertiary soft sediments is the basis of the quaternary topmost gravel layer. The power plant is situated near the deepest part of the basin (Schwechat depression). The backwater of the plant reaches back to the Flysch zone in the „Wiener Pforte" to the next upstream hydropower station Greifenstein.

Geology at the construction site

Based on the detailed pre-investigations of drillings and soil mechanic tests the geologic sequence of layers was well known before the start of civil works:

- gravel up to 25 m (including the sandy and silty top layer and fill)
- sand about 10 to 15 m
- clay and silt layer called „Wiener Tegel" about 15 m thick and a further
- deep sand layer

As the construction of the new power plant has to be performed in the Danube river – the so called island construction mode was performed in two phases. For the construction pits cut-off walls to the depth of the clay and silt layer were constructed (up to 55 m below ground), dewatering of gravel and the fine grained sand has to be performed. Water pressure of the deepest sand layer was reduced by vacuum wells to prevent raising of the foundation soil of the power house at the time of excavation of the pit 20 m blow the river bed. The profile shown gives the geology at the axis of the power plant.



Hydrogeology of the impoundment area

As the water level of the impounded river rises up to 8 m, inudation of the surrounding land is prevented by sealing walls. 13 km of cut-off walls were constructed at the right river bank. Boxes were formed by double thin diaphragm walls up to a depth of 33 m. To garantuee the proper function prior to impoundment, tests were performed by impounding water in the cut off boxes checking the water losses. In order to maintain the groundwater regime unaltered the flow is regulated with the help of 21 pairs of withdrawal and recharging wells placed on either side of the walls. The clogging processes due to impounding has to be analized and the data of ground water modelling were used for the planning of the impoundment area.

EVOLVING TECTONIC STRUCTURES IN ROMANIA

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Vorotilov drill hole stress measurements stated that East European Plate has its own stress direction N 137 degree E, wich are in good agreement with those measured for Central Europe, of N 145 degree E (counter clockwise rotation ?)(K.Huberm, Tectonophys.,1997). Albania paleomagnetic measurements stated that clockwise rotation was a general movement for Albanides, Circum-Rhodope and the Serbo-Macedonnean massif (H.J.Mauritsch, Tectonophys.,1995).

Paleomagnetic measurement made in Apuseni Mountains (Romania) stated that this area not only that it has suffered a clocwise rotation, but it is not on its birth site, being brought here from lower altitudes, and those combined movements started in Laramian orogenesis(Patrascu, 1988). Geophysical data in Apuseni Mountains suggest that Carpathian Alpine Chain is disposed onto an old suture zone, wich originally was a rifting zone, ophiolites being found outcropping, and then migrated eastward. Alpine Plate Eastward pushing made what is now Carpathian encourbed belt, the hanging wall being the East European Plate. Vrancea earthquake area is just a remnant from those huge plates struggle.

Recent studies stated that at subduction zones, earthquakes occurs at deepths depending on the time when the subduction process begin. In Vrancea area, earthquakes have focal deepths up to 300 km, so the time when the process of consuming lithosphere started is younger then 70 Myr. (Wortel, 1980,Wortel and Vlaar,1988).

Geophysical maps on Romanian Carpthians outline a maximum gravity anomaly parallel to a minimum one and this is generally the same aspect for all mountains lineaments elswhere. To note that maximum gravity anomaly does not follow surface geological structures, on the contrary, it continues to the Vrancea earthquake area. So, it could be sayed that it reflect the deep structures ones. Gravity map pointed out in Carpathian bending area (Vrancea area) an offset East - West directed, with a 15 km width. Same is case with the Wiese vector map, wich points out a conductivity lineament parallel with Carpathian chain, and wich present an offset in Vrancea area, East-West directed. Magnetotelluric soundings (MTS) method applied on romanian teritory on severeal lineaments outlined deep faults, and intense subasment encourbement. Perharps this is correct taking into account that here we are in a plate border emplacement. It is well known the case of three plates junction point, and this seems to be the case in Vrancea area, and with all relating consequences (i.e. earthquakes, high geophysical anomalies), there where meets East European Plate, Moesian Plate and Alpine Plate. Being at borders plates, pushing forces intensitie varies, and could act on different and even opposite directions. Accordingly, the shear directions are in Eastern Carpathians disposed on two directions (Nort West- South East, and North East-South West), and in Southern Carpathians on an only one, East- West. This study assembled all the availbale data, and tried to make a 3D deep structural model.

BIOSTRATIGRAPHY OF THE EARLY MIOCENE OF THE SOUTHERN POLAND BASED ON FORAMINIFERA AND CALCAREOUS NANNOPLANKTON

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In the southern Poland the marine Miocene sediments (Fig. 1) occur successively in the flysch sequence of the Outer Carpathians and in the foredeep. In the Outer Carpathians the sediments in question represent Aquitanian and Burdigalian (NP 24 to NN4 coccolith zones). Foraminifera form 3 local assemblages: Aquitanian with Tenuitella inaequiconica, Early Burdigalian with Tenuitellinata pseudoedita, Globoquadrina dehiscens, and Late Burdigalian with Paragloborotalia siakensis, Globoconella incognita. Radiometric datations confirm the Miocene age of the upper part of flysch sequence.

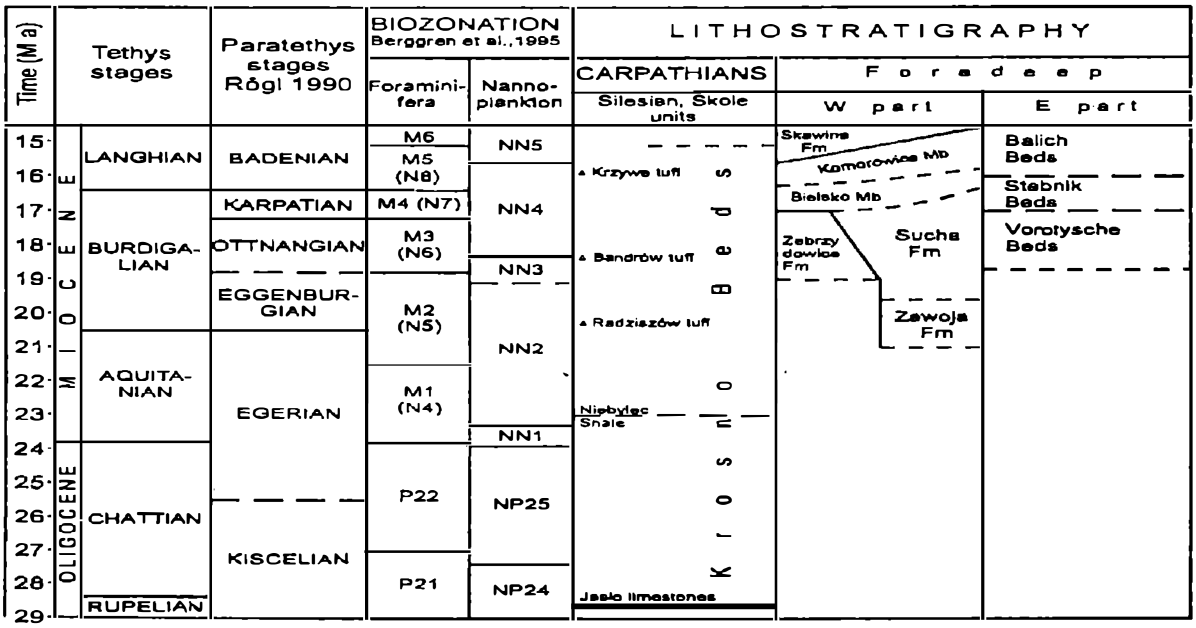

Fig. 1 Stratigraphy of the Early Miocene sediments of Carpathians and their foredeep.

The Lower Miocene sediments of the foredeep display considerable facial variability. The larger stuctural element of the eastern part of the foredeep is the Stebnik unit. Coccolith and foraminiferal species encountered in the Lower Miocene deposits of the foredeep can be assigned to N6 - N7 foraminiferal and NN3 NN4 coccolith zones. They suggest late Eggenburgian for the begginning of Miocene sedimentation in the Polish part of the Carpathian foredeep and the earliest Badenian age for subdivision previously assigned to the Early Miocene (i.e. Stebnik Beds).

LATE CRETACEOUS FORAMINIFERIDS AND CALCAREOUS NANNOPLANKTON FROM THE WĘGLÓWKA MARLS (SUBSILESIAN UNIT, POLISH FLYSCH CARPATHIANS). PRELIMINARY RESULTS.

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The Late Cretaceous part of the Węglówka Marls studied have been dated as Campanian - Maastrichian (elevata ? to mayaroensis zones) on the basis of the planktonic foraminiferids and as CC 21- CC 23b zones (Late Campanian - earliest Maastrichtian), on the basis of the calcareous nannoplankton.

A morphogroup analyses has indicated that suspension feeders (*Rhabdammina* type tubular taxa) become more numerous as keeled taxa decrease; this is probably related to an increasing organic flux to the sea bottom, during the regression episode. In particular, the latest sample studied showed a decrease in the number of keeled taxa and an associated increase of the suspension feeders morhogroup. Nodosariids are relatively abundant in samples with a rapid decrease in planktic taxa; suspension feeders were relatively numerous in these sample and this can be interpreted as an indication of falling sea level which caused increasing organic flux on the sea bottom (cf. Corliss & Fois, 1990; Gasinski, 1998). These samples probably represent an environment which was located under a shallower water column, affected by eustatic and/or tectonic sea level changes. Towards the Maastrichtian samples, there was also a marked decrease in the quantity of calcareous benthics. *R. szajnochae*, characteristic of the middle bathyal zone, was also relatively abundant in the samples dated as Campanian and this genera gradually decreased towards the Maastrichtian sample. However, keeled planktics are relatively scarce or even absent among these samples. *Stensioeina* is also relatively abundant in samples, where *Reussella* is relatively numerous. Taking into consideration the above findings, the Campanian samples were deposited in a deeper (uppermost mid slope) environment, while the Maastrichtian samples indicate shallower conditions (outer shelf - uppermost slope).

The foraminiferids are affiliated with the Tethyan biogeoprovince, although the calcareous nannoplankton assemblages have indicated a "transitional (Tethyan / Boreal) affinity. Therefore, a consideration to be taken into account, is that this part of the Carpathian domain is located and / or influenced by the so-called "Transitional zone" (i.e. ecotone between Boreal and Tethyan realms); this influence is mainly expressed among the epipelagic nannoplankton associations.

STRATIGRAPHY OF MEZOZOIC PLATFORM DEPOSITS OF UNDERTHRUST OF THE UKRAINIAN CARPATHIANS

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The platform basement (autochtone) nearly horizontal were revealed as the result of deep drilling in the Eastern Ukrainian Carpathians the areas of Lopushna, Petrovetska, Sechivka, Biskiv, Sergiyi etc.) under the nappe of the Folding Carpathians (alochtone) at the depth from 4000 m to 5000 m. They are represented by Neogene, Paleogene, Cretaceous, Jurassic and Paleozoic.

Stratygraphic dissection of the Cretaceous and the Jurassic systems into stages and substages as well as determination of their thickness were implemented on base of investigations and identification macro- and microfauna from drill cores.

In the Upper Cretaceous deposits there were indicated: Maastrichtian, Lower and Upper Campanian, Santonian, Coniacian, Turonian, Upper and Lower Cenomanian, Aptian?-Barremian, Barremian, Hauterivian, Valenginian were distinguished in the Lower Cretaceous.

Jurassic deposits are represented by kimmerigian Titonian - the suit of Nyzhniv, by kimmerigian - the suit of Rava Ruska.

Biohermic formations and organogenic-detrital limestones of reefogenic origin were revealed in limestones of the suit of the Nyzhniv by individual drills. The limestones, mentioned above, have good trap features and they are oil-bearing under favourable conditions (the drill of Lopushna 8, 11).

As the result of tectonic movements (uplift and subsidence) in Pre-Albian period and mountain-forming processes of the Alpian folding the Mezozoic basement of the underthrust part of the Carpathians is dissected by a very thick net of both lateral and longwise faults. In this connection stratigraphic horizons of Mezozoic autochtone occur now on different hypsometric levels. Amplitudes of their heights on the individual blocks reach the difference above 1000 m. Thus, the depth of Cretaceous surface in the drill of Lopushna-13 is 5028 m, and that one of the neighbouring Lopushna-11 is 3945 m. The difference between the heights is 1083 m and generally it reaches 1145 m on the area of underthrust.

Rather considerable difference occur in the heights of Jurassic surfaces. It is 980 m on the area of Lopushna and 1378 m for the underthrust, accordingly.

MAGMATIC AND METAMORPHIC EVOLUTION OF THE POLISH PART OF THE WESTERN TATRA CRYSTALLINE BASEMENT (W-CARPATHIANS, S-POLAND)

Aleksandra Gawęda[1], *Kazimierz Kozłowski*[1]

The structure of the Western Tatra Mts. crystalline basement consists of the E-W elongated granitoid intrusion and its metamorphic envelope, cropping out mainly in the westernmost part of the massif, called Western Tatra Mts. In the Western Tatra metamorphic complex one could distinguished two units: **lower unit** and **upper unit**, divided by the shear zone. These units are possible to distinguish both in the northern and southern parts of the metamorphic envelope. The preliminary comparative studies showed that both the lithology and P-T metamorphic conditions are slightly different in S and N parts of the massiff.

The Polish part is the subject of the detailed studies.

In the metamorphic complex in question the **lower unit** is composed of the mica schists and paragneisses with the subordinate amphibolite intercalations. Typical mineral assemblages are: **Pl(An_{20})+ Fe-Bt + Grt (Fe-Mn) + Q + Ky + Mg-Ms ± Stilp ± St + Ilm/Mt.** The calculated conditions of metamorphism are typical for greenschist facies: **P = 5-6 kbar; T = 446-550^{0}C**. In the **upper unit** migmatites and amphibolites are the predominant lithology, gneisses and mica schists are of subordinate amount. Amphibolites show some features of metamorphosed tholeiitic basalts with the intermediate WPB-MORB affinity, while the rest of the rocks are metapelites-metapsamites. Typical mineral assemblages are as follows:

I. for amphibolites: **Mg-Hbl + Pl(An_{35-40}) + Q + Grt (Fe-Ca) + Bt + Ilm/Mt + Sph**

II. for migmatites/gneisses: **Pl(An_{18-22}) + Bt(Fe-Mg) + Grt(Fe-Mg) + Q + Sill ± Ky ± St + Ilm + Gph**

The metamorphic history of the complex in question started at approx. 380-400 Ma, during the granitogneiss, so called older granit, emplacement. At that stage of evolution the metamorphic penetrative foliation was formed. The shear zones, running NE-SW and dipping to SE, associated with small alaskitic and pegmatitic intrusions was formed at about 345 Ma. The PT conditions of shearing are as follows: **680-780^{0}C** and **7,5-11 kbar**. The whole complex showed the features of an inverted metamorphic zonation. The Early Variscan strain field was inherited by the younger granite intrusion (Piotrowska, 1996). The Main Tatra Granite was emplaced in the complex approx. 300-327 Ma (Burchart, 1968, Janak, 1994). The shear zones were rejuvenated during the younger periods of geological history and served as migration paths for mineral-bearing fluids. The carbonate-quartz-polimetallic-barite mineralization, found both in Western and High Tatras (Paulo, 1997)., as well as organic mineralization are spatially connected with the shear zones mentioned here. As the final conclusion we can state that the Early Variscan epizodes strongly influenced both the location of granitoid magmatism and mineralization and were rejuvenated during the younger episodes of the development of the W-Tatra crystalline basement.

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ROMANIA - MINERAL WATER ATLAS

ABSTRACT

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Cornelia Maieru**, M.Iliescu**, Camelia Iliescu**

The Atlas of mineral waters is materialised for the first time and it describes on the districts the sources of mineral waters in Romania.

The Atlas presents about 3000 mineral sources distributed on tectonic geological units and chemical types (bicarbonated, clorurated and sulphated).

The graphic representation is carried out on geological maps scale 1:200.000 and the sources caracteristic are describes taking into account, the geology, hydrogeology and geochemisty and are represented into anexa books.

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LATE OROGENIC REBOUND AND OBLIQUE ALPINE CONVERGENCE: CONSTRAINTS FROM SUBSIDENCE ANALYSIS OF THE AUSTRIAN MOLASSE BASIN

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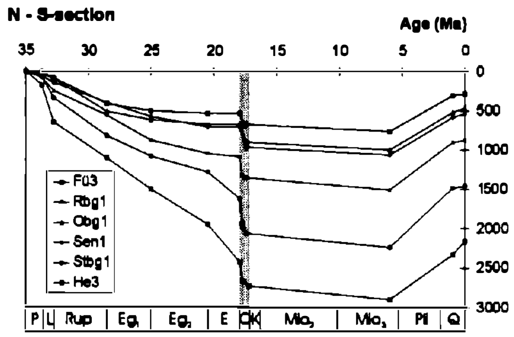
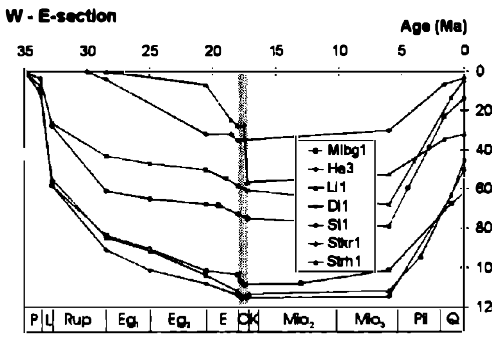
The Molasse basin, the foreland basin to the Alpine orogen, displays striking lateral changes in basin width and depth, albeit of a straight orogenic front. Subsidence analysis in the Austrian Molasse basin documents also major spatial and temporal changes in basement and tectonic subsidence.

Along a N-S section in the western part of the Austrian Molasse basin, normal to the strike of the basin, all wells show similar temporal subsidence evolutions. Subsidence started in the Late Eocene, in the early Oligocene, the basin strongly subsided to greater water depths and reached already large fractions of the maximum amounts of tectonic subsidence. The basement subsidence curves display for this time slice decreasing subsidence rates, followed by an increase in the Ottnangian. Basement subsidence is mainly driven by sediment loading and thus mainly reflects changing sediment accumulation rates. Only in the Ottnangian minor tectonic subsidence occurred. After the Ottnangian subsidence rates decreased strongly. Subsequently, uplift to the present observed depths occurred with similar, only slightly decreasing amounts away from the orogen along the whole profile. The estimated tectonic uplift is in the order of 500 m, leading to a reduction of the present tectonic subsidence to about a half of its maximum values in the southern part of the basin and to net uplift in the peripheral part of the basin.

Parallel to the Alpine front the basin displays marked differences in its subsidence history. Towards the east, initial subsidence is retarded, occurring only in the late Egerian east of the spur of the Bohemian Massif. There, tectonic subsidence rates strongly increased in the Eggenburgian and Ottnangian, leading to the formation of the present eastern Austrian Molasse basin and the N-S trending spur of the Bohemian Massif. The subsequent tectonic uplift occurred along the whole strike of the basin, decreasing towards the east from about 600 m to 200 m. At the spur of the Bohemian Massif, tectonic subsidence was almost completely reversed.





The progression of main tectonic subsidence from early Oligocene in the western part of the peripheral foreland to the early Miocene in its eastern part reflects a change from oblique dextral to sinistral convergence between the Alpine nappe stack and its foreland. Dextral convergence led to earlier flexural loading in the western part, but subsequent full coupling of the internal orogen with the Molasse basin led to a transition to eastwards directed lateral extrusion, and therefore to progressive loading of more eastern parts of the foreland. The main phase of sediment accumulation was retarded to the early Miocene and must reflect the build-up of topography in the Alpine mountain chain, as the configuration of the basin did not change dramatically in this time span.

The pronounced late-stage regional uplift of the entire Molasse basin marks the transition from lateral extrusion to orthogonal contraction within the Alpine-Carpathian system, but no major phase of near surface orogenic activity in the vicinity of the basin is associated with it. The uplift pattern is not compatible with viscous relaxation or simple unloading of the flexed foreland plate, but must reflect deep-seated changes in geodynamic boundary conditions, most likely delamination and/or convective removal of previously thickened lithosphere.

TIMING OF ALPINE COLLISION - CONSTRAINTS FROM ^{40}AR/^{39}AR DATING FROM THE PENNINIC - AUSTRO-ALPINE BOUNDARY, EASTERN TAUERN WINDOW

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Single grain ^{40}Ar/^{39}Ar laser probe (step-wise heating) dating was carried out on white mica, biotite, and amphibole across the Penninic–Austro-Alpine (AA) suture at the eastern margin of the Tauern Window in order to constrain the timing of the main Alpine deformation events that led to the juxtaposition of the regarded units. Along the investigated section one can distinguish three tectonic units in the hangingwall, mainly basement units, and two major units in the Penninic footwall, a higher ophiolitic and a lower basement unit. The Austro-Alpine nappes are characterised by different amounts of pre-Alpine metamorphic overprints and a generally inverted Alpine metamorphic sequence from lower greenschist to amphibolite facies. In the highest Bundschuh nappe, Alpine metamorphic peak conditions post-date the main tectonic overprint, related to W-directed nappe emplacement, in the two deeper nappes, the Middle Austro-Alpine Aineck nappe and the Lower Austro-Alpine nappe, the main deformational event, related to the same W-directed thrusting, is essentially synmetamorphic. A second, static Alpine metamorphic overprint, related to fluid infiltration, occurred after a folding of the penetrative Alpine foliation. The Penninic units within the window exhibit an increase in metamorphic peak conditions from middle greenschist to amphibolite facies conditions towards the footwall. The first main deformational event, a N-directed thrusting, affected mainly higher parts of the Penninic units and predates the metamorphic peak, the subsequent WNW-directed shearing affected also the deeper Penninic units and occurred up to the thermal climax. An extensional event, detaching the Austro-Alpine from the Penninic base, occurred on the cooling path of the Penninic unit.

A muscovite from the Bundschuh nappe yielded an integrated age of 107.5 ± 1.3 Ma, which is compatible with other age data from this unit, giving a minimum age for the main deformation. The Aineck Nappe gave disturbed Variscan ages for hornblende (integrated ages of 295.1 ± 8.2 Ma and 248.1 ± 2.4 Ma for duplicates) and an integrated age of 83.5 ± 2.3 Ma for muscovite of the peak metamorphic assemblage. Muscovite of a second generation, grown due to the static, fluid-driven metamorphic overprint, gave ages of 80.8 ± 6.1 Ma and 85.1 ± 4.7 Ma, respectively. Two white mica from the Lower Austro-Alpine unit, close to the next higher unit, show late Variscan ages (242.9 ± 2.2 and 239.6 ± 1.1 Ma), one close to the Penninic unit a very disturbed Alpine spectrum (integrated age of ca. 100 Ma).

White mica (phengites) from tectonic higher parts of the Penninic unit display ages between 32 and 22 Ma (32.0±1.4, 27.1±1.3, 22.9±1.1, 21.9±1.1, 29.9±0.2).

Biotites from all units gave too old ages compared to white mica, interpreted to indicate extraneous argon.

These age data support the following points:

- Thrusting in the Austro-Alpine units occurred over an extended time-span. The Alpine thrusting in the highest unit (pre-metamorphic) and the subsequent cooling from the highest greenschist facies to about 350-400 °C predates 100 Ma. In the next lower unit thrusting could have persisted until ca. 85 Ma. Nappe stacking must have propagated from the hangingwall to the footwall, therefore, incorporating successively more external and deeper units.
- The attainment of higher peak temperatures in higher nappes of the Austro-Alpine unit and the subsequent thrusting onto progressively cooler units of the same mega-unit points to a continuous accretion of parts of the footwall to the hangingwall in the stacking process. Thus thrusting could be explained by an intra-Austro-Alpine subduction. This progressive accretion can also explain the observed inverted metamorphic gradient, without need to invoke inverted temperature gradients.

  The beginning of subduction of the oceanic Penninic lithosphere could be dated by the second generation of white mica at the base of the Austro-Alpine unit, that grew due to fluid infiltration. The ages of 80 – 85 Ma indicate a possible interference between intra-Austro-Alpine thrusting and commencing subduction of the Penninic ocean beneath.

  The main deformation in the higher Penninic parts, related to their subduction and intra-Penninic stacking is pre- to syn-metamorphic. Hence the oldest age from that unit, already cooling ages, give a minimum age for N-directed shearing, the oldest, ductile deformation. The ages of about 22 Ma place a lower age limit on the WNW-directed shearing, occurring at about peak metamorphic conditions, and an upper age constraint on the subsequent ESE-directed, extensional shearing.

NEW METALLOGENIC ASSESSMENT OF THE CHIPROVTSI – MARTINOVO SEGMENT OF THE WESTERN BULGARIAN SILVER BELT

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The Western Bulgarian ore belt is the westernmost border stripe of the Central Balkan metallogenic belt, transit for Eastern Europe. This silver belt is defined by the Paleozoic – Mezozoic activization of the Adriatic – Strouma – Vardar rift belt, which is the continental stage of its evolution. The metallogenic belt also appears as transcontinental, connecting analogical structures from Island and the Lower Rhein ridge through the Strouma – Vardar to the Red sea rift belt.

The principal regularity of the distribution of silver mineralization in the West Bulgarian ore belt is the aging migration from the Paleozoic through the Mezozoic to the Neozoic silver polymetallic deposits directed from N to S toward the rift megainterception in Aegean sea. It is analogical to the global geochronic migration within the Great Europian Silver metallogenic belt from Germany and Austria to Bulgaria and Greek, which presumes the prospecting of analogical deposits.

The next regularity concerns the imperative disposition of the Au – Cu – polymetallic deposits along the meridional zones like the Govegda, Iskar, Etropole – Oboriste, etc., of the Black sea rifting with suboceanic stage of exceptional Au – bearing productivity of the meridional veins and deposits.

New great in length silver-ore zones directed NW to WNW, and also longitudinal NNW and Short transverse NE to ENE directions, are deducted according to the new metallogenic distriction of the Chiprovtsi – Martinovo segment. Along with the long meridional (NNE) Au-ore zones, short transverse zones with subequatorial direction and big rich deposits in their cross points are also separated.

New mineral types of silver ores are specified: of importance are the silver – sulphohalites (Dragov, 1993) and the Ag –Co – Ni – Bi ore-bearings represented by the "Yavorova glava" and the Ophiolitic ore zone. They have completely analogical composition and position to the "precious ankerite" and the precious Bi – Co – Ni – ore formations from the Freiberg deposits (Gotte, 1963).

A tomography large-scale imaging in the mantle of main tectonic structures of Europe and flanked areas

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New large scale 3-D *P*-velocity model of the mantle under Europe EUR-*PG* (sector 20° W-60° E * 30°-85° N) to 850 km depth and more represent. As unit examines the mantle below immense terranes of northwestern Eurasia occupying Europe, seas and oceans washed its, northern coast of Africa, Asia Minor, Near East, Caucasus region, Caspian Sea, western Kazakhstan. The massive collection containing first-arrival times of *P*-waves from strong earthquakes and explosions exploits as initial observed data set. For data recovering uses new traveltime tomography method developed by author. The errors in velocity recovering do not exceed $|0.015 \text{ km s}^{-1}|$. Analysis of the model EUR-*PG* deduces to the following general solid property's establishment of the mantle under Europe considering as unit. (1) Separated great tectonic structures, belts and assemblies tectonic structures imaging as unit at the same time can distinguish motley heterogeneous inner pattern. One of the well expressed they is the Alpine orogens belt where the Mediterranean, South and Central European, Anatolian, and Caucasus-Iranian segments mapping differ sharply from each other. In turn specially two firsts characterise exclusively not uniform own structure. (2) Into velocity inhomogeneities of the recovering model found contrast mapping not only major tectonic structures but also locates and traces sutures and boundaries between great structures. The most important Teisseeyre-Tornquist zone observes distinctly in Poland, the southern part of Jutland and the western margin Scandinavia and traces clear to the Faeroes Islands. Diffusing of the contact zone well observes under the western flank of EEP. (3) Such as the East European and Afro-Arabian platforms, Alpine orogens belt greets tectonic structures distinguish almost opposite image into velocity inhomogeneities of the upper and lower tectonosphere (see Fig. 1). (4) Lateral inhomogeneity of the mantle is mainly determinate by thermal regime heterogeneity of the Earth. Recovered *P*-wave velocity values are the comparatively precise determined physical characteristic of the mantle reflecting objective its true material composition and *PT* conditions. They can consider as original basic data for proved combine different geological and geophysical information interpreting and for meaningful tectonic and tectonophysical explaining. It is key result of this paper.

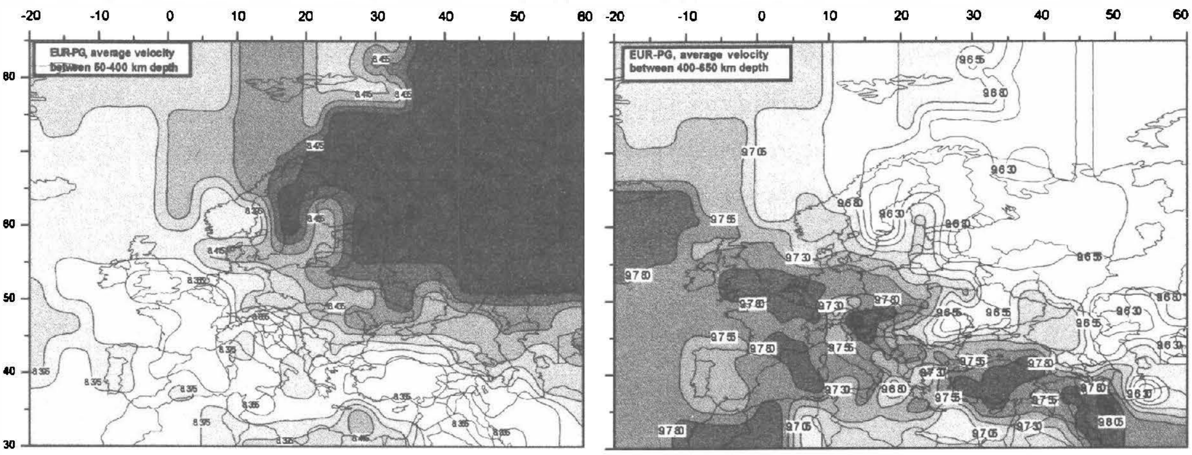

Fig. 1. *P*-wave average velocity distribution within the two layers of the mantle beneath Europe

SEPIOLITE IN THE CONTACT AUREOLES ASSOCIATED WITH LARAMIAN INTRUSIONS FROM BUDUREASA, APUSENI MTS., ROMANIA

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Hydrothermal mineral assemblages, including sepiolite and carbonates, occur on small veinlets, in the contact aureoles developed in the Anisian dolostones around the Laramian intrusions (granodioritic massif and the huge rhyolite-rhyodacite dyke that cross the granodiorites from NW toward SE - Ionescu, 1988).

Macroscopically, sepiolite from Budureasa occurs in two forms: a) fibrous aggregates of a fabric-like appearance and high flexibility (sepiolite 1) and b) compact, fibrous masses, without flexibility (sepiolite 2). In both cases sepiolite is associated with calcium and magnesium carbonates.

Sepiolite 1 is present as fabrics of long fibers (tens of mm) and parallel orientation, interupted by narrow zones with different orientated short fibers of sepiolite. Small grains of calcite (d_{104} = 3.03) and rarely dolomite (d_{104} = 2.888) occur in the groundmass of short fibers, as relics of primary dolomite crystals, now substituted by sepiolite. The refraction indeces of sepiolite are low (N_g = 1.53 and N_p = 1.52), with N_g în the direction of the fibers.

Sepiolite 2 occurs in a groundmass of low-magnesium calcite (d_{104} = 3.024), as small fibrous agglomerates or fine veinlets that cross calcite crystals or as replacement rims around calcite grains.

The chemical analysis of sepiolite 1, corresponds to the standard formula. The structural characteristics of the minerals described above are follows:

Mineral	**System**	**a (Å)**	**b (Å)**	c (Å)	a	b	g
Sepiolite	Triclinic	13.520(16)	26.951(32)	5.251(7)	90°	90°	90°
Calcite 1	Trigonal	4.993(2)		17.036(9)			
Calcite 2	Trigonal	4.985(1)		17.051(6)			

The genesis of sepiolite is related to the late stage of the postmagmatic processes which are low temperature, hydrothermal processes, associated both to the rhyolithe-rhyodacite dyke and to the granodiorite body (Ionescu, 1996).

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Quaternary palaeoenvironment reconstructions on north-western Transylvania (Romania) based on clay minerals

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The mineralogy of several thin clay layers accumulated within a peat deposit (11 m in thickness) in the closed basin of a former crater has been studied. The peat deposit is located in the eastern part of the volcanic chain of Gutîi Mountains and at the southern limit of the Livada-Oraşul Nou- Săpânţa Valley spring raised area. The marsh formed on the north-western slope of the Pietroasa peak has a circular shape with a diameter of about 200 m.

The core sediment we analysed was extracted from a depth of 7.5 to 8.5 m. It has on the upper part (30 cm) an organic-rich sediment, but the lower part turn into siltstones in which layers of clays are to be found. Clays and detritic sediments that were transported down the slope, accumulated in a former crater as centimetric layers at the bottom of a 7.8 m of organic-rich deposit (gyttja). The argillaceous sequence identified on our core includes the following terms:

Silto-arenitic clay (silt: 25-30 %; arenite: 10-15 %) in the lower part (between 7.8 and 8.5 m); it can contains up to 5% lithoclasts (rudaceous < 5 mm diameter), made of either pyroxenic andesite having pilotaxitic and/or intersertal texture or a basic subvulcanic porphyry-gabbros. The texture is unoriented;

Siltitic clay (silt: 20-35%) interbedded at different levels of the core. It shows an oriented granular texture. At certain levels (7,90-7,91 m) soft gravels having various composition were kept in flow structures.

The silt fraction consists of sub-angular crystaloclasts and only subordinate angulare, proving that the material was short distance transported. From the mineralogical point of view the minerals we identified were quartz (both magmatic and metamorphic origin), plagioclase feldspars, pyroxenes (hypersthene and augite), green hornblende (accidentally), lamellae of muscovite and biotite (sometimes with very low iron contents), and subordinate: olivine, zircon, titanite, garnets, epidote, tourmaline, apatite.

The clay minerals association consist of kaolinite, rolled kaolinite (already transformed into halloysite), halloysite, illite and illite/montmorillonite. Through the weathering processes the feldspars and parly the micas were transformed into kaolinite. Some of the mafic minerals such are olivine and pyroxens were transformed into smectites long before their deposition took place. Given this fact they appear as pseudomorphosis.

Kaolinite and halloysite formed in two different phases, as the latter one superimpose the other clay mineral. The clay mineral associations identified within the siltitic clay deposit are proving conditions of rather humid climat, rapid drainage and slighly low values for the pH. Halloysite formed at later stage by gradually hydration of the kaolinite in a low pH environment. In order to acquire such a low pH it would have been necessary to have the lake transformed into the marsh.

A sample from the lower part of the core we analysed was dated by means of ^{14}C (AMS) to 12.465 ± 115 yr BP. The age fit perfectly into the time range between 9 to 13 kyr when the climate in the north-western part of Transylvania was rather cold and wet as various proxy data already showed (U/Th dating of speleothems, pollen analysis and studies on mammals).

TRACHYTE-RHYOLITE VOLCANISM AT THE PERIPHERY OF ALBANIAN OPHIOLITES

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Albanian ophiolites are issued in MIRDITA graben structure located between the ADRIA plate in the West and KORABI-PELAGONIAN microblock in the East. The onset of sea floor spreading, generating oceanic crust, started to Ladinian-Early Lias(?) culminating during Middle Jurassic (Bajocian to Early Callovian). It's inferred that the contractional deformation episode was developed during the Middle-Late Jurassic. It led to the closure of oceanic basin and the beginning of the subduction and intraoceanic thrusts. These successive events caused the formation of the bidivergent thrust sheets of the ophiolites and subjacent metamorphic and volcano-sedimentary soles onto the passive continental margins. Just to this closing stage of Mirdita oceanic crust basin corresponds an intensive volcanism, mainly trachyte-rhyolite and their pyroclastics.

The subalkaline intermediate-acid and acid volcanic-subvolcanic complex located within the "block in matrix" sequence is represented mainly of trachytes, trachytes-rhyolites, trachyandesites, trachybasalts, etc. These rocks crop out as dikes, sills, stocks, flows. Hypoabissal facies are represented of granosyenites, syenites and syenit-trachytes. The most characteristic are the tuffs and coarse-clast agglomerates as well. Interbedding relations between lava flows, tuffs and sediments indicate an intermittent and renewed volcanic activity during the Upper Jurassic.

The trachytes and trachyte-rhyolites indicate a remarkable LREE enrichment and a significant Eu negative anomaly. The development of numerous geochemical-radiometric anomalies in hydrothermal altered trachyte-rhyolites is verified. The last ones contain high REE values (locally 4000-5000 ppm REE), Nb, Ta, Zr, Rb. The statistical distribution analysis evidences the different behavior of the elements. Th shows a positive correlation with REE, Nb, Zr. In the altered and recrystallized trachyte-rhyolites, apatite (with 7,5 % REE), monazite, Nb-Ta bearing ilmeno-rutile (with 4-5 % Nb_2O_5 and 5,55 %Ta_2O_5), rutile, orthite, zircone, and other unidentified interesting hydrothermal minerals are evidenced. An unknown mineral contains up to 30,21 % Ce_2O_3. In the hydrothermally altered trachyte-rhyolites the cerium bearing leucoxene, fluocerite (?), fluorite, strontium - barite, different types of the carbonates are recognized. In the hydrothermal phases, a probable REE, Th, etc., mobilization is developed. It seems that a major role to the concentration of these elements belongs to the carbonate-phosphate-fluoride solutions.

ON THE SEISMIC ACTIVITY MIGRATION PRIOR TO THE CATASTROPHIC 1928 EARTHQUAKES IN SOUTH BULGARIA

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Seventy years ago, on the 14 and 18 of April 1928, two catastrophic earthquakes occurred in South Bulgaria. During the time of the first main shock (M=6.8) two antithetic ruptures almost parallel to each other were formed ?n the Earth surface: the one following nearly the northern boundary of the Maritza graben, the other at the southern periphery of the same graben, the rupture length being of 38 km to the north and of 62 km to the south of the graben. The second main shock (M=7.0) caused prolongation of the south rupture up to 105 km. A vertical slip of 3.5 m was observed, too. Charles Richter in his "Elementary Seismology" specially noted the levelling measurements fulfilled prior to and repeated after the great 1928 earthquakes as a successful example of measuring the surface coseismic cracks. Actually, the good fit of the aftershocks space arrangement to the surface deformations caused by the earthquakes suggests that the cracks on the surface might be considered as a direct manifestation of the seismogenic sources themselves. Thus, the fault system at the southern periphery of the graben (an average strike of 110^{o}) which is traced out along the north facing slope of the Rhodope massif as well as the fault some 15 km to the north were considered as seismoactive ones in 1928.

This study examines the space, time and energy patterns of seismic activity during a 37-year period preceding the 1928 earthquakes. The beginning of systematic observations on earthquakes in Bulgaria was fixed as a starting point for detailed studying. The considered area was accepted roughly three times greater than the 1928 seismogenic zone. Such a choice is founded on some well known theoretical and laboratory investigations on the earthquake preparedness space. The present-day known distribution of seismogenic zones in the neighbourhood was taken into account too. The initial data analysis had to be performed exclusively on the description of the effects as at the turn of the 20th century the instrumental seismology was rather weak. Thus, the seismological compilations by Spass Watzoff /Bulgaria/ and Jelenko Mihailovic /Serbia/ were exploited. After making a thorough analysis of the reports in relation to the activity of each locality and depending on the frequency and intensity of previous excitations, and considering especially whether the reports had a stable tendency to overestimate/underestimate the observed effects (according to the instruction of the Observational Survey the observers were obliged to give an intensity degree), the intensity assessments were clarified and mapped. Based on the point-intensity distribution, earthquake parameters such as the magnitude and hypocentral coordinates, important for characterizing the active structures, were determined. The comparison of the focal zones position with the tectonic faults outlines two phenomena: appearance of relatively deeper seismogenic sources along the Maritza graben's boundary and clustering of events somewhere in the adjacent areas. Some decrease of the energy released is also established prior to the 1928 earthquakes in the impending zone as well as in the whole region under consideration.

THE EARLY CRETACEOUS SEDIMENTARY ENVIRONMENTS AND PROCESSES OF FORMING THE DEPOSITS IN THE UKRAINIAN FLYSCH CARPATHIANS

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Recently, the problem of the sedimentation of the Lower Cretaceous deposits from the Ukrainian Carpathians is discussed. The sedimentary conditions of forming Barremian-Albian Spas, Shypot and Bila-Tisa - Burcut formations are considered in the article. Black shale Spas and Shypot formations are located in the Skyba, Chornogora, Duklja, Krosno tectonic units. Bila Tissa - Burcut "dark-gray" formation is developed in the Porkuletz (Sukhov-Burcut) nappe.

The Spas formation (thickness 300 m) consists of mainly black and dark-gray claystones, rarely marls and cherts. Sedimentary features indicate that these deposits are chiefly background sediments (hemipelagites) deposited by the settling of particles from the water column. The macroscopic texture of the claystones is usually horizontal-laminated. Hemipelagites comprise thin layers of the bedded sandstones with Bouma's textures T**cde**, rarely T**bcde**, T**abcde**. The Spas formation locally contain the thick lenses (30-60 m) sandstones (Tershiv member) without lamination and with uniform massive texture. These psammites are interpreted as a deposited ones by the grain flow. Thus, the Spas formation consists of the hemipelagites, thin bedded turbidites and deposits of the grain flow. The Spas sedimentary sequence is compared with the analogous ones (Kennet.,1982) of the continental slope - floor.

The Shypot formation (thickness 300 m) is very similar to the Spas unit. The lower part of the formation consist of hemipelagites (black and dark-gray claystones, somewhere marls, limestones) with thin intercalations of turbidites (bedded sandstones with Bouma's texture T**cde**). These deposits are comparing with the sediments of the continental floor. The upper part of the formation represented by sandy thick-bedded turbidites (textures T**bcde**, T**abcde**). Background deposits - black claystones, firestones - sporadically occur as thin intercalations within thick bedded sandstones. These turbidites are interpreted as a lobe-like accumulative bodies (Reading et al.,1986) of the continental floor.

The Bila-Tissa - Burcut formation (thickness at least 1000 m) is composed of dark-gray shales and marls, thick-bedded sandstones (Burcut member) and conglomerates (Bronka-Bogdan member). These deposits can be regarded as hemipelagites, which contain the lenses (thickness 100 - 500 m) thick-bedded turbidites and fluxoturbidites, deposited in the trench-like basin.

Thus, the analysis of sedimentary features of the Barremian-Albian formations indicate that black and dark-gray claystones, marls, cherts represent deposits of continuous accumulation from the water column like "particle by particle" (background deposits). In contradiction to them bedded sandstones, coarse-grained formation with Bouma's and/or Lower's structures redeposited by gravity flows of different density.

The Spas-Shypot sedimentary basin was situated on the continental slope - floor of the European passive continental margin. On my opinion the Bila-Tissa - Burcut formation was deposited in the fore-arc trench of the non-volcanic Marmarosh arc. This arc could be regarded as a heterogenic orogenic belt (accretionary complex) which comprised both crystalline Marmarosh and flysh Rachiv nappes. Arc's system marks a convergent southern margin of the Early Cretaceous Carpathian flysh basin.

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CHERTIFICATION IN THE CARPATHIAN MARLS (EXAMPLIFIED BY SUB-CERGOWA OLIGOCENE MARLS, DUKLA UNIT)

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Silicified marls, called siliceous appear in the formations of different ages nearly in all tectonic units in the Flysch Carpathians. This name is applied to marls distinguishing by considerably higher compactness, splitting often containing cherty lenses and beds. The presence of the silica minerals in the marls of numerous flysch formations is only suspected and a source of the silica is uncertain.

The forms of occurrence of silica in Carpathian marls are presented here, being examplified by Oligocene sub-Cergowa marls (formation Jawornik Marl) of the Dukla Unit.

Sub-Cergowa marls are underlain by Sub-Chert Marl and Shale and overlain by Cergowa Sandstones. They were formed, at least partly, by the activity of turbidity currents. They were examined and sampled in Lipowica at Dukla. These marls are dark brown to rose brown, massive, strongly bioturbitisized, very hard and splitting. They occurs as intercalations, from several cm to about 2 m thick, forming sequences with thickest beds in the bottom part. Sedimentation of the thickest marls beds is initiated by thin, a dozen cm thick bed of brown calcareous sandstone or arenaceous shale. Further to the top of this sequence, the thickness of marly beds diminishes and locally there appear in them intercalations of soft, calcareous, brown shales and of brown marls showing thick, shaly fissility and lower hardness. In the uppermost part of the sequence there appear lamines of lighter coloured, rosa-brownish, strongly bioturbitisized marls several cm thick, containing a layer of strongly ferruginous shale in the top. This indicates a change of sedimentation conditions from anaerobic to disaerobic (bioturbation in light-coloured lamine) and an interval in sedimentation marked by thin ferruginous layer. Marls, except of dark brown variety showing coarse-shaly fissility, contain, especially in the top part of the sequence, lenses and intercalations of dark brown chert, up to several tenth cm thick.

In the Sub-Cergowa marls carbonates are represented mainly by calcite and ferrous dolomite, occurring but in traces. Among clay minerals mixed layer smectite/illite distinctly dominates, being accompanied by small amounts of illite, kaolinite and chlorite. Silica minerals are represented by chalcedony and quartz whilst opal A and CT occur in trace amounts.
Micrite calcite shows platy or more rarely, microsparitic habit. Moreover, scarce and poorly preserved organic relics (foraminiferas, coccoliths) are also calcitic.
Mixed layer illite/smectite mineral forms platy aggregates, several micrometer thick.
Chalcedony occurs in the form of sponge spicules and fine plates, several micrometers in size.
Calcite, illite/smectite and chalcedony show distinct micromorphologic similarity. They are dispersed and only locally form concentrations enriched in clay component and chalcedony.

Chalcedony with relicts of other components of marls forms cherty lenses and layers. The transition between chert and marl is not sharp. It indicates early diagenetic origin of this generation of cherts forming due to replacement of calcite and smectite mineral by silica. An increase of the number of siliceous sponge spicules in the vicinity of cherts indicates biogenic source of silica.

Illite/smectite with chalcedony and relicts of calcite form thin lenses, several micrometers thick, in these parts of strongly compact marls, in which no cherts are megascopically observed. These lenses display parallel orientation resembling lenticular lamination. Such structures, called „horsetail" are the effect of dissolution of calcite under increased pressure condition. The pressure-solution fronts are marked by residual micro-layers enriched in clay minerals. These late diagenetic process is accompanied by illitization of smectitic mineral and consequently, by liberation of silica. The top part of marl sequence are enriched both in clay minerals and cherts. This indicates the existence of a second source of silica - late diagenetic illitization of smectitic mineral. Rigid tectonic deformations, observed in some lenses of cherts, seem to confirm the existence of two stage of chertification of Sub-Cergowa marls; early- and late diagenetic.

RESULTS OF VECTOR WIESE TIME CHANGES INVESTIGATIONS IN CARPATHIANS

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Since 1989 on the base of permanent observation of geomagnetic field baylike variations at the regime station "Nyzhnje Selyshche" we have been calculating the monthly values of vector Wiese components. In general the obtained values of vectors Wiese one can reflect as a result of the well known Carpathian anomaly of electroconductivity. Thus, during the whole time of observation, for 4 ranges of baylike variation periods there were obtained about 320 values of vector Wiese, and amongst them about 300 values can be reflected as resulted by Carpathian anomaly. These are so called normal (for observational point) Wiese vectors. The normal Wiese vectors peaks are located in streaky section in fig.1. During the same time there were obtained 19 values of Wiese vector with peaks out of this streaked normal region. These vectors can be reflected as anomalous ones. All anomalous Wiese vectors are shown in fig.1.

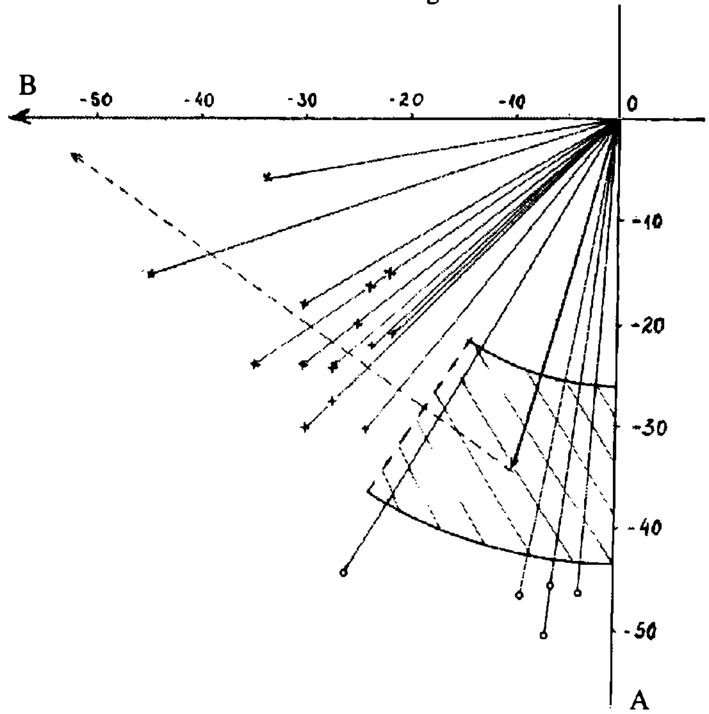

Fig.1

It is evident from fig.1 that all anomalous vectors may be naturally divided into two types. The 1-st type consists of vectors of anomal direction (these vectors are marked by "x" in fig.1) and the 2-nd type consists of vectors with only anomal values of modulus (in fig.1 marked by with "°"). The main conclusions of obtained results interpretation are as follows.

1. The 1-st type anomalous vectors source is located to south-east of the station of observation (in antidirection of discrete line in fig.1). This source activity doesn't correlate with local earthqukes, but may be explained by activization of seismic regime in whole Carpatho-Balcanic region, as well as by quasiseasonal phenomena.

2. The 2-nd type anomalous vectors source is located in shallow layers of Carpathian anomaly of electro-conductivity. These anomalous vectors rather well correlate with time of earthqukes that have been nearby the Carpathian anomaly of electroconductivity. So it is natural to conclude that changes of the Earth's core stress-strained state in vicinity of electroconductive anomaly cause changes of conductivity of this anomaly that are reflected by anomalous behaviour of vector Wiese of 2-nd type. Thus we can propose that this type of anomalous Wiese vector can be used as one of earthqukes precursors in vicinity of Carpathian anomaly of electroconductivity.

3. For the aim of more exact evaluations of similar sources parametres of temporal anomalous behaviour of Wiese vector the author have found some mathematical relations for operations with these vectors, at first- the vectors Wiese addition rule in case of rectilinear conductors model.

ALPINE TECTONICS AND TERTIARY EXHUMATION OF THE CRYSTALLINE SERBO-MACEDONIAN MASSIF IN W-BULGARIA.

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Stratigraphic and structural investigations combined with radiometric age determinations show that the Alpine evolution of western Bulgaria includes Cretaceous nappe stacking followed by late Eocene to Oligocene extension, which was responsible for the exhumation of the crystalline Serbo-Macedonian Massif (SMM).

The nappe system, including an upper nappe (the supragetic Morava nappe), composed of pre-Silurian continental basement rocks and lower Paleozoic metasediments, and a lower (Struma) nappe of Variscan basement rocks and Mesozoic sediments, overlies metamorphic basement rocks of the so-called SMM. Paleostress analysis of striations, combined with shear-sense criteria and fold vergence in this system, indicates two compressional stages during the Cretaceous. Nappe stacking during a first phase is characterized by an ESE-WNW striking σ_1-compressional axis, which is oblique to the corresponding (top to the SE) average movement direction. From this we may infer a transpressional setting for this first Alpine deformation phase. The subsequent development of recumbent folds and steep ramps reflects pure compression with a NE-SW oriented σ_1-axis and parallel average movement towards the NE. Nappe emplacement was preceded by Tithonian to ?Valanginian flysch deposition, and predates the sedimentation of Eocene clastic deposits which unconformably overlay the related structures. Nappe stacking therefore occurred during Cretaceous to Paleocene time.

From late Eocene to Oligocene (possibly even to Miocene), extension along NE-SW oriented σ_3-extensional direction, produced a series of SW-dipping and NW-SE-striking normal faults. The faults are listric and cut down into the basement where they merge into one or more low-angle detachments. Structural observations indicate general top to the SW normal faulting. Resulting crustal thinning led to the exhumation of the amphibolite-facies (Hbl, Grt, And) basement rocks of the SMM exposed in high-altitude culminations between low-altitude basins. Retrogressive metamorphism of greenschist facies (Chl, Ep, Ilm, Czo) and formation of cataclasites is associated with the shallow dipping detachment fault zones along which Pb-Zn-ores occur in tectonic breccias.

The high-grade metamorphic rocks of the SMM include gabbroic to granitic rocks with Cambrian intrusion ages (poster presentation by Graf et al.). These high-grade rocks are intruded by undeformed K-feldspar granites and partly covered by rhyolites. The crystallization age (U/Pb on zircons) for the granite is 32±2 Ma. This age is consistent with the Eocene to Miocene exhumation of the SMM amphibolite-grade rocks related to extensional tectonics and accompanied by anatexis.

GEOCHEMISTRY AND GEOCHRONOLOGY OF IGNEOUS ROCKS OF THE CENTRAL SERBO-MACEDONIAN MASSIF (WESTERN BULGARIA)

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The Osogovo-Lisez crystalline mountains are part of the SE-NW striking, 600 km long Serbo-Macedonian Massif (SMM). The SMM has been considered as a pre-Cambrian to Cambrian basement complex because it appeared to be covered unconformably by lower Paleozoic, weakly metamorphic sediments. However, our structural investigations show that the Paleozoic sediments and their greenschist-metamorphic basement belong to a thrust nappe of Cretaceous age (Morava nappe) and are separated from the Osogovo-Lisez complex by a system of Tertiary low-angle detachments (Graf et al., this abstract volume). The original relations between the Morava nappe and the Osogovo-Lisez complex are therefore still enigmatic.

The Osogovo-Lisez complex is composed of diorites, granodiorites, deformed lamprophyric pegmatites, gabbros and cumulate lenses. These rocks underwent post-magmatic high-T/low-P metamorphism of amphibolite facies (Grt-Hbl-And) with a later overprint under greenschist-facies conditions observed close to their surface. Undeformed calcalkaline granites intruded this basement.

U/Pb age determinations on single zircon and monazite grains, and X-ray fluorescence analysis (XRF) were carried out in order to determine the crystallization ages of the intrusive rocks and their origin. From the geochemical data we can deduce a distinct calcalkaline differentiation trend for the metamorphic basic to intermediate rocks. Of these, a gabbro lens crystallized at 568 ± 7.5 Ma. The crystallization ages of one granodiorite and one diorite sample are both in the range of 550 ± 5 Ma, and a granitic body within the diorite yielded an age of 545.1 ± 6.4 Ma. The zircons are all concordant and show no younger overprint.

The basic to intermediate rocks thus belong to the same magmatic cycle of Cambrian age, and we do not find any evidence of magmatic activity related to the Variscan orogeny. Reworked cumulates are found within the diorites and granodiorites, which in turn are cut by lamprophyric dykes and a few granitic bodies. The composition of the mafic rocks gives no indication for emplacement in a MOR environment, whereas the calcalkaline trend of the igneous rocks would be in line with strong extension of the lithosphere.

The undeformed porphyric granite shows also a calcalkaline signature but intruded at 32 ± 2 Ma. In this Oligocene rock, the zircons are concordant as well, but an older Pb component was also detected. This intrusion is contemporaneous with extension and exhumation of the Osogovo-Lisez complex along a low-angle detachment system, which explains the juxtaposition of high-grade metamorphic igneous rocks and low grade-metamorphic sediments (Graf et al., this abstract volume). We therefore interpret doming of the Osogovo-Lisez and the production of anatectic melts as a result of pronounced post-orogenic crustal thinning accommodated by a Tertiary detachment fault system.

GEOLOGICAL-STRUCTURAL COMPLEXES AND MINERAL PARAGENESES OF THE GOLD-BEARING FIELDS

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The geological-structural associations and mineral parageneses of the gold-bearing fields from different regions (Transbaikalian, the Caucasus, Transcarpathians) are considered on the basis of three principles: 1) interruption of the hydrothermal mineralogenetic process; 2) mosaic-block structure of the ore fields; 3) superpositions of mineral associations

The discrete development of the hydrothermal ore-deposition is proved by mineralogical and geological data. The principal mineralogical index of the ore- deposition processes interruption is the paragenetic lines of the ore-metasomatic associations, which form the mineral complexes of the concrete mineral deposition stages. These stages are characterized by the interruption of the deposition process in time.

The mosaic-block structure of the ore field is the result of discrete development of the mineral associations in space. Ore fields, as an integrity system (it is determined by the geological position) is the regular connection for geological-structural blocks (GB). By dynamic conditions two main ore fields of the block-structure type are singled out, they vary by the character of evolution of the graben-horst systems: a) the reversal development (RD type) - the complicated movements of different direction of GB; b) the inherital tectonic regime of vertical shifting of GB (ID type). Each block is characterised by structure-material integrity and main concordant shifting by the surrounding faults. The conditions of fault-dips determine the morphological peculiarities of GB and influence the movement character in the different tectonic regimes (compression-stretching). Accordingly two typomorphic fault-block parageneses were formed, the upthrust-horst-graben and fault-horst-graben Ore fields of RD and ID types are essentially distinguished by the development of typomorphic fault-block parageneses: for the first type both parageneses are displayed often alternating in space and time; for the second - mainly one of paragenesis - is characterized.

The mineral ore-deposit associations in fault-block paragenesis of ore fields of RD and ID-types are located not equally In concrete GB its resulted in the formation of different mineral associations and individual successions of mineral-tectonic-block units. The analysis of spreading of mineral associations of different ranges with their subdivisions into "background" and "accessory" revealed the principlal tendency more high-range mineral associations are located in geological-structural elements of lower range. The background RD-type ore-fields defines the mineral complexes; ID - the mineral parageneses. The accessory mineral associations are spread in local GB and its range is closely tied with the character of tectonic regime and formation of corresponding fault-block parageneses

KIMMERIDGIAN AND LOWER TITHONIAN SEQUENCES FROM EAST AND SOUTH CARPATHIANS -- ROMANIA

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In the last five years, detailed biostratigraphic studies on the Kimmeridgian and Lower Tithonian deposits were carried out in three areas of the Carpathians: two of them, namely the Lacu Rosu (Ghilcos) and Svinita areas, were explored by previous authors, such as Neumayr (1873) and Herbich (1878), and Raileanu and Nastaseanu (1960) respectively; the third one - Rasnov, is new. The Kimmeridgian - Lower Tithonian sequence (the interval from Platynota to Hybonotum zones) from the Lacu Rosu area belong to the Haghimas Nappe (Transylvanids; Sandulescu, 1984). In the Rasnov area (Mts. Postavaru) are exposed the Kimmeridgian deposits (the interval from the Hypselocyclum to the Beckeri zones), belonging to the Postavaru Nappe (Median Dacids; Sandulescu, 1984). In the Svinita area (SW of the South Carpathians), the Upper Kimmeridgian - Lower Tithonian sequence (the interval from the Acanthicum to the Richteri zones), namely the lower member of the Greben Formation (Pop, 1996) belongs to the Marginal Dacids.

The Lower Kimmeridgian is known only from the Lacu Rosu and Risnov areas. The Platynota Zone was recognised only in the former of these areas. The Hypselocyclum Zone is not well argued until now.. The Divisum Zone is better argued in Risnov area; is possible to demark the Divisum and Uhlandi Subzones.
The Upper Kimmeridgian is developed in all the areas we focused on, but is well argued only in Svinita. In the Rasnov area only the Acanthicum Zone was observed. In the Lacu Rosu area are recognised the Acanthicum and Beckeri Zones. In the Svinita area are recognised the Acanthicum (with the Loryi Horizon), Cavouri and Beckeri Zones. Up to date, the Lower Tithonian is proved by some pure assemblages, recorded exclussively in the Svinita area. The interval corresponding to the Hybonotum - Albertinum Zones, is yielded only common species. Owing to the low frequency of the index species, the Verruciferum Zone is mainly accepted on the ground of other species from its ammonite assemblage. The Richteri Zone is until now, only purely argued, because of the scarce ammonite faunas recorded in the upper part.

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PALEOGEOGRAPHIC CONFIGURATION OF THE SIRINIA BASIN DURING THE LOWER AND MIDDLE JURASSIC (SOUTH CARPATHIANS)

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The Liassic stratigraphic succession in the Sirinia Basin starts with the Cioaca Borii Formation, Hettangian – Sinemurian in age. It is a continental, predominantly detrital formation divided into two lithostratigraphic entities, superposed in the central zone and partially juxtaposed in the marginal area. The Omersnic Member, heterochronous, predominantly conglomeratic – gritty, Lower Hettangian in the central zone and Hettangian – Sinemurian in the marginal zone, is 20-50 m thick in the central zone and 150-500 m in the marginal zone (at Svinita), indicating an alluvial depositional system. The Pregheda Member, gritty-argillaceous with coals, is Upper Hettangian – Sinemurian in age, is 50-150 m thick and points to a fluviatile depositional system with paludal – lacustrine depositional system.

There follows the Sirinia Formation, Pliensbachian in age, marine, divided into two juxtaposed, lithostratigraphic entities: the Munteana Member, in the central zone, at Munteana, which suggests an inner shelf facies and the Dragosella Member, in the intermediary and marginal areas having about 150-300 m thickness, predominantly gritty-argillaceous, which indicates an outer shelf facies. Within the Munteana Member, carbonatic – ferruginous – oolitic, about 60 m thick, can be observed three lithostratigraphic entities: Piatra Lunga Beds, carbonatic – oolitic – ferruginous (hematite – chamositic) – skeletal, about 10 m thick and Piatra Alba Beds, Upper Carixian – Toarcian in age, carbonatic – bioclastic – oolitic – ferruginous (chamositic), about 50 m thick.

The Sirinca Formation, Bajocian in age, marine, in most cases discordant, is about 5-15 m thick and it is represented by spathic bioclastic limestones, locally microconglomeratic in the marginal zone, at Svinita.

Within the Bathonian – Callovian deposits, a central depression zone and a marginal (eastern, western and northern) zone can be distinguished.

The central depression zone is represented by the Bigar Formation, Bathonian – Calovian in age, mostly marly, about 200 m thick. In the surroundings of the Bigar locality, at the upper part of this formation, on a thickness of about 20-30 m, the Ceisu Member can be observed. It is Lower? Bathonian – Callovian in age, represented by calcareous marls, marly limestone and marly-limestone, grey coloured, with interlayers of red nodular, argillitic limestone, with prodisoconchs and protoglobigerinids. To the basal part of the Bigar formation, on a thickness of 170-180 m, the Buschmann Member, represented by grey marls with ammonites, can be observed.

The facies of the marginal zone is represented by the Saraoschi Formation, lenticular (up to 40 cm thickness), ferruginous (hematitic - limonitic) – oolitic – carbonatic, of hardground type, with a Bathonian – Callovian ammonitic concentration (association). There follows the Toplita Formation, Middle Callovian, represented by red, argillaceous, nodular, micritic limestone. The transition facies, between the central and marginal zones, of Bathonian – Callovian age, is known as the Ostresu Formation. It is about 15-30 m thick and it is represented by micritic limestone, marly limestone and marly limestone of grey color, locally having a nodular aspect.

The present paleogeogaphic image of the Sirinia basin, as having a central, depressionary zone and two marginal, less deep zones has been established by Boldor et al. (1963, 1964).

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THE CONTRIBUTION OF SERBIAN GEOLOGISTS TO THE CARPATHIAN-BALKAN GEOLOGICAL ASSOCIATION

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ABSTRACT

At the XIIIth International Geological Congress in Brussels in 1922 V. Petković, Professor of Geology in Belgrade, together with colleagues from Czechoslovakia, Poland and Romania founded the Carpathian Geological Association. He actively contributed to the work of the first three congresses of the Association (Poland 1925, Romania 1927 and Czechoslovakia 1931) together with other delegates from Belgrade.

Petković was authorized to prepare the VIth Congress of the CBGA (1935) un Belgrade and he did a lot to organize the meeting as good as possible. Sudden and tragical death terminated not only his life but also the work of the entire Association.

Our geologists (M. Ristić and T. Bogoievski) contributed to the renovation of the Association which happened at the XXth IGC in Mexico City, 1956. To the IVth Congress, now enlarged to Carpathian-Balkan Geological Association, in Kiev and Lvov (1958) Serbian geologists were not invited because of political reasons (it was the time of conflict with the COMINFORM).

From the Vth Congress held in Romania (1961) to the last one in Athens (1995) Serbian geologists have always been more or less represented (sometimes with more than 100 contributors), and very active, even in very unpleasant political situations (Bratislava 1973, Cracow 1985).

In 1967 Serbian geologists organized the very successful VIIIth Congress of the CBGA in Belgrade, with more than 300 attendants. However, when according to the decision of the XIVth Congress (Sofia,1989) they started to work on the preparation of the XVth Congress to be held in Belgrade in 1993, political difficulties came up again. Due to international sanctions on Yugoslavia, there was a total boycott towards the practically completely organized Congress. About 400 papers have arrived. The Serbian geologists gave up this work, and the organisation of the XVth Congress was taken over by Greece.

In the work of Serbian geologists in the CBGA misfortune and political problems, like some sort of destiny, affect almost every new generation. (It is unbelievable how it was possible that the VIIIth Congress in 1967 had no problems at all.) It would be good for the CBGA and for the Serbian geologists as well that this never happens again.

NEW EVIDENCE ON THE AGE OF THE KAŠAJINA BEDS IN THE NE SERBIA

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The Kašajina beds[1] are identical with the Azuga beds from Mehadinti region[2]. They are always found in the lowermost part of the geological column of Sinaia beds. They consists of brown siltstone, red and greenish siliceous claystones with manganese concretions. Lenticular bodies of diabase and serpentine are located in their lower part. According to all main characteristics they represent typical "lustrouos schist" formed on the deep ocean floor. In the Romanian Karpates they are interpreted as Tithonian[2]. In the Cosustea valley they contain a Tithonian association of the Calpioneleles[3] On the Yugoslav side, they are best exposed in the Kašajina river valley, but they do not contain any fossil material. These beds are also found on the west bank of Miroč, but only locally. Their best outcrop is found on the Majdanpek – Negotin road, about 6 km on the east from Klokočevac. Samples from that location contain good fossil material.

From these sediments, relatively abundant but rather uniform association of spores, pollen and marine phytoplanktonic remains are obtained. Palynospectres are dominated by *Cicatricosisporites, Appendicisporites, Trilites, Gleicheniidites, Contignisporites, Foveosporites* and *Cornutisporites* (*Welwitchiapites*). Rarely, there are also spores of *Cyathidites, Matonisporites, Deltoidospora, Biretisporites, Leptolepidites, Converrucosisporites, Trilobosporites* and *Cooksonites*. Concave spores with pilose appendices, usually very characteristic for the Lower Cretaceous sediments of Europe and Canada, were not identified in the palynofacies of the Kašajina beds. Especially important characteristic of palynospectres is rare presence of primitive Coniferae pollen grains of *Classopollis, Caytonipollenites, Alisporites, Tsugaepollenites* and *Sphaeripollenites* type. The forms of *Monosulcites, Ginkgocycadophytus* and *Podocarpidites* are more often present. The remains of dinoflagelates (*Cleistosphaeridium, Peridinium, Deflandrea, Gonyaulacysta, Pareodinia, Fromea, Ctenidodinium, Tenua, Systematophora, Scriniodinium,* and others) are present in significant amounts, with a dominance of Lower Cretaceous forms over Upper Jurassic (Kimmeridge) ones.

On the basis of the biostratigraphic analysis of fossil spores, pollen and dinoflagelates, investigated beds are most probably of Lower Cretaceous age (mainly Walanginian – Hauterivian). The palynomorphs from the layers of East Serbia can be well correlated with Walanginian – Hauterivian associations from Vojvodina and Stara Planina regions (Serbia).

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OIL AND GAS ACCUMULATIONS ASSESSMENT BY SURFACE GEOCHEMISTRY.

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Geochemical methods are widely used in the process of prospecting of oil and gas fields. The effectiveness of their application depends first of all upon the character of fluid migration and the used geochemical indices of oil-and-gas-bearingness under concrete geological-structural conditions.

The workers of Ukr GGRI carried out a wide complex of geochemical investigations in the northern board of Dnieper-Donets depression with the aim to determine optimal geochemical indices of oil-and-gas-bearingness for the given region. The area of the proving ground is 800 km^2, it includes Skvortsivka and Juliivka oil-gas-fields. Free, retained and occluded gases were studied, and also a number of non-organic indices of oil-and-gas-bearingness, in particular the content in the rocks of microelements (Cr, Mn, Fe, Ni, Co, Cu, Zn), carbonates, ratio Fe^{2+}/Fe^{3+} and in the waters NH_4^+, SO_4^{2-}, Br^-, J^-

The investigations results proved the priority of hydrocarbon gases, their heavy components (C_2-C_6) in particular, among the oil-and-gas-bearingness indices. The analysis of chromatograms of the retained gases from the depths of 1, 2, 3, 5 and 20 m and of free ones from geochemical wells, the distance between which did not exceed 1 m, shows that in the subsurface deposits the filter processes of mass-transfer prevail.

The majority of the hydrocarbon gas shows in the subsurface deposits, excluding gases of biological origin, belongs to tectonic breaks, that is proved by the presence of helium in the investigated gases. Thus we can make a conclusion, that tectonic dislocations directly influence upon the forming and preserving oil and gas accumulations. It is necessary to note, that the anomalies of free, retained and occluded gases do not coincide and do not correlate among themselves in the limits of the proving ground. Saying "the anomaly of free gases" we mean the modern shows of deep gases in the result of filter processes of mass-transfer. The anomalies of retained gases are considered as fixed in a rock the ways of modern and early migrational flows of free gases. Occluded gases are related to free gases, which were tied by the carbonates at the stage of the rocks diagenesis. The gas shows differentiation in time of their generation makes possible to trace the development of neotectonic processes and the character of the dislocations filter activity at the given territory, that is important for solving the problem of prospecting of oil and gas accumulations.

Basing on the results of investigations in the limits of Juliivka and Skvortsivka fields we propose the following scheme of carrying out the geochemical investigations:

1) the studying of the character of the fluid-conducting activity of tectonic dislocations, which took part in the field forming under favourable geological-structural conditions;
2) the studying of the conditions of the hydrocarbon accumulations preserving.

This scheme makes possible to use geochemical methods not only for the evaluation of the local objects oil-and-gas-bearingness, but with the aim of studying the forming processes of oil and gas fields.

It is necessary to mark also, that the non-organic indicators did not find synonymous application. But we think that it is interesting to investigate the influence of deep fluid flows upon the subsurface deposits, that will make possible to use the geochemical indicators of fluid-conductivity for solving the geological tasks.

TRIASSIC SEQUENCE STRATIGRAPHY OF THE TRANSDANUBIAN RANGE

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Surface extension of the Triassic formations in the Transdanubian Range is fairly large but due to physiographic conditions of the region successions of significant stratigraphic range are rarely exposed in outcrops. Fortunately, a relatively great number of cored wells were drilled in the last decades in the area, substantially complementing our knowledge on the Triassic sequences. Taking into account these circumstances, the following aspects were evaluated for recognition and analysis of the depositional sequences (3^{rd} order cycles) in the study area: 1/ regional subaerial exposure horizons, 2/ maximum flooding horizons or intervals, 3/ transgressive and regressive trends in the successions - inflections of 3^{rd} order cycles, 4/ platform progradations and backsteppings in the platform-basin transitional zones, 5/ signals of higher order accommodation in the high-frequency cyclicity patterns.

Based on experiences of the regional geological mapping and stratigraphic key-section project, 6 sub-regions were selected within the Transdanubian Range which appeared to be suitable for the sequence analysis. Analyses of the sub-regions were followed by their correlation using litho- and biostratigraphic methods. On this way, a synoptic chart was compiled providing the base of a summarising sequence diagram for the whole area.

Triassic evolution of the Transdanubian Range can be regarded as a long-term (2^{nd} order) megacycle which was primarily controlled by the Neotethyan rifting. In the pre-rift stage, during the Early to early Middle Triassic, a wide ramp came into existence on the moderately and uniformly subsiding continental basement. On the ramp, three sequences consisting of mixed siliciclastic and carbonate sediments were deposited in the Early Triassic and two carbonate sequences in the Early Anisian. Their deposition may have been controlled mainly by sea level changes, whereas their rock composition was substantially influenced by the climate.
Initiation of rifting in the Middle Anisian led to disintegration of the homoclynal ramp and formation of isolated platforms and intraplatform basins. It was roughly coeval with appearence of volcanic material from distal sources indicating the relation between the segmentation of the basement and the volcanic activity. During the syn-rift stage from the Middle Anisian to the earliest Carnian, condensed carbonate sequences were formed in the basins and thick. shallow marine carbonates on the platforms. Based mainly on the progradation of the platforms, three sequences could be distinguished within this stage, one in the Anisian and two in the Ladinian. Climax of deepening in the basins, i.e. maximum transgression of the long-term cycle, ocurred in the Late Ladinaian.
Termination of active rifting and penecontemporaneous increase in the terrigenous influx led to filling up of the basins by the latest Carnian. On the basis of the platform progradations, three sequences were recognised in this interval.
In the interval between the latest Carnian to the Early Jurassic, a huge carbonate platform evolved extending over a large part of the Transdanubian Range. However, in the Late Norian a new extensional basin began to form in the western part of the area whereas in the eastern part of the Transdanubian Range the Carnian intraplatform basins survived until the Jurassic. Fischer-plot analysis of the high-frequency cycles of the platform carbonates and platform progradations indicates four 3^{rd} order cycles for the interval from the latest Carnian to the end of the Triassic: one in the Carnian, two in the Norian and one in the Rhaetian.

The composite sequence stratigraphic chart for the Transdanubian Range is fairly well correlatable with those for the Southern Alps and for the Northern Calcareous Alps although it might be the result of their intimate paleogeographic relationships

CONTINUATION OF THE PERIADRIATIC AND NW DINARIDIC UNITS IN THE BASEMENT OF THE PANNONIAN BASIN

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Basement of the Pannonian Basin is made up by lithosphere elements of significantly different characteristics and evolutionary history. The southern part of the basement, the Tisia Terrane, as to its Variscan and early Alpine evolution shows European affinity. The northern part of the basement, the ALCAPA Composite Terrane is made up by units of Alpine and Dinaridic affinity. The terranes are separated by NE-SW trending lineaments. There is a great challenge for geologists of the Alpine-Carpathian-Dinaridic-Pannonian region to figure out the relationships among the Pannonian basement terranes and the structural units of the surrounding mountain ranges. Summarising and re-evaluating of the relevant surface and subsurface data in the area of Slovenia, Croatia and Hungary, we came to the following conclusions.

1. The concept that the Slavonian mountains belong to the Tisia Terrane is widely accepted. However based on well data, position of the Mid-Hungarian Lineament representing the northern boundary of the Tisia Terrane, was modified in the area of Croatia.

2. The Savia -- Mid-Transdanubia Composite Terrane locating between the Mid-Hungarian and the Balaton Lineaments, includes the following tectonostratigraphic units:

-Kalnik Unit. It is a tectonised ophiolite melange which is located in the basal part of the nappe pile in the Medvednica Mts. and crops out also in the Kalnik and the Ivanscica Mts. It is probably encountered in a few boreholes in the Hungarian area.

-Medvednica Unit. It consists of a Paleozoic-Triassic magmatic-sedimentary complex affected by Alpine low-grade metamorphism. In the Medvednica Mts., it is located above the ophiolite melange. In the basement of the basins. this unit could be followed in a stripe. in Croatia and encountered in a single borehole in the territory of Hungary.

-South Zala Unit. It is made up by Permian to Jurassic sedimentary sequence with deeper water carbonates in the Triassic and pelagic shales in the Jurassic. They were generally affected by very-low-grade Alpine metamorphism. This unit was detected in several wells in the territory of Hungary and in a few boreholes in Croatia. Triassic outcrops in the Ivansica Mts might belong also to this unit, although they are not affected by metamorphism.

-Julian - Savinja Unit. It is made up by unmetamorphosed, predominantly Triassic sequences with thick platform carbonates. In addition to the Savinja and the Julian Alps in Slovenia, the highest nappe in the Medvednica Mts. also belongs to this unit. It can be followed in a zone parallel to the Periadriatic-Balaton Lineament. In a predominant part of the Hungarian segment of the Savia – Mid-Transdanubia Terrane, this unit forms the basement of the Tertiary basin.

-South Karavanke Unit. It is characterised by marine Lower and Upper Permian and South Alpine-type Triassic sequences with deeper water, tuffaceous Ladinian formations. From its type locality in the Southern Karavanks. this unit can be followed in a narrow stripe, along the southern side of the Periadriatic-Balaton Lineament.

3. Summarization of the available data reinforced the formerly assumed relationship between the Periadriatic and the Balaton Lineaments. It is constrained in addition to the continuity of the South Karavanke Unit also by the presence of the granite-tonalite zone along the northern side of the lineaments.
4. North to the granite-tonalite zone, the Upper Austroalpine North Karavanke Unit can be traced in Slovenia south to the Murska-Sobota Massif as far as to the Transdanubian Range Unit.
5. Above the Middle Austoalpine metamorphic complex of the Murska-Sobota Massif, remnants of nappes are known which consist of unmetamorphosed Triassic rocks showing features similar to that of the Transdanubian Range.

PALEOMAGNETISM OF PLIO-/PLEISTOCENE VOLCANICS FROM THE PERSANI MOUNTAINS, ROMANIA: STRATIGRAPHIC AND GEOMAGNETIC IMPLICATIONS

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Pleistocene intraplate basaltic volcanics from the Persani mountains, East Carpathians show normal, reversed and intermediate polarities. Detailed paleomagnetic investigations in combination with geological mapping reveal a relative chronology of the volcanic activity. All sites from one volcanic complex comprising lava flows and a scoria cone reveal the same intermediate polarity, indicating an extremely short eruption interval for the whole complex.

Quaternary volcanic rocks occur in the north-western part of the Persani Mountains near the valley of the Olt river and its tributary the Bogata river. The volcanics are composed of basal pyroclastics, lava flows with intercalations of pyroclastics and scoria which are partly separated by well developed paleosols. Some of the flows fill valleys which have no relation to the todays geomorphology indicating their high age and the fast uplift of the area in the past 2.5 Ma. At least two main phases of volcanic activity can be recognized. Reported ages of the volcanic activity span the interval from approximately 0.5 to 2.5 Ma. 323 individually oriented cores from 18 sites were drilled resulting in 882 specimens. Mainly AF demagnetization was used to determine the characteristic remanence. It was possible to obtain paleointensities from 7 sites using a modification of the Thellier method.

Curie temperatures of ≤ 350° C and of ≤ 600° C indicate Ti-rich and Ti-poor magnetite as the main magnetic phase in the basalts. Hematite, with Curie temperatures ≥ 600° C, seems to be present in the scoria. The ratio Bcr/(SIRM/κ) displays a wide range in grain size of the carriers of magnetization, ranging from multi-domains to single-domains. This wide range in grain size is probably due to different cooling rates and oxidation states of the minerals. Analysis of the demagnetization experiments reveals ten sites of normal, three of reversed and five of intermediate polarity. The latitude of the virtual geomagnetic pole (VGP) of one of the normal and two of the reversed polarity sites diverge by about 30° or more from the axial dipole field. The intermediate directions occur only in the Racos volcanic complex.

Regarding the polarities and the available radiometric ages, the volcanic activity spans the Brunhes and Matuyama geomagnetic chrons at least. In the Bogata valley it is possible to distinguish the volcanics by their magnetic polarity. At least two volcanic events, producing lava flows, can be recognized. The uniformly intermediate polarity of all volcanics of the Racos complex sampled so far strongly argues for an extremely short eruption interval of probably less than 1 ka. Due to the most recent radiometric age of 1.19 Ma, the intermediate polarity of the Racos complex might be correlated with the Cobb-Mountain geomagnetic event.

Paleointensities ranging from 4.4 (Racos) to 82.9 μT were determined (todays local average about 48 μT). The extremely low paleointensity correlates with the low VGP latitude of the Racos complex supporting the model of decreasing virtual geomagnetic dipolmoment (VDM) during reversals of the Earth's magnetic field.

THE MIOCENE OF THE CARPATHIAN BASIN: NEW PALAEOGEOGRAPHIC AND STRATIGRAPHIC RESULTS

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The authors of that summary were active participants in different Hungarian and international projects e.g. IGCP No. 25, IUGS RDP, Hungarian startigraphic revision. In the frame of the last one, they developed the system of the Neogene lithostratigraphic formations, and their correlation (in space and time) with the Alpine-Carpathian-Dinaride region. The synthesis of the last ten years-researches were published in 1997 (Hámor G. 1997), showing the situation in three time-interval. The new results of that work are:

a)The maps deal with the Neogene evolutionary history of the Alpine-Carpathian-Dinaride system and connected basins, **on the base of tectogenetic conception**, with special attention to the influence of Savian-, Styrian-, Leithaian- and Rhodanian orogenic cycles in space and time.

b)The authors, on the base of their former researches, have **already proposed to set up Miocene superstages**, representing the Lower-, Middle- and Upper Miocene. The main points of that proposal are: Lower Miocene includes the Upper Egerian-Eggenburgian-Ottnangian (Savian orogenic cycle), Middle Miocene includes Karpatian-Lower Badenian [incl. Wieliczian (Middle Badenian)] (Styrian orogenic cycle), and Upper Miocene includes the Upper Badenian-Sarmatian-Panonnian s.str. (Leithaian orogenic cycle). The proposal stated by science-historical-, biostratigraphical-, cycle and event stratigraphical evidences.

c) On the base of the conceptions, described in the paragraphs a) and b), the three new map-versions of the Carpathian Basin and its sorroundings present the paleogeographic situation of the Lower-, the Middle- and the Upper Miocene inc. litho-, bio- and geofacies. This result proves:

- **the possibility of unification of chronostratigraphic stages** on the base of the tectonically determined similar sedimentary basins, similar palaeogeographic and palaeobiogeographic connections, nearly similar facies-zonation;
- **the markable differences between the Lower-, Middle- and Upper Miocene** in (e.g.): palaeogeographic and paleobigeographic connection, magmatic evolutionary history, the cycle and the space of the salinity crisises;
- **the significance of the NW-SE Vardar-zone** (as continuously working mobile-zone) in the forming and in the evolutionary history (in some particulars different) of the Neogene sedimentary basins;
- **the picture of the Pannonian Basin with uniform basin-structure**, formed in the Leithaian orogenic cycle (Upper Badenian-Sarmatian-Pannonian s.l.), which, after that time-slice, due to some minor differeces - can be divided for Western - and for Eastern Pannonian Basins.

Reference:

Hámor, G. 1997: Miocene paleogeographic and facies map of the Carpathian Basin.- Hungarian Geological Institute, Budapest

LOWER-, MIDDLE-, AND UPPER-AUSTROALPINE NAPPES IN THE EASTERN ALPS: NEW DATA ON AN OLD PROBLEM

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Since c. 60 years, there is an ongoing debate on the existence and significance of Alpine nappes within central sectors of the Austroalpine nappe complex in the Eastern Alps. The existence of internal nappes is specifically not clear for those regions where Permo-Mesozoic cover sequences are missing, like in the section NW of the Tauern window. The main questions are: (1) what determines Austroalpine "nappes"; (2) how many major "independent" Australpine nappes exist, and is it possible to trace them from east to west, (3) can these nappes be distinguished with respect to their Alpine tectonometamorphic evolution, and (4) how can Alpine cover sequence be related to pre-Alpine basement sequences.

At the eastern margin of the Eastern Alps, there is unquestionable evidence for the existence of three major Alpine nappe piles. These were imbricated due to footwall propagation of an Alpine master fault during ongoing contraction. There, Alpine nappes which experienced sub-greenschist- to lower greenschist-facies metamorphic conditions (Upper Austroalpine, UAA) were thrusted over Alpine medium- and partly eclogite-facies metamorphic rocks (Middle Austroalpine, MAA). The present state of the MAA/UAA contact is a late Cretaceous low angle normal fault juxtaposing rocks of different metamorphic overprint to each other. The MAA units were thrusted over Lower Austroalpine (LAA) units which, again, were affected by only greenschist-facies metamorphic conditions along northern margins in Alpine times. As revealed from detailed $^{40}Ar/^{39}Ar$ isotopic studies on white mica and whole-rock samples, deformation started at c. 100 Ma in todays uppermost tectonic units, and commenced in lowermost units at c. 70 Ma.

New $^{40}Ar/^{39}Ar$ isotopic data from central units of the MAA/UAA (e.g. Gurktal nappe complex) and units west of the Tauern Window (e.g. Kellerjoch area) reveal a similar tectonic evolution. In the Kellerjoch area, the Kellerjoch Gneiss is imbricated between LAA Innsbruck quartzphyllite units and UAA Paleozoic clastic sequences of the Graywacke Zone. Both units experienced only a weak overprint under lower greenschist-facies metamorphic condition in Alpine times. Preliminary results from $^{40}Ar/^{39}Ar$ analyses of white mica concentrates from ductile deformed Kellerjoch Gneiss display a concordant age of c. 105.3 ±2.9 Ma, interpreted to date ductile deformation under greenschist-facies metamorphic conditions during Alpine nappe assembly. Because Alpine thermal overprint in underlying LAA Innsbruck quartzphyllite, and overlying UAA Graywacke Zone is missing, this age suggests that the Kellerjoch Gneiss represents an independent tectonic unit. Furthermore, it indicates that the thrust between MAA/LAA units is similar to easternmost Austroalpine regions.

White mica from ductile shear zones along hangingwall margins of the MAA unit beneath the western Gurktal extensional allochthon yielded 99.4 ±5.8 Ma and 89.0 ± 4.8 Ma. Mineral assemblages and state of deformation suggest that deformation started at c. 450°-500°C. By contrast, detrital white mica from Late Carboniferous/lowermost Permian sequences yielded 317.6 ±4.7 Ma. This age indiates lacking Alpine thermal influence of these units, and a break in metamorphic conditions between MAA and UAA units in this particular region. Furthermore, the age of the detrital mica does not support a primary, pre-Alpine linkage between MAA and UAA basement units.

These new data, combined with previously reported geochronological and structural data, suggest the presence of similar contacts between major tectonic units throughout the Austroalpine nappe pile from east to west: These include (1) a Late Cretaceous transport of strongly overprinted MAA units onto nearly unmetamorphic LAA units subsequent to thrusting of UAA onto MAA units; and (2) a Santonian activation of low angle normal faults along the present MAA/UAA nappe contact during orogenic collapse.

GEOCHEMISTRY AND PETROGENESIS OF MIOCENE VOLCANIC ROCKS IN THE NORTHERN PANNONIAN BASIN AND WESTERN CARPATHIANS.

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Tertiary history of the Carpathian-Pannonian Region (CPR) can be characterised by complex geodynamic and associated magmatic events. The main tectonic activities which strongly influenced the evolution of CPR were (1) oblique subduction, slab roll-back and slab detachment along the Carpathian arc; (2) tectonic escape of the ALCAPA block; (3) extension of the Pannonian basin. During this about 20 Ma long period various magmatic activities took place. Genesis of the volcanic products is a subject of long debate. Recently, due to the available comprehensive geochemical data set, it tends to be widely accepted that upwelling of hot asthenospheric material - probably identical to the common European Asthenospheric Reservoir (EAR) - was responsible for the Late Miocene-Quaternary post-extensional alkaline basaltic volcanism. The calc-alkaline volcanism in the Eastern Carpathians was interpreted as it belongs directly to the subduction mechanism that involved also gradual slab detachment. However, the Miocene magmatism in the western segment of the Carpathian volcanic arc and in the Northern Pannonian basin is more controversial, partly due to the lack of precise trace element and isotope data.

In this presentation, using new major and trace element and isotope data we give an overall review of the geochemical characteristics of the following volcanic associations: (i) Early to Middle Miocene rhyodacite-rhyolite pyroclastic series of Bükkalja and Cserhát areas; (ii) Middle Miocene (Badenian) volcanic suites of the Börzsöny and Visegrád Mts. (BVM); (iii) Middle to Late Miocene volcanic rocks of the Central Slovakian Volcanic Field (CSVF).

This comprehensive data set allow us to propose the following main conclusions: 1. Primary magmas generated in enriched mantle sources previously metasomatized by subduction-related fluids. 2. High-pressure garnet+amphibole fractionation characterised the early evolution of the Badenian volcanism. 3. Crustal contamination was more characteristic in the early phases of the volcanism (Early Miocene and earliest Badenian) and then decreased with time. 4. Petrogenesis of the volcanic series of BVM can be described by combined assimilation and fractional crystallisation (AFC) processes, whereas in the CSVF and in Bükkalja both AFC and simple fractional crystallisation occurred. 5. From the Sarmatian, increased influence of EAR-like asthenospheric mantle can be recognised in the CSVF volcanic products. 6. Based on the available geological, geophysical and geochemical data we suggest that the Miocene volcanism in the Northern Pannonian basin and Western Carpathians could be attributed primarily to the extensional phase of the Pannonian basin and cannot be directly connected to the subduction and slab break-off mechanisms. Thinning of the lithosphere resulted in partial melting of the metasomatized lithospheric mantle and partly of the lower part of the crust. The post-extensional (post-Badenian) volcanism can be explained by increasing influence of upwelling hot EAR-type asthenospheric mantle. Tertiary magmatic activity of this region terminated by pure asthenosphere-derived alkaline basaltic volcanism.

Li, Na, K, F, B, Cl –METASOMATOSIS OF Mn - METAMORPHOSED ORE FROM BISTRITA MOUNTAINS (ROMANIA)

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The metamorphites of the Bistrita Mts belong to the Crystalline Mesozoic Zone of wich tectonic consists of superposed nappes, overthrust eastward to the Flych Zone. The Mn ore is included in Tulghes Formation – a retrograde polymetamorphic Series of Lower Paleozoic age.

The mineral paragenesses in the primary ore from Bistrita Mn deposits are the result of the ore's complex evolution through several retrograde metamorphism phases. The metasomatosis played an important role in the forming of the new minerals in the Mn-ore. Thus, the nambulite and natronambulite come from rhodonite by Li, Na, OH metasomatosis. The alkali pyroxene of Mn-aegirine type come from colorless pyroxene of the johannsennite-Mn hedenbergite type. The alkali pyroxenes have zoned compositions: in the middle there is the colourless pyroxene, the johannsennite-hedenbergite type, its margin is yellow-brown and belongs to the alkali pyroxene of aegirine type. The alkali amphibole (glaucophane, riebeckite, winchite, kozulite etc.)., were formed through the gradual substitution of the mangangrunerite by metasomatosis with Na, K, F. We have found all the intermediary stages from mangangrunerite to sodium amphiboles bots of riebeckite and glaucophane type. The Mn-humites (ribbeite, leucophoenicite, sonolite, etc) were formed by F, B, Cl and OH metasomatosis on pure tephroite. The mangapyroamalite group minerals have been formed by the substitution of the tephroite by solutions rich in chlorine and OH.

We wonder whether the metasomatosis is the result of an insitu evolution or is to un alien to the mineral source. The posibility of the ore' insitu evolution could to be supported by the presence in the premetamorphic precursors of the evaporites type sedimentary deposits, -the source of Na, K, Mg, Cl, F, B. The lithium also was probably present in sedimentary precursor deposits.

PALEOMAGNETISM OF UPPER CRETACEOUS TO NEOGENE STRATA FROM THE MOESIAN MICROCONTINENT, BULGARIA

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The Moesian micro-continent is a peri-Gondwanan continental fragment that had broken its attachment in the Early Paleozoic and accreted to the sub-Carpathian and Dobrudzha segments of the southern periphery of the Eurasian continent after the closing of the Paleotethys in the late Paleozoic.

We obtained paleomagnetic results from Neogene basalts (K-Ar age 22 Ma), Paleogene siltstones, Paleogene carbonate rocks, and Upper Cretaceous carbonate rocks from northern Bulgaria. The behavior of the Neogene volcanics during demagnetization clearly indicates magnetite as the mere carrier of the remanence. After removal of a viscous random component at very low alternating fields (AF), the remaining magnetization decays in a univectorial fashion towards the origin and is stable up to 560°C. Owing to the extremely weak natural magnetization of the samples from the Paleogene sediments, only three sites of clastics and one site of carbonates yielded interpretable results. Again, the behaviour during demagnetization indicates magnetite as the predominant remanence carrier. The Cretaceous carbonates show magnetite phases of various hardnesses, as the samples typically lose approximately half of their intensity when exposed to an AF of merely 5 mT, but their magnetization gradually decays at higher fields and remains stable up to 30 mT or more than 500°C, respectively. A part of these samples shows univectorial magnetizations but does not reach a final component, indicating the presence of a hard magnetic mineral, likely hematite. Of almost half of the Upper Cretaceous sites no stable magnetization components could be isolated due to very weak magnetizations, however the remaining sites show good within-site groupings. Isothermal remanence acquisition experiments support the above observations as to the magnetic mineralogy.

The following area means were calculated: Upper Cretaceous: 4.4°/53.4°/7.7°/5 (declination, inclination, confidence limit, amount of sites), Paleogene: 22.6°/53.6°/15.8°/3, Neogene volcanics: 14.8°/54.7°/14.3°/5. By comparison of these values with the expected magnetizations for this area with respect to the Eurasian apparent polar wander path, rotation and flattening were calculated. In each case, these values are small and statistically not significant. This result implies that the investigated area did not undergo significant movements relative to the European continental interior since the Late Cretaceous.

During the Alpine orogeny, the Moesian microplate formed a part of the active continental margin of the Eurasian continent, and its southern parts were subjected to repeated polyphase deformations. The regional stress field was characterized by sub-horizontal and generally north oriented compression and sub-vertical extension. However, our data indicate that the cratonized parts of the Moesian microplate were not significantly affected by these events. Jurassic carbonates from the Fore Balkan and Stara Planina mountain ranges just to the south of the Moesian platform were pervasively remagnetized in an Oligocene field, likely reflecting the thermal events associated with the active continental margin between the African and Eurasian continents during that time. The concordant nature of our data from the Moesian platform with respect to the European continent and the absence of remagnetizations implies that the structural motions controlled by extension within the general Aegean region and lateral movement along the North Anatolian transform fault still affected the Fore Balkan and Stara Planina mountain ranges, but ceased at the southern rim of the cratonized Moesian micro-continent.

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CRETACEOUS PALAEOKARST AND CENOZOIC EROSION OF NORTH SPORADES (GREECE)

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The relief history of the Magnesian Islands (North Sporades) has been studied by geomorphological field observations on Skopelos and by apatite fission track analysis on Skiathos, Skopelos and Alonnisos. The measured ages as well as modelled cooling paths reveal regional variations of post-Eocene erosion.

Two generations of pre-Eocene palaeokarst can be observed on Skopelos Island. The older one developed during the Lower Cretaceous on Triassic dolomites of the ancient Pelagonian shelf. This palaeokarst is sealed by bauxites and laterites which were derived from parent rocks of the Eohellenic nappe. A second palaeokarst generation developed on Upper Cretaceous rudist limestones and was buried under Palaeogenic flysch.

Three generations of Neogene peneplains occur on Skopelos Island above 300 m altitude. Modeled cooling paths and tectonic observations imply that these planation levels must have been formed between approximately 10 and 5 Ma ago, i.e. during the Late Miocene (Tortonian and Messinian).

In contrast to Skopelos, the preservation of pre-Pliocene relief elements can be mostly excluded for Skiathos and southwestern Alonnisos. Neogene horst-graben tectonics were distinctly active on Skiathos.

THE INFLUENCE OF SACKUNG-TYPE SLOPE DEFORMATIONS FOR ACTUAL DENUTATION IN HIGH MOUNTAIN REGIONS.

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Along the mountain chain of the Niedere Tauern (Eastern Alps) numerous Sackungen-type slope deformations occur. They are affecting glacial steepened slopes of the main drainage system, modelled in both polymetamorphic crystalline basement units of the Middle Austro Alpine and phyllitic series of the Upper Austro Alpine. Three general types of Deep-reaching Gravitational Slope Deformations (DGSD) can be distinguished: (1) DGSD small in size generally destabilizing steep slopes influenced by local glaciers. Instability is indicated by the generation of extension gashes using local pre-existing joint systems. (2) DGSD characterized through double ridge crest structures associated with ridge top grabens, huge single scarps and upphill facing scarps on significantly convex bulging hillslope geometry. (3) DGSD facing s-shape slope surface morphology, typically are showing bulging toe geometry ("Talzuschub"), up to seven square kilometers can be enlarged.

The resemblance of characteristic surface morphological features like double crested ridges, ridge top graben structures, scarps and trenches, especially in the upper part of hillslope (Fig.1), do indicate deep reaching disturbation of pre-existing foliation sets, but also brittle deformation of rock masses involved. This means, that mountains brickwork completely is relaxed and therefore does provoke accompanying secondary mass movements like shallow landslides in the central parts of the Sackung. Plaike systems followed by deposition of large debris fans also occur in lateral extension of main scarp, large scale landslides and rock fall occur especially at the lateral transition zone to stable host rock. (Fig.1).

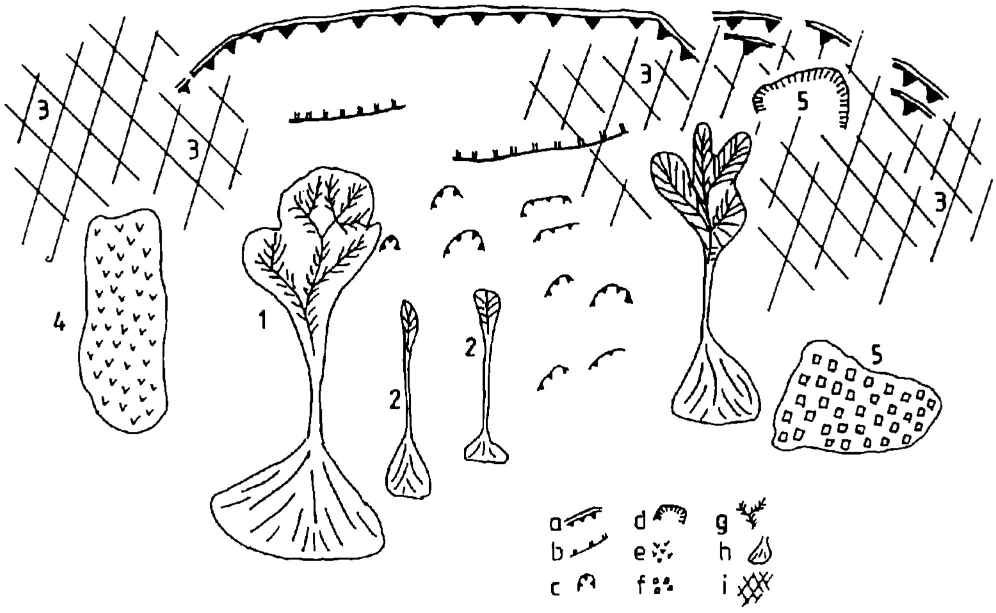

Fig. 1. Compilatoric sketch map of Sackung -type landslide and accompanying mass movements: (a) main scarp as outcropping normal fault surface, (b) uphill facing scarp as outcropping antithetic normal fault, (c) scarps of shallow rotational landslides, (d) scarp of rock fall, (e) landslide debris, (f) rock fall debris, (g) erosional gullies, (h) debris fan, (i) regions of more intense relaxed mountains brickwork. (1) Active plaike system following pre-existing drainage systems, (2) new generated plaike systems, (3) relaxed host rock of the transition zone, (4) mobile landslide, (5) sackung induced rock fall.

STRUCTURAL EVOLUTION OF THE SOUTHEASTERN NORTHERN CALCAREOUS ALPS: SIGNIFICANCE OF THE MELIATA/LOWER JUVAVIC NAPPE COMPLEX AND POST-GOSAU SOUTH-DIRECTED BACKTHRUSTING

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The structural evolution of the southeastern Northern Calcareous Alps (NCA) has been investigated in the area of Puchberg am Schneeberg and Neukirchen (Lower Austria). Here, the Upper Juvavic (Schneeberg) nappe overlies the combined Meliata/Lower Juvavic nappe complex and the Tirolic nappe complex. The Tirolic nappe complex is in primary contact to the Early Paleozoic basement exposed within the Grauwackenzone.

The present tectonic structure is the result of several stages of deformation which developed between early Late Cretaceous and Neogene. An early Late Cretaceous (pre-Gosau) stacking of the Schneeberg nappe onto the Meliata units, which include the Florianikogel and Geyerstein nappes, and over the Tirolic nappes occurred under semiductile deformational (deformation phases D1, D2) and low-grade metamorphic conditions. A flat-lying foliation parallel to nappe boundaries and W- to WNW-trending stretching lineations were formed. At least final stages (D2) resulted in ESE-directed extension of the assembled nappe complex. Formation of Gosau basins onto the assembled nappe stack occurred after Cretaceous metamorphism. No clear evidence was found for corresponding basin formation structures. However, post-Gosau deformation phases dominate the present-day structure. A structural succession includes, in part consistent with previous work in other sectors the Northern Calcareous Alps and with deformation within the Vienna basin:

D3 represents a phase of south-directed back-thrusting combined with N-S shortening which is characterised through south-directed backthrusts at the southern margin of the NCA and south-vergent E-W-trending folds with hinge zones in the Tirolic Hengst- and Edenhof-windows and in the Grünbach-Neue Welt syncline. We interpret the formation of the Hengst- and Edenhof windows as result of S-directed blind thrusting (Fig. 1). Slickenslide data measured along the southern margin of the NCA are consistent with the south-directed movement. We interpret this phase of backthrusting to be related to N-directed emplacement of the NCA thrust wedge onto the European lithosphere, accomodating the critical angle of taper and forming a pop-up structure.

D4 is a N-S compressional phase which is shown in N-directed, S-dipping thrusts. It is followed by NW-SE-compression D5, represented by major NE-trending thrusts. D6 is a NE-SW-oriented compressional phase with NW-trending thrusts and N-striking dextral strike-slip faults.

A subsequent E-W-extensional stage represented through NW-trending normal faults has been identified as D7. The youngest deformation in the area is a pahse of ENE-WSW oriented compression which is shown in E-trending dextral strike-slip faults.

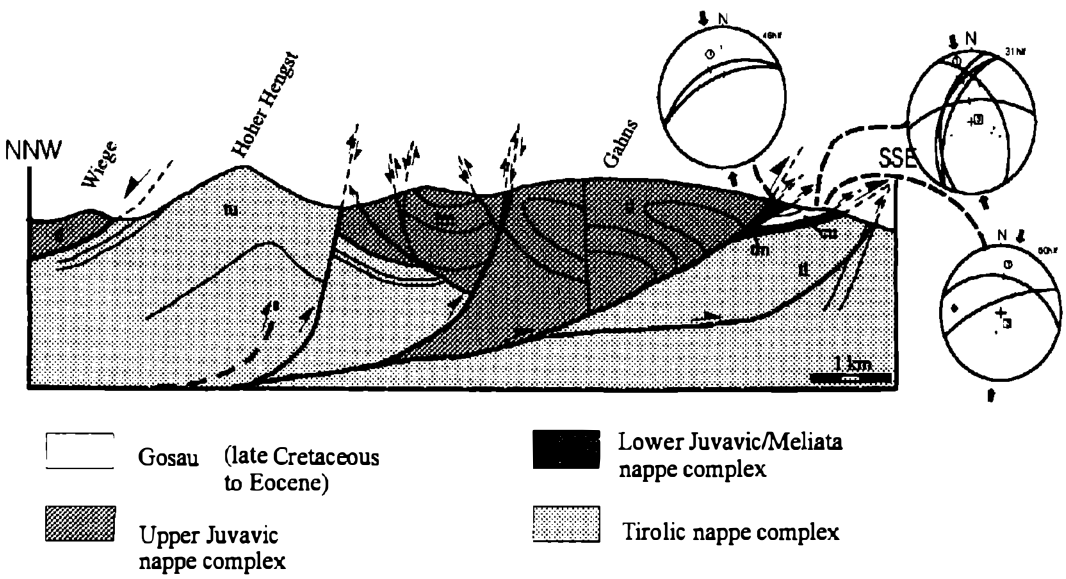

Fig. 1: Ca. N-S oriented cross-section through the southeastern Northern Calcareous Alps displaying structures related to S-directed back-thrusting and N-S shortening.

LOWER ANISIAN "GUTENSTEIN" FORMATION IN NORTHERN HUNGARY

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Lower Anisian "Gutenstein" type rock were studied in a cave section of overthrusting Silicicum in northern Hungary. The formation continuously evolved from the Lower Triassic ramp succession The overall poorness in fossils does not allow exact dating of the formation. Earlier it was accepted as a compromise that the lithostratigraphic boundary between the underlying and „Gutenstein" Formation coincides with the Scythian/Anisian boundary. But it seems to be more realistic that the lithostratigraphic boundary is not coeval. Light grey dolomites and dasycladacean limestones (Steinalm Formation) compose the overlying stratigraphic unit.
The type locality of Gutenstein Formation is defined from the Northern Calcareous Alps (Tollmann 1976). Because of the close similarities (black colour and fine crystalline composition), the Gutenstein name is used for the Early Anisian formation in southern West Carpathians, too. But the detailed study showed that the facies of the formations in the Alps and Northern Hungary are rather different.

In the Early Anisian, carbonates were accumulated on a gently sloping ramp, on the northern passive margin of the western Tethys. The depositional environments are represented by shallow marine inner ramp to open marine outer ramp carbonates. The sliding and slump structures refer to distally steepening of the ramp. The inner ramp facies are represented by laminated and brecciated dolomites with evaporites (sabkha facies), stromatolites and ripple cross-laminated carbonate siltstones (intertidal facies). In the shallow subtidal back-shoal area, grainstones with multiple coated aggregate grains are characteristics. The oolite shoals represent the highest-energy environment. On the mid-ramp microbial mounds buried by crinoidal or peloidal storm-sheets were built up. On the outer ramp micro-laminated mudstones/siltstones with filaments and silica nodules were deposited.

After the Permian-Triassic extinction event, first development of organisms adapted to the stabilization of sediments was enabled the smaller organic buildups to be formed. These organisms were probably predominated by blue-green algae which were binding and trapping of sedimentary particles, and stimulating rapid and early marine cementation; they were capable to built microbial mounds (Flügel 1982, Gaetani & Gorza 1989). Binding organisms were active not only in the shallow water and tidal flat environments (stromatolites and aggregate grains), but on the mid-ramp as well (from the outer parts of the high-energy oolite shoals down to the lower parts of the gentle slope). Besides the debris producer organisms, forams, molluscs, and crinoids, peloids are the prominent components of the Early Anisian carbonates.

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THE SOUTH-ALBANIAN OPHIOLITES IN THE FRAMEWORK OF THE DINARIC- HELLENIC OPHIOLITES

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The Albanian Ophiolites are part of a large ophiolitic belt ranging from former Yougoslavia across Albania to Greece. A more westerly belt (Mirdita Zone) is accompanied by an eastern belt (Vardar Zone) bordering the Serbo-Makedonian massif ranging from Central Serbia across the Vardar zone to Northern Greece. The western belt in turn, can be partly divided into two zones with distinct geology, petrology and geochemistry. These twofold division is best developed in Northern Albina but not so clear anymore in the South-Albanian ophiolites. In Greece generally one uniform zone is recognizable execept for the Pindos -Vourinos ophiolites.

In Albania the eastern zone is characterized by thick harzburgitic tectonites followed by dunitic and pyroxenitic cumulates as well as gabbros and plagiogranites. A well developed sheeted dike complex exists beneath the volcanic sequence consisting of basaltic pillow lavas, andesites and rhyodacites. The ophiolitic sequence ends with a relatively thin chert which in turn is overlain by Jurassic and Lower Cretaceous turbidites. The western ophiolites comprise harzburgitic and lherzolitic tectonites as well as plagioclase bearing lherzolitic and dunitic cumulates. Relatively thin troctolites and gabbros are directely overlain by basaltic pillow lavas. A sheeted dike complex is missing.

The geochemistry reflects the differences between both ophiolite types. Basalts of the western ophiolites show mainly MORB character. The basalts of the eastern zone are comparable with basalts formed above a Supra Subduction Zone environment or an Island Arc. Both ophiolites form metamorphic aureoles consisting of amphibolites, micaschists and greenschists at their basis. Age dating indicates an emplacement of the ophiolites and consequently the formation of the metamorphic soles at an age intervall of 161-173 Ma at middle to late Jurassic times. Paleontological evidence for the formation of the ophiolites indicates a middle Jurassic age.

Both belts, E and W of the Pelagonian and Drina-Ivanica Zones resp., or some of their segments were believed to be dominated either by harzburgite (eastern belt and central to southeren part of the western belt) or lherzolite (western belt N of the Scutari-Pec line). More recent studies on the Albanian ophiolites however, have revealed a separation of the Albanian Mirdita Zone ino a western lherzolite and a eastern harzburgite bearing area each with a characteristic ophiolite sequence. Comparison with the Hellenic ophiolites shows that towards the S no clear separation can be made between western and eastern ophiolites and that profiles contain elements of both zones.

There is obviously a wide variety in ophiolite composition alon strike over the whole western belt from southern Croatia to Central Greece. The variation within the western belt is probably as large as between the western and the eastern belts. The same middle to late Jurassic formation age, the occurrence of metamorphic soles and comparable sediments on top indicate a common formation and emplacement history.

GEOTOPE RESEARCH IN AUSTRIA: AN OVERVIEW

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Although the history of geological research in Austria dates back to the 18th century, systematic studies of the geological heritage started in 1995. The first attempts to protect geosites date from 1856 when the exotic granites of the "Leopold von Buch Denkmal" were purchased by the Society of Scientists and Doctores to protect it from quarrying activities. Within the first decades of the 20th century important geosites became protected by law. In Austria geotopes are protected by law in the nine federal states.
The aim of geotope research is a kind of "visitcard" for Austrian geology. This can only be reached by the cooperation of a nationwide network of all geologists.
This work is supported by a special project in charge of two ministeries, by the ministery of Environment, Yought and Family and by the Ministery of Science and Research. To the second one the Geological Survey of Austria belongs to.

The project has started with an evaluation of all geological monuments being protected by law. The evaluation has brought up a list of apx. 700 geological monuments. These are registered in a database which provides also topographic data (coordinates) and geological information (stratigraphy and tectonic units). Additionally literature and some recent photos are documented.

In the last three years this work made evident, that there are only a few many monuments which are not of pure scientific interest. Natural monuments are part of nature therefore there are many relationships to other scientific disciplines. Out of this there is not only a scientific approach, but also a public interest.

➢ **The importance for biology**
There are many monuments showing in an excellent way the interactions of geology and biology. From this point of view the terms "biogeotope" and "geobiotope" were poposed to show the close relationship between the biosphere and the geosphere. As a consequence of this arises a new chance to cooperate with biologists. This new challenge allows new ways for understanding the various connections between geology and biology.

➢ **The importance for customs**
Some of the natural monuments are protected because of some mythological or ethnological importance. So we find a "Devils Wall", some "Devil stones" and so an. These places have a long local tradition and from this point of view they are very important. So this rather traditional aspect, closley linked with customs, is one of the new chances for geotopes.

➢ **The importance for architecture, sculptures and buildings**
Some quarries turned out to be very important for the origin of famous sculptures and buildings. The most famous is the cathedral of St. Stephans in the center of Vienna. The quarries are used since the Romans have been in Austria. The Miocene Leitha limestone was widely used in the late 19th century and is even now very important for architecture.

These above mentioned relationships are new chances for the poularity and the protection of geotopes. As the evaluation of already protected geological monuments is now finished, the next step of the project will be to list up further important sites which are worth beeing protected. This second part of geotope evaluation should be finished in 2000.

THE PRESENCE OF STIOL SUBGROUP (RODNA GROUP) IN THE MARAMUREŞ MASSIF - ROMANIA

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Key words: Metamorphosed Formations, Lower Palaeozoic, The East Carpathians, Romania.

Abstract: The assumption of existence in the East Carpathians to the Metamorphosed Palaeozoic was issued from the end of 19th century (Paul, 1876 and Zapalowicz, 1886) and this existence was stated by Th. Kräutner (1938) through the petrographic similarity with the Moravo - Silesian Metamorphosed Palaeozoic.

Kräutner et al. (1983, 1989) was founded in the infra - Bucovinian Nappes from the Rodna Massif, some metamorphosed formations which Variscan were cousidered and overlied the Bretila Group.

These formations were named: Rusaia "Series", Repedea "Series" and Cimpoioasa "Series", which represented: the Valea Vinului Nappe, Stiol Nappe and Anieş Nappe. These "Series" Balintoni (1997) brought together in the Rodna Group. The presumed ages of these Subgroups are: the Valea Vinului and Stiol Subgroups to Silurian, and the Anieş Subgroup to Devonian - Lower Carboniferous (V Iliescu, Kräutner, 1976, 1978). Pitulea and Pitulea, A. Visarion (1972) described in the North - West from the Maramureş Mountains the Bistra "Series" which may be in similarity with Cimpoioasa "Series"

In the Vaser Basin (Maramureş Massif) these exist the so - called "iron formation" which includes weakly metamorphosed phyllite - carbonate rocks with index minerals: chlorite, albite, stilpnomelane, chloritoid (Zincenco et al., 1982). This "formation" represents the Stiol Subgroup, which appears as tectonic slices between the Rebra Group (sub - Bucovinian Nappe) and the Bretila Group (infra - Bucovinian Nappe), sometimes overthrust upon Jurassic formations ("Bardău Formation" Patrulius et al., 1968; Kräutner, 1972; or "Dovgorun Series" Gluşko, Kruglov, 1971).

The palinological complex of the Stiol Subgroup is founded on the determined palinological assemblages. The palinological assemblages are characterized especially as: *Chitinozoaires*, *Cyathochitina protocalix* Paris, *Lagenochitina macrostoma* Taug. et Jehk, *Acanthochitina secunda* Eis. and *Acritarchs*, *Aremoricanium squarrosum* Loebl Jr. et Mac Adams, *Nellia magna* Volk., etc.

The presence of *Chitinozoaires* and *Acritarchs* with the characteristic taxons in the interval Ordovician - Silurian attributes to this age, in a broad sense, for Stiol Subgroup in the Maramureş Massif. The K-Ar ages (103-148 M. a., Zincenco, 1995) suggest a possible age of the Alpine metamorphism.

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COMPARISON OF THE ALPINE METAMORPHIC EVOLUTION OF THE BÓDVA VALLEY, DARNÓ HILL AND SZARVASKŐ OPHIOLITE COMPLEXES IN NE HUNGARY

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Crustal blocks containing ophiolitic rocks all belonging to the Neotethyan Triassic-Jurassic Vardar (s.l.)-Meliata Ocean are well known from the NE part of Hungary. They include the Bódva Valley area in the Aggtelek-Rudabánya Mts, the Darnó Hill (near village Recsk) and the Szarvaskő complex in the western Bükk Mountains. These Mesozoic dismembered, incomplete ophiolitic sequences belong to the innermost tectonic unit of the Western Carpathians, forming parts of the Gemer-Bükk unit. Previous geochemical data refer to MORB character of the Bódva Valley and Darnó Hill complexes and to oceanic tholeiitic nature of the Szarvaskő complex, the latter forming in back arc basin setting.

In the Bódva Valley area various (ranging in diameter from few cm to few hundred meters) rock fragments of mostly serpentinite, metabasalt and metagabbro embedded tectonically in a non-metamorphic evaporitic matrix of the Upper Permian Perkupa Evaporite were crosscutted in several boreholes. The gabbroic layer of the ophiolite complex suffered Alpine polyphase metamorphism. The first metamorphic event was a blueschist facies one with min. 7 kbar and ca. 300-350 °C. The age of this low thermal gradient metamorphism may be middle Jurassic, extrapolating the K/Ar and $^{40}Ar/^{39}Ar$ dates obtained on phengite from the Slovakian part of Meliaticum. The second, greenschist facies metamorphic phase is characterized by the assemblage of actinolite-chlorite-epidote-albite-quartz. The estimated physical conditions of this younger, most probably middle Cretaceous (Austrian phase) event are ca. 4-5 kbar and ca. 300°C, respectively.

The Jurassic Szarvaskő complex consists of basic and ultrabasic rocks that had been intruded locally by acidic dikes and veins, the Darnó Hill complex is built up mainly by massive and pillow basalts. The sedimentary environment is represented mainly by deep-water sediments in both complexes. The meta-igneous rocks of the Darnó Hill complex show only prehnite-pumpellyite facies ocean floor hydrothermal metamorphism , while the related sedimentary rocks suffered only diagenetic alterations. Two distinct Alpine metamorphic events were differentiated in the Szarvaskő ophiolite complex. The earlier ocean floor hydrothermal metamorphic event resulted in assemblages, the metamorphic grades of which increase downwards from the prehnite-pumpellyite or zeolite facies in metabasalts, through the greenschist facies in metadiabases to the greenschist-amphibolite transitional and amphibolite facies in metagabbros. The younger, middle Cretaceous (Austrian phase) regional metamorphic event produced prehnite-pumpellyite facies overprint in meta-igneous rocks, and late diagenetic to low temperature anchizonal alterations in the sedimentary surrounding.

The Meliata branch of the Mesozoic Meliata-Hallstatt ophiolites

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In the Western Carpathians sector of the Tethyan belt there exists several Mesozoic lithotectonic units, which originated in various tectonic setting. Generally they should be ranked among piles deposited within shelf domain. Among Mesozoic units the only one, the Meliata unit, is represented by a rock-pile of pronouncedly oceanic type.

Evolution of the Meliata domain begins in the Anisian by the collapse of the carbonate platform and since that time deep water sedimentation is documented. So unit under consideration is formed generally by the Triassic limestones, the members of dismembered ophiolites (Hovorka 1979, Hovorka et al. 1984)) and the Middle Jurassic turbidite-olistostrome formation.
The ophiolite complex is represented by:

a. intensivelly (90-100 per cent) hydrated (serpentinized) metamorphic peridotites with rarely found fabric of layering, dunite and very rarely also chromite nests. Leading serpentine-group minerals are represented by lizardite and chrysotile. In several bodies processes of rodingitization are reported.

b. Tholeiitic basalts are represented by individualised bodies locally with badly preserved pillow character. Ocean-floor metamorphism is dokumented.

c. Blueschists of the basaltic as well as sedimentary precursors, and

d. deep water sediments (radiolarites, radiolarian shales) of various size of individual occurrences.

The occurrences of above listed members of the ophiolite complex under discussion are distributed uneven. At present they occurs in two planparalelly oriented belts/branches: the northern and the southern one. Between them huge Early Paleozoic elevation, the Volovec zone, occurs. The original sedimentation area of the Meliaticum is supposed to be present Rožňava-Šugov suture zone.

In the northern branch of the Meliaticum ultrabasites, tholeiitic basalts and radiolarites occur. For the southern branch ultrabasites, basalts and blueschists are typical.

Middle Oxfordian closing of the Meliata-Hallstatt realm (Kozur 1991) is documented. In the southernly oriented subduction documented by the blueschists occurrences, only part of the Meliaticum oceanic crust has been consumed. The blueschist metamorphism was dated to be 165-150 Ma (Maluski et al. 1993).

Extremely complicated architecture of individual blocks and the different intensity of metamorphic recrystallization of the Meliaticum documents diversity of the Alpine geological processes which influenced complexes of the Inner Western Carpathians.

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DISTRIBUTION OF SI CONTENTS IN THE METAMORPHIC PHENGITES FROM THE METAGRANITOIDS OF THE VEPORIC BASEMENT (WESTERN CARPATHIANS).

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Palaeozoic granitoid rocks from the whole territory of the Veporic basement (Slovak Ore Mts.) show a strong to medium recrystallization caused by the Alpine metamorphism. Phengitic micas are common constituents of the Alpine metamorphic mineral association (with biotite$_2$, albite, oligoclase, ± K-feldspar, zoisite and Ca-rich garnet). The Si contents in phengites range between 6.35 - 6.95 per formula unit (22 O). Its composition is controlled by the bulk rock composition, by mineral paragenesis and by pressure.

The effect of bulk rock composition upon the phengite composition is clear when we compare lithologics richer in biotite (metatonalites, metatronhjemites, metamigmatitic layers) with the lithologies poor in biotite (metagranites, metaleucogranites). In more mafic lithologies, the phengites contain less Si, the celadonite substitution is lower and Na substitution is higher. The lithologies lacking biotite contain phengites with higher Si and celadonite contents. The compositions of phengites also depends on the composition of the coexisting biotite. The Mg / (Mg+Fe$_t$) ratio in the phengites and coexisting biotites is nearly linear. In the presence of chlorite phengites are less magnesian. The phengite composition is also controlled by its position in the rock texture. The preserved plagioclase clasts (composed of association - albite, phengite, zoizite ± Ca-rich garnet) contain the higher pressure phengites, with Si content higher, than phengites in the surrounding metamorphic matrix.

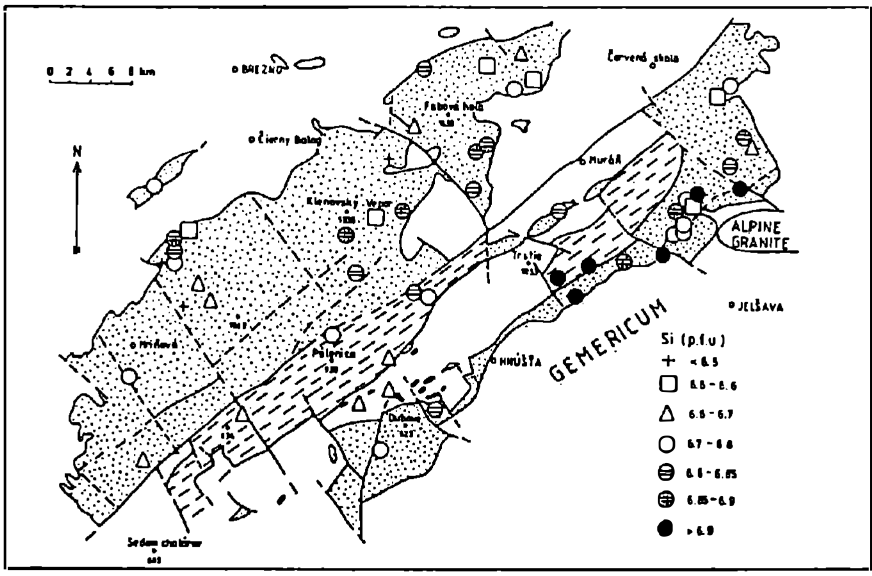

Fig.: The maximum Si values form phengites recorded in selected sampies.

Dotted area - granitoids, dashed area - hybrid complex (gneisses, migmatites, granitoids)

The maximum Si values (over 6.9) were recorded in the phengites in the metagranitoids from the SE of Veporicum, near Rochovce Cretaceous granite intrusion and in central part of the granitoid pluton. This indicates the highest pressure condition in this area. These phengites are zonal, with a strong decreasing of Si towards rims. Discontinuous zoning of the phengites revealed, that two metamorphic phases were here present. Phengites of the higher pressure M1 metamorphic phase (Phg Si > 6.8) are present as relict cores in the lower pressure phengites of M2 metamorphic phase (Phg Si < 6.8).

EVALUATION OF THE GEOENVIRONMENT FOR TOWNS DEVELOPMENT

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The present development of the society involves a fast increase in the town-type urbanisation. This brings about the problems with rational use of the landscape and of the geological environment (geoenvironment), as well. The first group of problems is in multifunctional nature of the geoenvironment, which can be utilised for various purposes, within the urban development including. The second one lies in the proper sites selection for various type of constructions, because the suitable ones are usually built up and the new constructions are to be erected in less suitable engineering-geological conditions (on foundation soils of low bearing capacity, in water saturated soils, on less stable slopes, etc.) or in protected areas of various types (water protected areas, protected landscape areas, protected areas of deposits, etc.).

From this point of view requirements have grown for quantity and quality of geological information in the land use planning procedure, especially for the new types of engineering geological maps expressing not only the engineering geological conditions, but the suitability of the territory for the certain types of constructions, the optimum land-use (from several alternatives), the geoenvironment vulnerability and the long term changes of the engineering geological conditions, as well.

The land units delimited in the suitability maps are defined in terms of their suitability for a particular land use (e.g. industrial or residential structures) and are prepared on the basis of specific classification of individual componets of the engineering geological condition reflecting the purpose of the map. They are more accessible and useful to the wide public than maps of engineering geological conditions since they record the same information in a rather compact way, concetrating on the specific typ of land-use. Besides of those geological factors (geofactors) which have a direct influence upon the urban development (slope, landslides, bearing capacity, depth to groundwater table, etc.) also other geofactors of the environment may be taken into account in compiling the maps (mineral resources, water resources, fertile soils, etc.). They represent on the one hand the constraints to urban development and, on the other hand, show others (may be better) possibilities of land-use.

In spite of the comprehensive and useful information the suitability maps cannot provide a satisfactory answer to the question which way of land-use is most suitable within a particular territorial unit and neither they can exactly specify which territorial unit within the area of interest is most suitable for a particular land-use because the same suitability class may be brought about by different quality of various geofactors. These problems tackle the optimisation maps in which the suitability of each land unit is quantified by means of categorise, ranking and weighting of all relevant geofactors. If further factors of the geoenvironment and the landscape are included a comprehensive map of optimum land use and environmental protection can be prepared.

The maps of the changes of engineering geological conditions show the existing as well as the potential changes of the geoenvironment due to the natural development and/or by human activities. The prediction of the changes is based on an extrapolation of the geological development taking into account the natural and/or man made changes in climatic, hydrological and hydrogeological conditions, as well as the changes in the way of land-use (e.g. deforestation, water reservoirs building, urbanisation, etc.). They may cause e.g. the vorsening of strength and deformation properties of rocks, changes in the volume and consistency of soils, changes in the groundwater corrosiveness, etc. The engineering works which were designed without consideration of this changes cannot always adapt them without damages or even destruction.

The maps of engineering geological vulnerability are in their nature the prognostics ones, too. In opposite to natural and induced long term changes, evaluated in the maps of the changes of engineering geological conditions, the maps of the vulnerability predict the immediate and usually hazardous changes caused by unfavourable geological processes (sliding, suffosion, erosion, sagging, etc.) which may be involved due to man's interference with geoenvironment at construction, mining and other economic activities. To this group of maps belong e.g. the maps of susceptibility to sliding, the maps of susceptibility to sagging, the maps of susceptibility to erosion, etc. The comprehensive maps of susceptibility to hazardous geological processes may be compiled as well. Each of these maps indicates the weak points of the geoenvironment, in which it is vulnerable in the process of urbanisation or other way of land utilisation. These maps are very helpful at the processes of land-use planning and environmental impact assessment, as well.

GEOLOGICAL FACTORS OF THE ENVIRONMENT

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The environmental-geologic system, as a specific model of the geoenvironment, is created by its four (in some way defined) basic components: rocks, groundwater, relief and processes which take place among them. In terms of environmental geology we call this system as environmental-geologic conditions. The individual components (geocomponents) as well as the whole system of environmental geologic conditions are influenced by other components of geographical (landscape) system, mainly by climatic and hydrological factors and by human intervention in the geoenvironment. Thus, it is of a great importance to study not only the components of the geoenvironment but also the interactions within a larger system of landscape. The geological factors (geofactors) of the environment have the significant importance in this system.

The geofactors of the environment are the properties of the geocomponents which have a cosiderable influence upon the environment, mainly upon the quality of landscape and possibilities of land-use. Geofactors which through they character and quality, permit or in some way positive affect the exploitation of an area are called geological potentials (geopotentials). Geofactors which limit or in a negative way affect the land-use are called geological barriers (geobarriers). Those geopotentials which are taken from the geoenvironment are called georesources (mineral resources, water resources, etc.), those ones, which are utilised in place, we call geofacilities (fertile soils, foundation soils of high quality, etc.). As geological hazards (geohazards) are called those geobarriers which endanger landscape and the environment or even health and life of people (ruinous earthquakes, large landslides, etc.). Those geobariers which limit the land-use or raise the price of land-use (unsuitable foundation soils, susceptibility to landslides, etc.) we call geoconstrains. The whole system is given in Tab 1.

Tab. 1. Classification of the geological factors of the environment

Geological potentials (geopotentials)	geological barriers (geobariers)
Geological resources (georesources)	geological hazards (geohazards)
Geological facilities (geofacilities)	geological constrains (geoconstrains)

The best way how to express the geoenvironmental conditions of a territory and/or its suitability for a particular land-use is to compile a map. The maps of geofactors consist of several map sheets covering practically all branches of geology mainly engineering geology, hydrogeology, geochemistry, economic geology, geophysics and pedology. Regarding the great amount of the maps, as wel as the high degree of specialisation of some of them, the simplify comprehensive maps of the most significant geofactors are compiled for the purposes of land-use planning and environmental protection. The maps contain only some, the very relevant geofactors, which in a high degree affect the land-use (significant mineral and water resources, unsuitable foundation soils, high quality fertile soils, seismic intensity, important landslides, high radon risk districts, etc.). The maps of geofactors of the environment provide useful information for compilation various types of maps. However, these maps, mainly the map of significant geofactors, may be employed directly for land -use planning purposes, too.

RELATION BETWEEN RADON RISK AND NEOTECTONICS IN SW. PART OF THE MALÉ KARPATY MTS. AND IN SURROUNDING BASINS (SOUTHWESTERN SLOVAKIA)

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Abstract

In frame of the "Bratislava - environment,abiotic component" project, the radon risk map of the subsurface layer has been compiled. Besides this, the map of Rn-222 volume activity distribution in groundwaters (springs, wells, pumped wells) has been constructed too.

The area of interest lies in sw. part of the Malé Karpaty Mts. (Bratislava Capital area) and surrounding intermontane basins (Vienna basin - Borská nízina lowland, Danube basin - Danube lowland, Trnavská pahorkatina upland).

The region under study is built by crystalline complex (granites, granodiorites, amphibolites, gneisses), Mesozoic carbonates, sedimentary rocks of the Neogene and Quaternary ages. Whole area has complicated tectonic pattern (presence of old faults, seismoactive and neotectonic fault systems as well as several registered earthquake epicentres) of various courses and ages.

The Rn-222 volume activity (a_v) in soil air has been determined in 0.80 m deep holes, located in "reference areas (RA)", with density of 3 RA per 1 sq.km. One RA represents 20 observed stations in regular network of 20 x 20 m. The map of Rn-222 distribution in groundwaters is based on determination of a_v at 140 water samples.

The comparison of radon risk and neotectonic maps clearly shows that young active fault systems are ideal ways for rising up a radon emanation to the surface and groundwaters. In contrary, the radon survey should be effective method for mapping the seismoactive and neotectonic fault systems.

Follow-up monitoring the equivalent volume radon activity (EVRA) in apartments of Bratislava Capital, located in the areas of high radon risk has shown values, several times exceeded Slovak and international limits (Devínska Nová Ves, Marianka, Raca, Vajnory localities).

COMPLEX GEOPHYSICAL INVESTIGATIONS - A STAGE OF GOLD-SILVER DEPOSITS EXPORATION IN WEST BALKAN

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It has been considered in the article an example of complex geophysical methods application in the region of West Balkan from Vrushka Chuka to the town of Berkovitsa. The opportunity for a new metallogenic assessment is based on the geophysical exploration methods carried out in well separated stages. A new geologic conception founded on the rift global tectonic was promoted for the study region in the last years.To explore the structural characteristics there in the preliminary stage the gravimetric and magnetic data at scale 1:50 000 has been used. The regional field maps after Tihonov-Bulange method with radii 2; 3,9 and 5,8 raising the field in the upper semispace in height of 4 km also have been used. The structural characteristic of the huge magmo-tectonic Chiprovtsi-Govejden gold-silver polimetal knot has been derived according to the anomaly values of the total vector Δt from the magnetic survey. It is formed by the folowing basic faults NNE (Govejden ore zone), WNW (Chiprovtsy ore zone), NNW and the prolongation ENE transfom zone Pache – Skutare – Montana which have been marked by the gravity field gradient changes and the linear magnetic anomalies. The detailed studies in scale 1:10 000 and 1:5 000 have been included in the second stage of geophysical applied methods. As a result folding and fault structures with increasing and decreasing electric resistivity values have been established. For the region of Yavorova Glava the magnetic survey methods have been applied to outline the weak positive anomalies identifying magmatic manifestations. Radiogeochemical method of specialization has been used to measure U, Th and K. For the region of ore reveal Naidenitsa applying the statistical analysis of RGS for the distributions of these elements concerning gold and silver bearing structures.

The example for the geophisical methods application in prospecting presious metals for ore–bearing structures shows that according to the aims and geological study grade the efficiency in metallogenic prospecting is achieved observing well determined stages in working with differend applied methods.

STRUCTURAL DATA ON THE METAMORPHIC COMPLEX OF THE MID-BOSNIAN SCHIST MONTAINS

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Key words: structure, Bosnian transversal strike, fabric elements, foliation, folds, transposition of s-surface, metamorfism, quartz veins.

The paleozoic metamorphic complex of the Mid-Bosnian Schist Mountains to date has been studied to a less extent. By the elaboration of the new geological map, carried out during the period 1987-1997, data as follows were obtained: mapping of metamorphic rocks, determination of their age and metamorphic degree, geometry and classification of their fabric and succession of occurrence in the fabric-all of them as very significant are-controlling factors. Based on all these data, in this paper is proposed a probable model of the genetic evolition for the Mid-Bosninan Schist Mountains as a contribution to the explaination of the "Bosnian transversal strike" proposed by Katzer (1925).

Greenschist facies metamorphic rocks are represented varietied by quartz-sericite schict+chlorite+ chloritoid+actinolite+biotite, carbonate schist, marbles, quartzites and metamorphosed rhyolites. K-Ar measurement on pfresh biotite gave on overprint age of 35 Ma.

Basic fabric elements are bedding, foliation, cleavage, fissure and lineation. Mainly NW dip of bedding with low inclination is brought about by isoclinal folding and the transposition of s-surfaces. Foliation is developed along axial-plane celavage and bedding surfaces. First pre-metamorphic deformation gave isoclinal folds. Second generation of axes are related to quartz-ptygme folds. Axes of the third generation reflect slight folding which deform all existing s-surfaces. Axes of the fourth youngest folds are related to faults. Most common shearing fissures are NW-SE directed.

Genetical model of structural formation is as follows: the oldest stage gave rise to folding whish, by the increasing intensity, graded into isoclinal folding accompanied by the generation of axial – plane cleavage and further by sliding along it into the complete transposition of s- surfaces. Concering the products of this structuration two main structural levels can be distinguished:

-The lower one is characterized by isoclinal folding, complete transposition and foliation developing along the axial-plane cleavage and bedding with excelletly pronounced lineation.

-The upper level is characterized by less pronounced folding without the complete transposition of s-surfaces and with less developed foliation and lineation.

Vertical relation between these two levels of different fabrics (complete transposition – isoclinal folding-folding lower index) and degree of metamorphism (greenschist with foliation cleavage and beds-gradational weak metamorphism with weak foliation) suggest a possible genesis of the fabric by sliding of the whole block of the Mid-Bosnian Schist Mountanis, together with its southwestern Mesozoic envelope along the zone of lower level brought about by NE-directed underthrusting ot the southern Gondwana margin (F_1 and F_2). The isoclinal folding, transposition and metamorfism commenced probably in Triassic as inicated by the fact that the younger formations display less pronounced fabric but of the same quality as the underlying Paleozoic formation. The underthrusting from the southwest continues during the whole Mesozoic. The northeastern part of the Paleozoic complex close to the Busovaca fault was uplifted before the Late Jurassic giving rise to large fold forms with slight secondary fine-scale folding (F_3). In the frameund of this model very significant are tectonic structurtes located southeastward from the Paleozoic complex which have the direction perpendicular to strike of the Dinarides suggesting to one component of the SE-NW direction. Such a mechanism can be the explaination of Katzer's "Bosnian transversal strike" Northeastward underthrusting of the Adriatic microplate and its Late Cretaceous-Paleogene convergence with the Eurasia gave rise to strong SW-NE reduction and thus to changes of mutually perpendicular predominant stress and compression.

The Mid-Bosnina Schist Mountains include numerous and differend mineral deposits and ore occurences of quarzt, barite, iron, gold, antimonite, pyrophyllite, fluorite and others. Structural data indicate that at least three generations of quartz vein exist. The first one corresponds to quartz-ptygmes of decimetre size, the second quartz generation which originated along the foliation surfaces (after F_1 and F_2), is up to 1 m thick and can be traced along strike for 50 m. The third generation quartz, which is 1 to 6 m thick and can be traced along strike for 20-30 m, cust the second generation quartz.

GRAVITY IMAGES OF THE BOHEMIAN MASSIF AND THE WEST CARPATHIANS CONTACT ZONE

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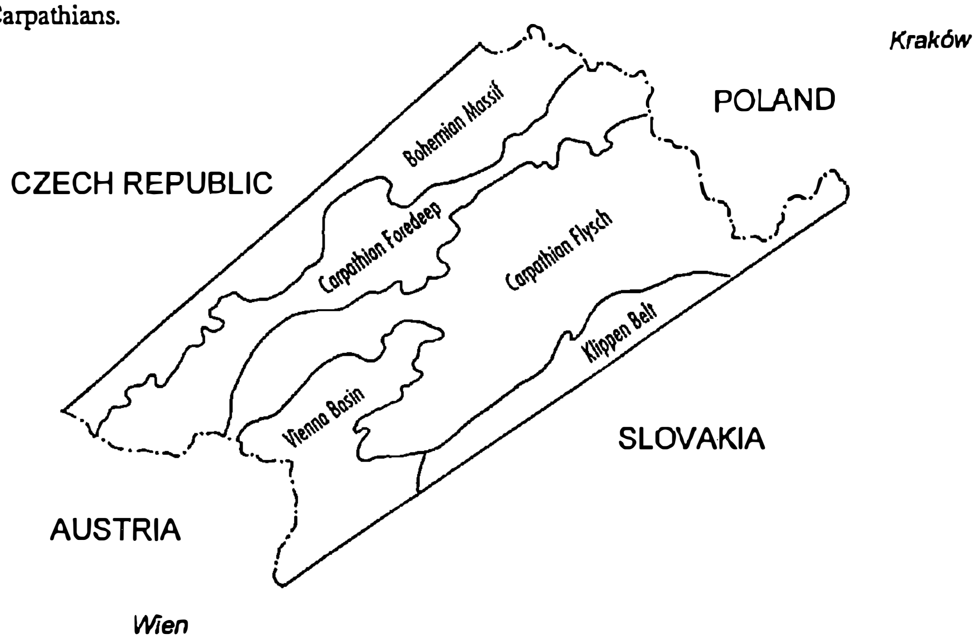
The study area, in the eastern portion of the Czech Republic, near the border with Slovakia, covers the contact zone between the Bohemian massif and the West Carpathians. The Bohemian massif is represented there by the crystalline fundament of Brunovistulicum and its Paleozoic and Mesozoic sedimentary cover. Toward the southeast, the Bohemian massif plunges beneath the Carpathian Neogene foredeep and the nappes of the Carpathian flysch belt, in the southeastern part of area with the successor Vienna Basin on top. Klippen belt outccrops has been located along the eastern margin of the study area. It follows the contact of Inner and Outer Carpathians.



Densities of study area's lithologies vary within a relatively large interval 2.00 - 2.90 gcm^{-3}. As a result separate elements of the geological setting are clearly recognized within the gravity maps. Gravity images at the area of 19 000 km^2 are based on 75 000 gravity points. Shaded map of Bouguer anomalies has been constructed through the N illumination. Numerous linear indications has been emphasized, among them the eastern edge of the Bohemian massif, the front line and also the inner structure of the Carpathian flysch nappes, northeastern limit of the Vienna Basin and also the trend of Klippen belt. These NE-SW indications have also been recognized in the maps of residual anomalies and gravity gradients and reflect primarily the configuration of young tectonic elements. The NW-SE structures have also been identified in the gravity maps. They are mostly associated with deep structural elements including the basement and its platform cover. Distinct NW trending throughs, eroded on the slopes of the Bohemian Massif, has subsequently been filled up by low density Tertiary formations. Due to density contrast the buried throughs with significant hydrocarbon potential are clearly expressed in the gravity field images.

CIRCUMSTANCES OF CARL FERDINAND PETERS' GEOLOGICAL WORK IN DOBROGEA (ROMANIA).

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Carl Ferdinand Peters, born on August 13th of 1825 in Lib©eves (Bohemia), studied medicine in Prague and Vienna. Having started a medical career after finishing his studies, he was not satisfied to practise this profession. During the summer months of 1850 he accompanied his uncle, August Emanuel Reuss, mapping the Gosau of Gams (Styria) by order of the 'Geologische Reichsanstalt' (Austrian Geological Survey). Peters was deeply impressed by the geological field work and considered to change his profession. On the very same year he joined the staff of the 'Geologische Reichsanstalt'. Between 1855 and 1861 he held a Professorship at the University of Pest (Budapest); later, from 1861 to 1863 he was Professor at the Vienna University.

In 1864 he received a call of a Professor for Mineralogy and Geology at the Graz University. Before starting with his new employment in Graz he carried out geological investigations during May to September in the Dobrogea by order of the Austrian Academy of Sciences. This work was very effective. Peters had collected many new data (including geographical, ethnological and social aspects) on this region, which was poorly known in central Europe. Unfortunately the evaluation of his journey and investigation on the samples happened under an unlucky star: Back in Austria some heavy blows afflicted Peters. His wife, Anna von Blumfeld, died some weeks after his return. She left 5 children, the youngest 5 month old. At this time he had to establish the geological branch of study at the University in Graz (this branch did not exist before). Neither a specialised library nor a geological and mineralogical collection existed. In the same year an enigmatic disease probably tracing back to a bad fall in the Dobrogea affected Peters. From year to year the paralysis of his muscles intensified up to his early death in 1881.

LOWER DEVONIAN AGRELOPOS LIMESTONES (CHIOS ISLAND, GREECE) AND THE BIOGEOGRAPHIC SIGNIFICANCE OF THE "*LANCICULA* FLORA"

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Palaeozoic rocks containing fossils are very restricted in the Aegean region. In the northwestern part of Chios Island a palaeozoic sequence variable in lithologic character and age is exposed. This sequence, Llandoverian to upper Carboniferous in age, belongs to the autochthonous nappe of Chios. Due to several tectonic events only few persistent stratigraphic profiles are known.

The "Agrelopos Limestone" represents a highly fossiliferous shallow marine development whose stratigraphic range (Upper Silurian vs. Lower Devonian) is not clearly identificable at this stage.

Since halimedacean greenalgae were reported from the lower Devonian (Siegenian-Emsian?) basal parts of the Agrelopos limestones (Fenninger 1983), a section of these limestones forming a morphologically prominent ridge was sampled bed by bed in the vicinity of Agrelio (a "ghost village" in the northwestern part of Chios Island).

Nearly all samples contain algal thalli differing in their modes of fragmentation and preservation. The majority of the algal fragments can be assigned to the 'lanciculoid group'. This algal group is characterised by typical thalli consisting of a series of bowl-shaped elements (internally build up with some central filaments) surrounding the thick central stems.

Some years ago all representatives of the 'lanciculoid group' were entirely summarised in the prominent genus *Lancicula*. Due to its simple recognisability representatives of "*Lancicula*" have been reported worldwide through publication of numerous taxonomic articles. In addition "*Lancicula*"s worldwide distribution resulted in biogeographic considerations for the lower Devonian.

Ref.:

Fenninger, A. (1983): Codiaceen aus dem Unterdevon von Karaburun (Türkei) und Chios (Griechenland).- Mitt. österr. geol. Ges., **76**: 273-288, Wien.

MINERALOGICAL AND GEOCHEMICAL CONSIDERATIONS ON THE AMPHIBOLITES FROM BUZIAS HILLS (ROMANIA)

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The aim of this study was to investigate the mineralogy and geochemistry of the massive (metagabbros) and foliated amphibolites (with diablastic and nematoblastic schistosity) from Buzias Hills (north-western part of Semenic Mountains), belonging to Silagiu lithozone. The rocks of this lithologic unit, represented mainly by plagiogneisses and auxiliary by paragneisses with microcline, quartzitic micaschists with biotite and muscovite, injection gneisses, feldspathic pegmatites, plagioclasic amphibolites, limestones and biotite-bearing quartzites, were previously assigned to the Lotru Lithogroup which has been interpreted to represent a supracrustal megasequence including oceanic-type metasediments and tectonic slabs of dismembered oceanic crust (Iancu, Maruntiu, 1994). Six samples representing quartz-bearing amphibolites with plagioclase (An_{19-49}) + magnesiohornblende + quartz $\pm$ epidote, biotite, apatite, titanite and ilmenite as characteristic mineralogical assemblage, were determined by optical microscopy, wet chemical analysis, scanning electron microscopy with energy dispersive X-ray analysis (EPMA) and X-ray powder diffractometry, were investigated in this study.

The bulk chemical analysis and the content of some trace elements of the amphibolites, suggest for the pre-metamorphic rocks a genesis in relation with the oceanic crust.

Close to Buzias, nearby Silagiu village, on the Guranului Brook, a metamorphosed Fe-Cu-Ni mineralization in which nickeliferous monoclinic pyrrhotite prevails, was also identified in a lense-shaped amphibolite body situated within plagiogneisses. Taking into account the classification made by Godlevski and Lihacev (1979, fide Udubasa et al., 1988), which is based on the Mg concentration of the host rock, the Ni: Cu ratio and the $\delta^{34}S$ value of pyrrhotite, the mineralization from the Guranului Brook was assigned to the medium temperature group of the Ni-Cu magmatic deposits.

A computer application for performing the thermometric calculations based on a new hornblende-plagioclase thermometer (Holland, Blundy, 1994) was used in this study to estimate the temperatures and pressures under which the amphibolites with magnesiohornblende from Buzias Hills have formed and these range between 550°C - 700°C and 5 kbars (epidote amphibolite or amphibolite facies conditions).

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PRE-ALPINE SHEAR ZONE RELATED METAMORPHISM IN THE SOUTH CARPATHIANS.

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Dynamic versus dynamo-thermal (regional) metamorphysm in the pre-alpine basement of the alpine units in the South Carpathians is an important key in the litho-tectonic division of the incorporated Variscan and pre-Variscan terranes.

Pre-Alpine shear zones as regional tectonic contacts were identified in the gneissic units (medium to high-grade metamorphic complexes) of the Getic-Supragetic basement nappes as well as in the low-grade to medium grade terrane contacts in the external units of the Variscan nappe stacks (in Getic and Danubian too).

Regional pre-mesozoic simple shear zone belts and related dynamic metamorphism, as major paleozoic tectonic contacts, are preserved from the Variscan colisional tectogenetic events.

New dated shear zones, by $^{39}Ar/^{40}Ar$ age determinations: 346+/-3 to 331+/-4 Ma (Maluski) and U/Pb single zircon method, giving values of 338+/-11 to 332+/-14 Ma., (Cocherie, unpublished data) support a polystage tectono-metamorphic evolution, and late Variscan cooling processes (330-300 Ma; Dallmeyer et al., 1996).

The characterisation of the dynamic, shear zone-related metamorphism in respect with the complex polystage or polycycle regional metamorphism, is based on the complex criteria and argumentation.

Two main types of mineral, rock-assemblages and related fabrics, in the mylonitic rocks can be identified:

a - Pre-mylonitic relics: inherited, mineral phases (from the regional metamorphesed para and ortho-derivates); rock-relics (as lithons or dismembered slabs); relictual fabrics of metamorphic or magmatic pre-mylonitic rocks. Pre-mylonitic relict elements (as passive markers) were used for the discefering of the paragenetical assemblages of reginal events, and for the shear sens criteria;

b - Mylonitic, syn-tectonical mineral phases and connected S-C-C' type plano-linear and linear fabrics (active elements), in the simple shear zones, in which non-coaxial deformation is coeval with progressive blasthesis and recrystallisation. Both, material and non-material structural elements can be identified.

The relative timing of the progressive mylonitisation precesses is marked by:

- the passive behaviour of the first crystalised (syn-tectonic) mineral phases related to "active" S planes;

- the progressive, non-coaxial rotation of the planar and linear syn-tectonic phases ending with the last crystallised phases, in C and C' planes orriented;

- the progressive changing in chemical composition of the succesively recrystallised mylonitic phases, as a consequence of the local chemical gradients in the relative constant bulck chemistry;

- the prograde to retrograde character of the dynamic, progressive metamorphism (PTt paths of the mylonitic rocks), is very diversified concerning the physical conditions of the mylonitisation;

- normal to reverse tectono-metamorphic zonations, superposed shear processes and intersection relations in the Variscan thrust or nappe tectonics are preserved in some areas in the pre-alpine basement.

Examples of different physical conditions of the pre-alpine simple shear zone related metamorphism, from the sillimanit-kyanite (Fagaras, Cibin, Lotru mountains, in Getic-Supragetic basement) or sillimanit-andalusite (Almaj mountains, Danubian) bearing mylonites to the epidote-amphibolite facies and eclogite-facies mylonites (Leaota-Iezer mountains), are presented.

CONTEMPORANEOUS COUPLES VMS + PORPHYRY COPPER THE MAIN FEATURE OF INTRUSION-CENTRED ORE SYSTEM IN CENTRAL AND SREDNOGORIE BELT - BULGARIA.

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The Central and East Srednogorie porphyry + VMS couples occur in close association with subvolcanic and hypoabyssal felsic and intermediate porphyry intrusions.

The porphyry copper centres were generated during an expansion of magmatism. This activity covered an elongated belt traced by the Upper Cretaceous andesite stratovolcanoes along section pointed out the zone of accretion of the south margin of the Moesian platform to south.

As a products of contemporary porphyry and epithermal environments of the intrusion-centred ore system, both porphyry and VMS deposits were coupled with the available geological data such as: close spatial and temporal relations, distinct geochemical environments, comagmatic and coeval intrusive and volcanic hosted rocks, similar alteration assemblages, analogous principal ore-mineral constituents, local overprinting of K - silicate by advanced argillic zones, affinity of porphyry copper deposits and massive sulfide deposits of replacement origin, etc. Although the genetic association has not been proven, the evidence mentioned above strengthens the arguments for a genetic link between these two styles of ore deposits.

Recognition of the couple VMS + porphyry copper represents one of the main features of magmatic-hydrothermal models as well as compositional and mineralogical zoning of intrusion-centred ore system in Srednogorie volcano-plutonic belt.

While ore-magmatic porphyry system is incarnated in two types of environments : porphyry and epithermal, VMS are two-fold subdivided and are known as stratified copper and precious metal deposits - high and/or low sulfidation.

When ore-magmatic porphyry system is unmatured, epithermal ore body is principal (or alone) economic deposit in both porphyry and epithermal environments.

VMS occupy the neighbouring parts of porphyry environment. The place of MS ore is not a function of the distance from the porphyry intrusion, but it is always limited in the volcanic pile.

The couples discussed here, incorporate more than 80% of the porphyry and epithermal deposits in Central and East Srednogorie belt.

Finally, the magmatic-hydrothermal models discussed here has an implication for exploration because where one style of mineralization is known or is found, there is potential for other nearby.

ORNAMENTAL STONES IN THE YUGOSLAVIAN PART OF THE CARPATHO-BALKANIDES

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Up-to-date exploration works of ornamental stones, in the area of the Carphato-Balkanides in the Eastern Serbia (Yugoslavia), although rather modest in volume and unsystematic, and discontinuous in character, have proved that this area disposes of a large and diverse mineral materials base of ornamental stones neither from aesthetic aspect nor technical requirements of which are lagging behind other famous Yugoslavian and world's ornamental stones.

In Yugoslavian part of the Carpatho-Balkanides, the deposits of ornamental stones are concentrated into several productive areas. These areas are located in the vicinity of larger settlements with stone dressing industry. They stretch from the North of this area near Brnjice (on the Danube), Kučevo, Žagubica, Bor, Paraćin, then between Boljevac and Soko Banja in the vicinity of Aleksinac, between Knjaževac and Svrljig, near Niš, Babušnica, between Pirot and Dimitrovgrad over to the Bulgarian border. At present, only three limestone deposits are exploited while one gabbro deposit is prepared for exploitation.

Some of those areas are known for significant deposits of ornamental stones such as: Tisnica (Žagubica), Slivovac (Boljevac), Tijovac, Palilula, Ravno Bučje (Knjaževac), Bobac, Mrtvački most, Bukovski Do, Dojkinci etc. (Pirot), Grza (Paraćin).

In the Carpatho-Balkanides of the Eastern Serbia, the previous exploitation was performed in the following deposits of ornamental stones: Grza (sandstones), Ravno Bučje (granites), Palilula and Tijovac (limestones). Grza was abandoned long time ago, and Ravno Bučje and Palilula since recently. Apart from Tijovac, limestone quarry Slivovac near Boljevac as well as Tisnica near Žagubica started with ornamental stone production. Limestone deposits "Bukovsko-Kotul" near Kučevo, sandstone deposit "Bobac" near Pirot and marble deposit "Potaj Čuka" near Žagubica have been explored while the gabbro deposit "Crna Rijeka" has thoroughly been explored and its initiating in ornamental stone production is underway.

Table 1. Review of come significant deposits of certain types of ornamental stones in the Yugoslavian part of the Carpatho-Balkanides.

Type of stone	Number of deposits	More significant deposits	
		Deposits	Areas more explored
Granites	14	Ravno Bučje	Karibanja
Syenites	1	Tanda	
Gabbros	13		Crna Reka
Tuffs	12		
Limestones	39	Tisnica, Slivovac, Tijovac, Palilula	Bukovsko, Đula, Rujište
Sandstones	12	Grza, Manastirište, Mrtvački Most 1, Bobac, Bukovski Do, Mokre Stene	Dojkinci 1
Marbles	8		Potaj Čuka
Calcareous tuffs	28		Sladaja, Klisura, Reka Bigar

MORPHO-STRUCTURAL TYPES OF MAGNESITE DEPOSITS OF THE KOSOVO-METOHIJA AREA, SERBIA

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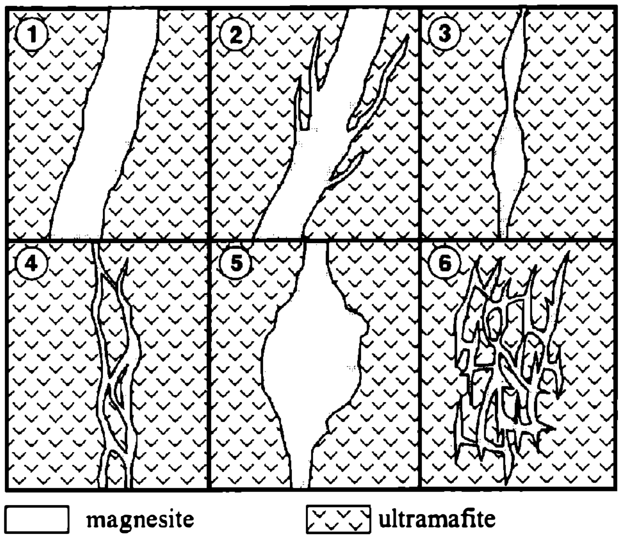
In the ophiolite zone of the Inner Dinarides, in the Kosovo-Metohija area, four genetic types of magnesite deposits occur: hydrothennal-vein, hydrothermal-sedimentary, infiltration and detrital types.

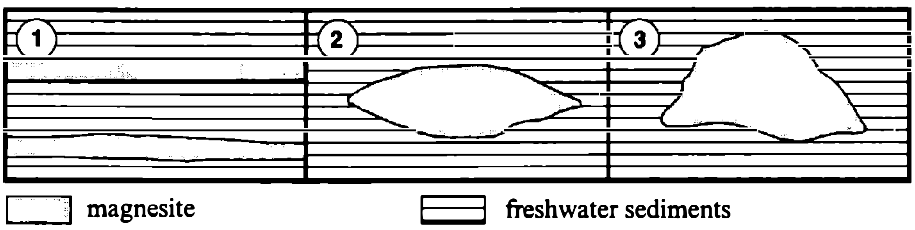
Economically most significat are deposits of hydrothermal-vein type: Goleš (the largest deposit of the type in the world), Dubovac, Dobroševac and others. The deposits are of hydrothermal origin (related to Neogene volcanism), situated in ultramafic rocks and contain magnesite bodies of the following morpho-structural types:

1. simple vein
2. vein with apophyses
3. rosary-like vein
4. complex vein
5. irregular body
6. stockwork



Hydrothermal-sedimentary type is represented by the Beli Kamen magnesite deposit in the Strezovce Neogene freshwater basin. The deposit contains magnesite bodies of the following morpho-structural types:

1. bed
2. lens
3. haystack-like body



Infiltration type is represented by a net of magnesite veins and veinlets (stockwork) in weathering crusts on ultramafic rock masses.

Detritial type is represented by magnesite-bearing conglomerate (subtype of basal clasties) in the Kosovo Neogene freshwater basin.

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GREAT CONTRIBUTION OF FOREIGN SCIENTISTS IN MINERALOGY TO DEVELOPMENT OF THE BALKAN PENINSULA

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ABSTRACT

Much effort has been made to collect something as fascinating as the scope of work of mineralogists and geologists throughout the former Yugoslavia. The gathered literature data have been published in the Bibliography of Yugoslav Mineralogy. The great contribution of the world's scientific leaders in Mineralogy is certainly significant from nay aspects. The number of mineralogical finds as well as the opus of mineralogal and geological literature puts Yugoslavia right next to the French literature as the most numerous one in Europe. The overall contribution is very hard to collect at present. However, the works from the 13th century to 1992 have already been bibliographically recorded. This inventory clearly shows that the works published before 1920 were in a foreign language (mostly in German). 1687 authors have been listed. Many of them have been leaders in contemporary scientific and geological thought. Out of that number 451 scientists were foreigners. 276 foreign authors have much contributed in a part of the Balkan Peninsula geographically belonging to the Carpatho-Balkanides. An attempt has been made to list all the foreign miners, geologists, mineralogists and geographers responsible for fostering the development of our geological disciplines connected to the development of mineralogy. Taking into consideration the geographic position and territory of the former Yugoslavia, the names of the authors from the former Yugoslav republics have been eliminated because they are considered as citizens of former Yugoslavia. Revising the bibliographical material the lists of authors have been corrected and updated including the omitted data.

The first contribution dates back to the Middle Ages when Saxon miners were invited to introduce and advance medieval Serbian mining. It is a little known fact that between 1719 and 1736 Austrians worked in the Serbian mines of Majdanpek, Kučajna, Rudnik etc. the 18th and 19th century evidence shows that the leading experts of those times, miners, geologists and others searched through the Balkan peninsula. It is now 170 and 158 years, respectively, that the first publication was printed in 1828 and the "Esquisse géologique de la Turquie d'Europe" by Ami Boué was printed in 1840. After A. Viquesnel, in 1835 Baron S.A. W. von Herder first gave an expert survey of Serbian mines. Maximilian von Hantken laid a stone in the foundations of the building of Serbian geology (J. Zujović) and in 1889 Franc Toula, the best expert of the Balkans at that time published a very significant monograph.

The contribution of the world's scientific leaders in mineralogy who have searched through the territories, must not be forgotten. The scientific thought of development, the reflective openness they radiated, turned this part of the Balkan peninsula towards Europe. Our scientists, following the current of thought in the world's mineralogy, cleared the way and also greatly contributed to the development of geology in the world.

ECHINOIDS FROM THE CRETACEOUS- TERTIARY BOUNDARY SEQUENCES AT BYALA, VARNA AREA, BULGARIA

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The study is based on fossil material from 4 K/T boundary sections near the town Byala, Varna district. The echinoids form an essential part of the fossil macrofauna at all outcrops. Representatives of 23 species from 5 families are collected and examined. They are as follow: fam. *Stegasteridae- Stegaster chalmasi* Seunes, *Seunaster heberti (*Seunes*)*, *Seunaster lamberti* Charles, *Lampadaster lamberti* Tzankov, *Lampadaster gauthieri* Lambert, fam. *Pourtalesiidae- Galeaster bertrandi (*Seunes*)*, fam. *Holasteridae- Cardiaster cf. granulosus* (Goldfuss), *Echinocorys edhemi* Boehm, *Ech. renngarteni* Posl. & Moskvin, *Ech. douvillei* Seunes, *Ech. sulcatus* Goldfuss, *Ech. sulcatus orbiculatus* Moskvin & Schimanskaja, *Ech. sulcatus sulcatus* Moskvin & Schimanskaja, *Ech. legindensis* Wind; fam. *Aeropsidae- Coraster vilanovae* Cotteau, *Coraster freshi* Boehm, *Coraster beneharnicus* Seunes, *Coraster sphaericus* Seunes, *Ornithaster marsooi* (Seunes), *O. munieri* (Seunes), *Homoeaster abichi* (Anthula), *Homoeaster conicus sp.n.* and fam. *Cyclasteridae- Cyclaster danicus* Schlüter.

The composition and distribution of the irregular echinoids from uninterrupted K/T sections show gradually decrease in species variety at the end of the Late Maastrichtian. We should note the extinction of genus *Stegaster*, *Seunaster*, *Lampadaster* and *Cardiaster*. It is observed a complete change of the echinoid species at the boundary without evidences for mass mortality. The survivors are *Coraster*, *Echinocorys* and *Galeaster*. The new elements in post-maastrichtian fauna in these sections are representatives of the genus *Ornithaster*, *Homoeaster*, *Cyclaster*. There is a bloom in development of these Paleocene species in first meters above the boundary, but some of them have ancestor in the Maastrichtian. The K/T boundary is distinct mainly on species level.

CRETACEOUS	TERTIARY	SYSTEM
UPPER MAASTRICHTIAN	DANIAN	STAGE
-40 -30 -20 -10	10 20 30 40	Distance (m) Species
- - - -- -- -		*Stegaster chalmasi*
- - -		*Seunaster heberti*
- - - - -		*Seunaster lamberti*
--- - - -		*Lampadaster lamberti*
		Lampadaster gauthieri
- -		*Guettaria rocardi*
-		*Galeaster bertrandi*
	- - - -	*Echinocorys edhemi*
	- - -	*Echinocorys douvillei*
	- - - - - - - -	*Ech. legindensis*
		Ech. renngarteni
	------ -----	*Echinocorys sulcatus*
	------ ------	*Ech. sulcatus sulcatus*
	--	*Ech. sulc. orbiculatus*
	- -	*Coraster beneharnicus*
	- - - - - - - - - -	*Coraster sphaericus*
	- - - - - - - - - - - -	*Ornithaster marsooi*
	- - - - - - - - - -	*Ornithaster munieri*
	- - - - - - - - -	*Homoeaster abichi*
	- - - - -	*H. conicus* sp.n.
	- -	*Cyclaster cf. danicus*
M. murus / M. prinsii	NP1 / NP2 / NP3	Nannofossil zone (aft. Ivanov & Stoykova, 1994)

Fig. 1. Position of the Echinoids from uninterrupted K/T section in the area of Byala (2b).

REGIONAL TECTONICS AS INFERRED FROM GRAVITY & GEOIDAL ANOMALIES

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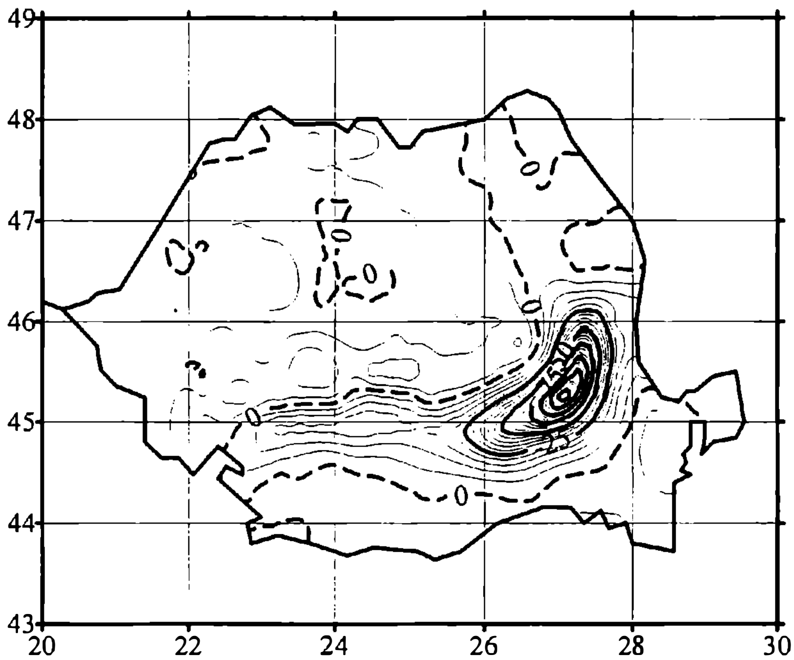

Free - air gravity / Gravimetric geoid

Due to the advent of GPS technology, the urgent need for precise gravimetric geoids on continental areas involved geophysicists in determining gravimetric solutions in order to geophysically interpret the "geoidal anomalies" in connection with the gravity ones.

The Geological Institute of Romania started a research project based on its national gravity database, aiming to determine a gravimetric geoid for the territory of Romania and to derive the geophysical significance of the geoidal undulations in terms of crustal or lithospheric density inhomogeneities. Using the Bouguer gravity map of Romania, a set of 5'x7.5' mean Bouguer anomalies has been prepared. The mean free-air gravity anomalies have been computed by using the mean Bouguer anomalies and the corresponding mean topographic heights in 5' x 7.5' blocks. In order to determine the geoidal undulations on the Romanian territory, the Stokes integral has been evaluated by FFT in planar approximation, having the mean free-air anomalies as input. The long wavelength components of the geoid have been obtained from the OSU91A global geopotential model. An important requirement for the determined geoidal anomalies before they are geophysically interpreted is that they represent real features of the Earth gravity field on this region. A study on the ability of the OSU91A GGM to recover the gravity field appeared as a necessity, due to the poor terrestrial gravity information included in the region of Romania and some of its neighbours. The comparison with the astronomo-gravimetric quasigeoid and the free-air gravity data illustrated an inconvenient situation for accurate geodetic purposes, but a rather good one for geophysical utilization. This conclusion enabled us to consider residual geoids obtained by detrending the OSU91A as valuable information sources for the crustal structure, the removal of low frequencies up to degree and order 16 emphasizing a geoidal height gradient on the geodynamically significant Intramoesian Fault, a tectonic feature which proved difficult to be observed by deep seismic investigations.

The map of the "Free-air" gravity / Gravimetric geoid ratio, computed in an attempt to illustrate important density inhomogeneities such as sedimentary basins, evidently contoured the Focsani Depression, a tectonic feature with the thickest sedimentary filling in Romania (exceeding 18 km, with ca. 11 km low density Tertiary deposits), closely located to the Vrancea geodynamic active area.

The recent release of the EGM96 global geopotential model offered new possibilities in geoidal data processing and interpretation for the region where Romania is located (by incorporating good quality gravity data sets), the detrended residual geoids showing interesting deep mass inhomogeneities.

TWO DIFFERENT RELICS OF THE PRE-ALPINE BACK-ARC BASIN CRUST IN THE INNER WESTERN CARPATHIANS: THE RAKOVEC AND ZLATNÍK FORMATIONS

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The northernmost part of inner Western Carpathians is built up by the Gemeric Unit. It consists of a group of nappes and slices of Paleozoic and Mesozoic formations. Nappes of Paleozoic rocks form the central part of the Gemeric Unit and structurally overlying nappes of Mesozoic rocks bound this subautochton from the north and south. Rakovec and Zlatník Formations are located in the northern part of the Paleozoic subautochton. Both formations are mainly composed of metamorphosed basic rocks and minor amounts of pelitic metasediments and they are thought to be relics of back-arc basin crust. Despite of those similarities between Rakovec and Zlatník Formations there are differences in: (1) geological position, (2) lithology, (3) magma composition and its evolution and (4) metamorphic path. Both formations forms separated nappes (slices) having independent tectonic histories. The Rakovec Formation (Fm.) is lying between nappes (slices) of the Early Paleozoic formations, whereas the Zlatník Fm. slice is surrounded by Late Paleozoic rocks.

Rakovec Fm. is built up of basalt or basaltic andesite lava flows whose magmatic features are well preserved despite the metamorphic alteration. Aphyric basalts prevail, but porphyric basalts with clinopyroxene and/or plagioclase phenocrysts also occur here. Metamorphosed dacites, pelitic sediments, rhyolitic volcanoclastics and sandstones occur subordinary. The Rakovec Fm. underwent multi-stage metamorphic low-temperature alteration. Peak metamorphism reached a mid- to high-pressure stage. Metabasalts of the Rakovec Fm. are geochemically close to E-MORB/OIT They display typical LREE/HREE fractionation (La_N/Yb_N= 4.4 - 7.61) and HFSE enrichment relative to oceanic floor basalts. Fractionation of clinopyroxene, olivine, plagioclase and ilmenite, caused variations in the concentration of SiO_2, MgO, TiO_2, Cr, Sc and total REE (La_N= 29.8 - 143.3). Volcanic rocks of Rakovec Fm. were formed during the inicial stage of back-arc opening, probably on a continental crust.

The Zlatník Fm. is composed of metabasalts, metadolerites, metagabbros and banded black metapelites. Subvolcanic development seems to prevail among magmatic rocks. Metabasalts are aphyric, rarely plagioclase-phyric, originally with ophitic textures. Metamorphic alteration progressed in volcanics in the prehnite-pumpellyite to upper greenschist facies conditions, in gabbros oceanic ridge-type metamorphism reached amphibolite facies conditions. Metabasalts are geochemically close to BABB. REE content is relativelly low (La_N= 17.2 - 27.4), LREE/HREE are little fractionated (La_N/Yb_N= 1.01 - 1.51) and HFSE contents are similar to oceanic floor basalts. Despite a low fractionation of plagioclase, the metabasalts of the Zlatník Fm. do not show fractionial crystallization. Zlatník Fm. was formed in immature back-arc basin setting as a product of oceanic-like crust generation in the spreading ridge.

Rakovec and Zlatník Formations experienced different postmagmatic geotectonic evolutions (subduction vs. obduction) and they are probably different in age (Early vs. Late Paleozoic).

COMPLETE OPHIOLITES AS CLASTS IN THE GOSAU-TYPE CRETACEOUS CONGLOMERATES FROM DOBŠINSKÁ ĽADOVÁ JASKYŇA (GEMERIC UNIT, INNER WESTERN CARPATHIANS)

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Remnants of the oceanic crust of the Triassic-Jurassic Meliata-Hallstatt ocean are very scarce on the present-day surface of the Western Carpathians and the Eastern Alps. They have been restricted to several occurrences of metabasalt or serpentinite bodies untill now. Complete, although dismembered, ophiolite association representing full section of the oceanic crust of this ocean have been recently found as clasts in the Gosau-type Cretaceous conglomerates near Dobšinská Ľadová Jaskyňa village (Slovenský raj Mts.). Cretaceous formation at this locality is composed of conglomerates, sandstones, marly slates and limestones. Conglomerates build up the lowermost part of the sequence and they are represented by two types differing in the composition of clasts. First type of the conglomerate contains mainly limestones, in less amount also silicic rocks (Jurassic radiolarites and hornfels), calc-alkaline effusive basalts and sporadically serpentinites. In the second type of conglomerate, mostly red in color, the ophiolitic rocks are principal clast types. Marble, hornfels, sandstone, calc-alkaline basaltic andesite and rhyolite clasts are present in subordinary amounts only. All clasts are differentially rounded in accordance with their resistency. The conglomerate is poorly sorted and it has serpentine matrix.

The uppermost part of the original ophiolite profile is represented by clasts of red radiolarites and radiolaritic limestones Liasic in age, as well as of efussive basalts and their autoclastic lava breccias. Basalt clasts with glassy, intersertal, variolitic, ophitic or subophitic textures were originally composed of glass, clinopyroxene and plagioclase with less amount of olivine and ilmenite. Magmatic mineral association is variably replaced by chlorite, prehnite, epidote, albite and pyrite as a result of low-grade metamorphic overprint. Clasts of dolerites, usually intensively altered in the greenschist to epidote-amfibolite facies conditions are thought to be derived from the former sheeted-dyke complex. Plutonic rocks from the central part of ophiolite sequence are represented by clasts of cumulate and non-cumulate gabbros with very variable grain size. They vary from several cm to 1-2 mm sometime in the range of one sample. Primary magmatic mineral composition of plutonic rocks - ilmenite, orthopyroxene, clinopyroxene and plagioclase - were partly or fully modified by oceanic ridge-type metamorphism evolving from the upper amphibolite to the lower greenschist facies conditions. Moreover some gabbros were metamorphosed in the prehnite-pumpellyite facies conditions probably in an accretion wedge. To the lowest part of the ophiolite cumulate complex were related clasts of cumulate pyroxenites mostly altered to aktinolitic rocks. The base of former ophiolite profile was built up by spinel peridotites (mainly harzburgites). It follows from the study of most wide-spread clasts in the conglomerate - lizardite-chrysotile serpentinites. Antigorite serpentinites has been also found but only in subordinate amounts.

Geochemical study of the basalt clasts indicate that original ophiolite profile was not formed as the crust of a mature ocean but it originated in the spreading ridge of a back-arc basin. The same result followed from the study of other basalt occurrences thought to be relics of the Meliata-Hallstatt ocean. In the course of further evolution of the back-arc basin was closed and the ophiolitic rocks were subducted or partly trapped in an accretionary prism. Evidence for subduction was found also in the conglomerate as the rare clasts of blueschists, partly with well preserved primary intersertal or ophitic texture.

Based on the petrographic variability of clasts as well as their form indicating short transport only, an ophiolite mélange as a source region of second conglomerate type with the opiolitic rock clasts seems to be most probable. Such interpretation is supported by mélange occurrences known from the Meliata Unit in the soutern part of inner Western Carpathians.

THE NAPPE CONTACT OF THE CONTRAST TECTONIC UNITS - NEW RESULTS FROM GEOLOGICAL MAPPING OF THE TRIBEČ MTS.

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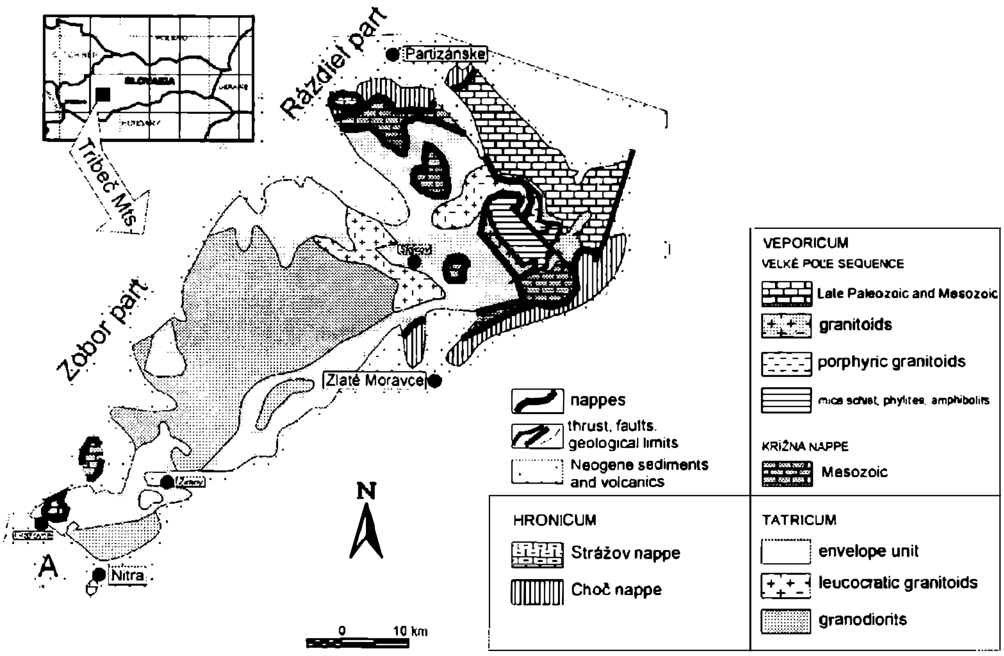
Cropping out from under the Tertiary sediments of the Danube Basin, the Tribeč Mts. represent the westernmost salient of the inner belt of the core mountains of the Western Carpathians. They form a NE-SW striking horst divided by the Skýcov fault system into a northern Rázdiel part and a southern Zobor part.



- **TATRICUM UNIT**

Composed of a crystalline basement and of a Permian-Mesozoic rock envelope this unit represents the lowermost structural unit of the region. In the Zobor part the Tatricum, crystalline rocks are represented mainly by the granitoids of several petrographic types that make up a large, zonally structured, Tribeč-Zobor pluton. In the Rázdiel part, of the Tribeč Mts. the crystalline rocks are made up of fine- to medium-grained leucocratic granites that contain amphibolite bodies. The crystalline core rocks are transgressively overlain by Permian and Mesozoic sediments of the envelope sequence. The envelope sequence are dynamometamorphosed and, in the Zobor part, they have a structure of tectonic slices (of Dražovce and Žirany areas).

- **VEPORICUM UNIT**

The lowermost horizon of the Veporicum Unit is represented by crystalline rocks composed of assemblages of imbricated of metasediments, granitoids and amphibolites. In the NE part of the Rázdiel part of Tribeč Mts. formations of Mesozoic sediments whose lithological content and lithostratigraphic units show close links with the Zliechov type of Krížna nappe crop out. The overall character of this rock assemblage shows a strong affinity to the Veľký Bok sequence and, tectonically, it a part of the northern Veporic envelope (the Veľké Pole sequence). In other areas of the Tribeč Mts. the Krížna nappe occupies an allochthonous position and overlies the envelope sequence of the Tatricum Unit; however, its rocks are unmetamorphosed.

- **HRONICUM UNIT**

The Hronicum Unit is represented by the Choč and Strážov nappes, occurrence of which is limited to the Rázdiel part of Tribeč Mts. The Choč nappe is represented by Late Paleozoic formations and by Mesozoic clastic and carbonate assemblages whose development spanned the time from Lower Triassic to Norian. Sliced up and metamorphosed Late Paleozoic members occur on the SE side of the Rázdiel block.

The Neoalpine-Tertiary tectonic development brought about a morphologic, and tectonic characterization of the Tribeč Mts. in contrast to the Neogene grabens and Neogene volcanic rocks. A decisive role in the development of the SE margin of Zobor part played the gravitational tectonics associated with the uplift of the granitoidic core.

PALYNOORICTOCENOSES CLASSIFICATION OF COAL-BEARING FORMATION OF LVOV - VOLYN BASIN (WESTERN UKRAINE)

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Facial-palynological analysis or palynoorictocenoses method worked out with the complex lithological - facial and palynological investigations of the coal - bearing Carboniferous formation of the Lvov - Volyn basin, is the instance of a system approache to studying palynological remnants. The main object of the facial - palynological research are palynoorictocenoses. It is the complicated system of undissolved dispersed organic particles which is identified by palynological method and united in a structural integrity by environmental factors. Palynoorictocenosis structure is defined by components composition. By structural peculiarites, origin, character of conservation elements are divided into 2 groups: humus (structureless opaque coaly remnauts) and liptynite ones included miospores, acritarch, algae, fragments of megaspores, plant tissue. Components of palynoorictocenoses may form different combinations which have tendency to repeat depending on sedimentation conditions. This point is the basement for creating the classification. With facial - palynological studying of Carboniferous of Lvov Volyn basin 5 types and 9 subtypes were singled out. Type distinctions are based on degree of dispersed organic matter (DOM) concentration, saturation by miospores, character of miospores ratio of main plant groups. The first of three types are characterized by considarable DOM concentration and miospores saturation. Miospores of treelikes dominate in Lycospores (L) type and most of grassy Lycopodium - likes miospores are in Densospores (D) type. Mixed (M) type is characterized by the equal miospores presence of main plant groups or - ferns miospores predominate. The fourth lowspore (M) type with the strong and moderate DOM concentration mainly consists of numic elements. Miospores are lack or not numerous. The fifth type (N) is with low concentration of organics and compose by single fragments of humic elements. Types L, D, Z, M are divided into 9 subtypes on the basis of character ratio of components of humus and liptynite groups, their dimensious, facial timing, presence of acritarch and so on. Subtypes L1, D1, Z1, M1 timed only to continental sediments are charaterized by no lack of mainly big humic components. Subtypes L2, D2, Z2, M2 are distinguished only transitional from continental to marine deposits. Their typical signs are decreasing demensions of humic elements and plant tissue, presence of acritarch, equel relationships of humic and liptynite groups or prevalence of liptynite components.

The created palynoorictocenoses classification take in to consideration many genetic and morphological signs. Distinguished units are easy diagnosed and established in palynological slades. Palynoorictacenoses are the base ment of facial - palynological studying of the coal-bearing formation of Lvov Volyn basin and presented classification is the main moment of the research results generalization.

STRATIGRAPHY, PALEOECOLOGY AND SOME BIOCONSTRUCTION IN THE CENTRAL FORE-BALKAN (NORTH BULGARIA)

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Urgonian complex in the Central Fore-Balkan has been nominated as Lovech Urgonian Group. Within this group eight formal lithostratigraphic units (formations) have been distinguished. They include typical urgonian carbonate bodies as well as terrigenous-carbonate ones (Khrischev, 1966; Nikolov et al., 1991).

Recently the chronostratigraphic range of the Urgonian complex is corrected and improved mainly on the basis of new ammonite finds (Ivanov & Nikolov, 1995; Ivanov, 1995; Ivanov & Damianova, 1996). In the sediments underlying Urgonian complex, Late Hauterivian and Early Barremian ammonites are recorded (*Pseudothurmannia angulicostata* and *Crioceratites emerici* zones). The lower part of the Urgonian is assigned to the Lower Barremian (*Crioceratites emerici* zone) due to the occurrence of *Barremites, Holcodiscus, Acrioceras, Astieridiscus.* In the middle part of the complex, some single finds of *Barremites subdifficilis, Pseudosaynella stretostoma, "Emericiceras" barremense, Imerites* sp. indet. indicate the presence of the Upper Barremian. Aptian age (*Procheloniceras pachystephanum* zone) is assigned only to the topmost part of the Urgonian, documented with the occurrences of *Cheloniceras crassum, C. quadrarium, Procheloniceras albrechtiaustriae.*

Paleoecological study has lead to the caracterisation of scveral molluscs assemblages in the siliciclastic intervals. The assemblages are classifyied and arranged into zones from the coast to the open basin (Damianova, 1997). Diverse organic bioconstructions are reported both in the typical Urgonian limestones and in the terrigenous- carbonatc sediments. The Rudists banks built up of Requienidae and Monopleuridae are characteristic for the carbonate bodies. They are formed on the reef-flate (Upper Barremian-Lower Aptian, Smochan and Devetaki Fms.). On the reef front and fore-reef slope, biochermes and biostromes of colonial corals arc observed. Latters commonly occur in different stratigraphic levels Lower Barremian (Balgarene Fm.) and Upper Barremian (Smochan Fm.).

Relative sea-level changes were caused several transgressive-regressive migrations of the carbonate platform, and 3-rd and 4-th order cycles in the depositional sequences (Ivanov et al., 1997).

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BIO-EVENTS (AMMONITES AND CALCAREOUS NANNOFOSSILS) AND STRATIGRAPHIC SEQUENCES IN THE UPPER BARREMIAN - LOWER APTIAN OF THE MOESIAN PLATFORM (NORTH BULGARIA)

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Upper Barremian and Lower Aptian sediments in the Moesian Platform are represented by various facies (Nikolov, 1987). During the Late Barremian, several significant bio-events in the ammonite development are recorded. At the beginning of the Late Barremian, the first occurrence (FO) of *Emericiceras barremense*, *Pseudosaynella strettostoma* and *Silesites* is documented. The representatives of the genus *Imerites* have their FOs toward the end of the Late Barremian, although the simultaneous FO of *Colchidites*, *Martelites* and *Paraimerites* are documented as latest Barremian events. In the Barremian - Aptian boundary interval the occurrence of the g. *Turkmeniceras* has been observed (Ivanov,1992) . The presence of *E. barremense* and *T. turkmenicum* is of high stratigraphic value in this interval.

During the Early Aptian, the successive FO of *Procheloniceras*, *Prodeshayesites tenuicostatus*, *Deshayesites forbesi*, *Deshayesites deshayesi* and *Dufrenoya subfurcata* is observed. Analysis of the ammonite occurrence in the Upper Barremian - Lower Aptian interval has shown partly overlapping of some genera and species ranges which are widely adopted as zonal indexes in Tethyan realm, as for example *Colchidites* and *Procheloniceras*, *Turkmeniceras* and *Barremites*, *Prodeshayesites* and *Deshayesites* (Stoykova, 1990; Ivanov, 1992). Some of these taxa are simultaneously distributed in different facial (or bathymetric) zones of the basin, for example *Imerites* and *Hemihoplites*, *Paraimerites* and *Colchidites*, partly *Procheloniceras* and *Turkmeniceras*, *Prodeshayesites*. Consequently the zones based on the occurrence of the species from the above pairs should be considered as eco- zones.

Direct calibration of calcareous nannofossil events with the standard ammonite zonation of the Barremian-Aptian interval is carried out. The obtained results in the present study are folliws: 1. FO of *Chiastozygus litterarius* is observed in the Upper Barremian, within *I. giraudi* ammonite zone; 2. FOs of *Hayesites irregularis* and *Flabellites oblongus* are Late Barremian events, correlatable to the middle part of *M. sarasini* zone; 3. FO of *Rhagodiscus angustus* and *Nannoconus truitti* is detected within the middle part of *P. pachystephanum* Zone.

In the studied sections a couple of 3-rd order depositional sequences are recognised, reflecting the sea-level changes (Ivanov et al., 1997). Two significant falls of the sea-level are reported: at the bases of *M. sarasini* and *Deshayesites forbesi* Zones. They are marked by tempestites on the basin slope and subaeral wash-out and hiatuses on the carbonate platforms.

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DISTRIBUTION, COMPOSITION AND PROPERTIES OF QUATERNARY DEPOSITS IN SOFIA KETTLE

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The Quaternary sediments represent the uppermost part of the geological sequence in the Sofia kettle region. These deposits are wide-spread and lie over older rocks and soils. The Quaternary cover is thick from 2-3 m to 100 m and more. Quaternary soils diversing in origin are observed in the Sofia kettle - alluvial, alluvial fan and deluvial deposits and culture layer. That is the reason for the diferences in their spreading, composition and properties and reflects on the costructing conditions and on the appearence of diverse unfavorable processes and phenomena.

Culture layer is composed of remnants of old structures, technogenic soils, industrial and household waste. The first type is the thickest one in the central parts of the town and reaches up to 9-11 m. The distribution of technogenic soils is around the opened pits, the big city blocks of flats and the power stations. They are composed of reworked rocks and soils and industrial waste. Household waste is stored at more than 30 sites, the biggest of them are in Dolni Bogrov and Suhodol. Black organic silty and sandy clays (smolnitza) are widespread over the western and north-western parts of the town of Sofia. They vary in thickness but rarely are thicker than 3-4 m. These clays have a high content of organic matter-up to 8-10%. Hydrophilic properties are strongly expressed (tabl.1). During the dry periods they are in a firm state. During the humid seasons clays become saturated, swelled and softened. The volume swelling is more than 12% and this is characterizing them as strong swelling soils. More buildings founded on the black organic clays are cracked.

Table. 1. Physical properties of Quaternary deposits

Lithological varieties	Age	Bulk density	Dry density	Particle density	Water content	Plastisity index	Void ratio
		g/cm^3	g/cm^3	g/cm^3	%	%	-
Black organic silty and sandy clay (smolnitza)	aQh	1,91	1,52	2,71	23,9	30	0,850
Brown sandy clay	aQh	2,01	1,65	2,70	21,6	17,8	0,636
Sand	aQh	1,86	-	2,69	-	-	-
Gravel with sandy-clayey filler	aQh	2,05	1,77	2,72	16,7	-	0,531
Brown sandy and silty clay	dQh	1,90	1,51	2,73	25,8	24,5	0,800
Gravel and boulder with sandy-clayey filler	prQh	2,04	1,68	2,69	21,6	16,5	0,600
Sandy clay with gravels	pr-dQh	2,05	1,70	2,73	20,3	12,3	0,627

Deluvial brown sandy clays with gravels cover the hill slopes. Their thickness is varying from 0,5 to 1,5 m. They are referred to normal consolidated sediments. During the water saturation they change their consistency and their bearing capacity decreases. The alluvial sandy clays with single gravels are a constituent of the river terraces as an upper covering layer and often appear as an upper aquifuge of groundwater. Their thickness is from 1,5-2,5 m up to 3-4 m, with relatively high density and stiff state. Alluvial sands appear as intercalations in the river terraces and often lie into their basement. Thickness is 1-2 m. Mostly they are water saturated and probably possess a tendency to liquefaction under dynamic influences. Unsorted alluvial gravel with layers and lenses of sand and sandy clay are wide-spreaded in the floodplains and other terraces of the rivers Iskar, Lesnovska, Blato, etc. These deposits are the main underground water accumulator. At the foot of the enclosed mountains deluvial and alluvial fan deposits are spreaded. Their grain-size composition is heterogeneous and is composed of rock pieces with a clayey-sandy filler. The physical and mechanical properties change depending on the correlation between the rock fragments and the filler. In the alluvial fan deposits the underground water lies at a depth of 0,5-1 m from the terrain and that determines the appearance of many marshlands. A lot of landslides appear in the region too.

The Quaternary deposits in the Sofia kettle are characteristic generally with wide area spreading, a great diversity in the composition and properties. They act as an environment for the development of many unfavorable processes as shrinkage, swelling, liquefaction, landslides, erosion, marshlands etc.

UNIQUE FINDINGS OF GOLD IN THE LIMESTONES OF THE EPICONTINENTAL UPPER CRETACEOUS SEA: CENTRAL BULGARIA

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The area under investigation is located in the Central Balkan in the region of the peak Botev.

The gold was found in the sediments with Upper Campanian and Lower Maastrichtian age. They are represented mainly by micritic and biomictric limestones, very rarely with sandy admixtures and dolomitized to some extent horizontal stratification and sometimes modular structures are typical. Carbonate content in the samples varies from 64.47 to 94.50 %.

For the first time in these limestones were found terrigenous gold with the grain size from 0.063 mm to 0.5 mm. The shape of the gold grains is platy, subrounded or subangular, sometimes flaky. The grains' surface is indented by pits and grooves of different size. Gold was found in the mineral assemblage composed of electrum, corundum, garnet, rutile, zircon, amphibole, tourmaline, epidote, sphene, quartz, amethyst, plagioclase, K-feldspar, glauconite

High purity (from 95.68 wt % to 99.20 wt %) is very characteristic for the gold. The impurities are represented from: Zn (0.35 - 2.36 wt %); Cu (0.12 - 1.43 wt %); Fe (0.53 wt %). High-resolution scanning microscope SEM/JEOL JSM-T-300 and X-ray diffraction LINK-860 do the analytical work at 25 kv

The possible source of the gold is dyabase dykes which cut Riphean-Cambrian rocks of the low matamorphic diabase-phyllite complex (DPC). Polimetal mainly cassiteritic mineralization specified as "medium temperature cassiterite sulphur mineralization related with moderately acid granitic magmatism" are established in the dykes. The following elements from the zone of mineralization were determined: Pb - 0.23 %, Zn - 0.20 %, Cu - 0.70 %, Ag 89 gr/t, Au 0.8 gr/t, Ar - 7.61 %, Bi - 0.016 %, Co - 0.040 %, Fe - 9.6 %, (Чешитев, 1958).

The investigated limestones are formed in the epicontinental sea which was a part of the Boreal Euro-Asian paleobiostratigraphic province. The basin as inhabited by different kinds of organisms: foraminifera, radiolaria, bivalve, echinoderms, ammonites and belemnites. The established bentonic fauna suggests that the sedimentation was realized in shallow basin (100 - 300 m) with normal salinity and water temperature between 13.3 - 28.5 ° C (Йолкичев, 1982).

The presented results are preliminary and a more detailed investigation is under preparation.

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MERCURY IN THE MENILITOVA SUITE OF THE UKRAINIAN CARPATHIANS.

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This report is a preliminary generalisation of the obtained data of mercury concentration in the black shales of the Oligocene Menilitiva suite in the Flysch zone of the Ukrainian Carpathians. The Menilitova suite is divided into following three subsuites: Lower Menilitova subsuite, Lopyanetska one overlaid Lower subsuite, and Upper Menilitova subsuite. We have studied the Lower Menilitova suite as the most spread in the Folded zone of the Ukrainian Carpathians. It consists of finely laminated noncalcareous mudstone layers varying from brownish to black, sandstones and a siliceous-calcareous horizon on the base. The organic carbon concentration ranges from 3% to 7% reaching, in some locations, the level of 15% to 25%. Pyrite makes up a large portion of the mudstone composition. Pyrite is found in the framboid form and fine grain accumulations. Deposits of the Lower Menilitova subsuite are enriched with many elements concentrated in clastic and clayey minerals of fine-dispersed fraction (Fe, Mn, Sr, Ba, Sc, Zr, Ti, Cr, Zn, Co, Mo), or may be associated with an organic substance (V, Cu, Mo).

All samples sampled along the valleys of Dnister, Stryi, Lomnitsa, Bystritsa, Prut, Bily Tcheremosh, and Luychka rivers content mercury ranging from $nx10^{-6}$ % to $nx10^{-5}$ %. Mercury concentrations in argillaceous rocks are higher than in sandstones. Mercury concentrations do not exceed abundance ratio for corresponding rocks, but this comparison is not correct because of old clark data which are as follow: 8 ppb and 8,3 ppb - for Earth's crust according to S.R.Talor and A.P.Vinogradov; according to A.P.Vinogradov, 1965 - for sedimentary rocks - 4 ppm (clay and shale), from < 1 ppb to n ppb for sandstones, from 1 ppb to 30 ppb for argillaceous shales. In accordance with belief of some researches (N.A.Ozerova among them) values of mercury abundance ratio for argillaceous rocks can be overstated. The statistic parameters were calculated for black and brownish mudstones (shales) as well as for sandstones (see table, reliable level 95%).

Rocks	Mean	Standart error	Median	Standart deviation	Sample variance	Min	Max	Min. anomaly	Certain anomaly
Black Sh.	15.12	1.13	17.30	7.26	52.58	3.10	31.20	26.74	39.08
Brownish Sh.	14.09	1.76	12.50	8.23	67.77	2.50	33.30	23.20	37.20
Sandstones	11.21	2.90	6.90	11.94	142.49	1.95	50.40	22.42	42.71

Two anomalies are minimum. We can suggest the following abnormal areas with in the Menilitova suite on the Folded Carpathians territory: 1) in the valley of Luchka river near Yabluniv; 2) in the upper stream of Stryi river. Abnormal mercury contents in area near Yabluniv are accompanied by abnormal contents of Co, Zn and Pb in sandstones and brownish shales, and Co, Zn and Mo in black shales. Mercury content in siliceous-calcareous rocks is 20,7 ppb and in the same rocks with thin layers of brownish shales near Yabluniv mercury content reaches 3,3 ppm with increasing of contents of Mn, Co, Cu and Zn. Abnormal mercury concentrations in this area are related to the zone of Beregovyi overthrust dividing the Scibova zone and Precarpathian foredeep.

Some base metal shows in the Miocene rocks with similar nature as the Truskavets deposits of Pb and Zn where native mercury was found are known in this area. Abnormal mercury concentrations in the Yubluniv area as well as the Truskavets Pb-Zn mineralization are most likely to be epigenetic. This fact is indirectly attested by predominant values of a mercury sublimation temperature (300-400° C for mercury in brownish shales, that give evidence of its sulphide form; 600° C for mercury in black shales and sandstones, corresponding to isomorphic form) as well as mercury positive correlation with Cu and Mn in black shales, with Co and Ge in brownish shales, and with Zn, Pb and Co in sandstones. The last allows the relations between mercury and sulphides in sandstones.

The anomaly of indeterminate type is revealed in the upper stream of Stryi river. It is difficult to suggest its nature because the mercury concentration level is comparatively low. It should be noted this anomaly coincides with the aureole of postdiagenetic reconstitution rocks (up to stage of early metagenesis). These alterations have probably happened due to a heat flow of a latent intrusion accompanied of mercury supply. Epigenetic nature of mercury abnormal concentrations allows determination of perspective areas for mercury-polymetallic mineralization.

AN OVERVIEW OF TECTONOMETAMORPHIC EVOLUTION OF THE BRANISKO AND ČIERNA HORA MTS. (WESTERN CARPATHIANS)

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The Branisko and Čierna hora Mts. form the eastern margin of the Tatric and Veporic domains of the Western Carpathian Internides (WCI). Their pre - Alpine structure comprises two Late-Variscan basement nappe sheets, namely the Upper lithotectonic unit (ULU) and the Middle lithotectonic unit (MLU). Cover sequences are build of Late Carboniferous to Malmian formations. The units are topped by klippes of the Choč nappe pile and/ or by Paleogene and Neogene post-nappe sequences, respectively.

The tectonometamorphic evolution of the pre - Tertiary units has been reevaluated by available palynological, geochronological and PT data and by new structural and field mapping. On the basis of these results four Variscan and four Alpine tectonometamorphic events have been recognized in these units.

* The first (likely Late Devonian - Early Carboniferous) HP-HT event occurred in ULU with P-T conditions of 630-1000 MPa and 675-770 ^{0}C. In the MLU reached the pressure of 300 - 500 MPa at temperature of 520-540 ^{0}C. Mesoscopic structures of the event indicate their formation in a simple shear regime. They are mostly represented by tight, rootless, generally E-W oriented cm-dm folds and their axial plane cleavage set, which represents the pre-Alpine schistosity of the basement metamorphic rocks.
* The second and third events are restricted to ULU only. They are related to granodiorite intrusions (334,5 Ma, Ar-Ar method). The second MT-MP event occurred at 620-648 ^{0}C and 400-450 MPa. The third, scarcely developed MT-MP event is tied to exocontacts of tiny autometamorphic granite bodies and resulted in replacement of mineral assemblage of previous events.
* The fourth, the LT-LP event (330-312 Ma, Ar-Ar method) relates to thrusting of the ULU onto MLU.

* The absence of Cretaceous cover formations and 135,7 Ma Ar-Ar age of muscovite from mylonitized granite of the ULU indicate the beginning of the Alpine tectonometamorphic events in the region. All four Alpine events (AD_{1-4}) occurred in green-schists facies conditions.
* The AD_1 E-W recumbent folding of the units, Choč nappe thrusting and a successive growth of chlorite, white mica and quartz within axial cleavage set of folded basement and cover units are typical for this likely Valangian-Albian event.
* During the AD_2 event the units have been penetratively folded into-SW-NE folds. For this event is typical a postkinematic blastesis of Chl + Mu ± Ab assemblage within the folds in the basement units - namely in diaphtorites of the MLU. The fold structure of all pre-Tertiary units has been successively sheared within the Margecany type reverse shear zones of the same direction. This event probably relates to the Middle Cretaceous uplift of the Veporic basement
* Within the AD_3 - the pre - Gossau event as well, the NW-SE shear zones have been opened for hydrothermal mineralization and rarely resulted in postkinematic growth of Q + Mu + Bi ± Ab.
* Regionally significant sinistral wrench zones of AD_4 event containing duplexes of Paleogene sequences likely connected with the Early Miocene oblique collision of the WCI edge with the Northern European Platform.

ALPINE TECTONOMETAMORPHIC EVOLUTION OF THE WESTERN CARPATHIANS - THE VEPORIC UNIT

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The Veporic unit is the middle one of three principal tectonic units of the Western Carpathians. It overthrusts the Tatric-Fatric unit to the north and is overridden by the Gemeric, Meliatic and higher units in the south. The Veporic unit was affected by several deformational stages. The most important is the Alpine deformation AD1 which is penetrative in both the basement and the Permo-Mesozoic cover. The principal AD1 structures are: (1) subhorizontal metamorphic foliation S1 reflecting strong vertical flattening, (2) stretching lineation L1 in SW-NE to W-E direction and (3) flow folds F1 in the carbonate-bearing Foederata cover unit. Stretching lineation is pervasive in the low-angle shear zones, associated with extensional structures related to non-coaxial shearing during the unroofing of the Veporic metamorphic dome. Generally, the AD1 structures record the post-collisional extension which was coeval with the Late Cretaceous uplift. The exhumation shows dominantly top-to-the E kinematics, i.e. it was orogen-parallel and roughly perpendicular to the earlier top-to-the N - NW thrusting.

In the pre-Late Carboniferous basement. Alpine recrystallization strongly affected the pre-Alpine assemblages whose relicts are only sporadically preserved. Peak Alpine mineral assemblages in the basement are: (1)metapelitic micaschists: garnet II (grossular-rich) + kyanite + staurolite + phengite/paragonite + quartz + rutile; (2)metabasites garnet II + amphibole(blue-green tschermakite) + epidote + albite/oligoclase; (3)metagranitoids: garnet (grossular-rich) + phengite (up to 6.7 Si p.f.u) + K-feldspar + albite. Geothermobarometric calculations yield the peak Alpine metamorphic conditions of 8-10 kbar and 550-580°C in the deepest exposed basement. The Permian cover metapelites contain mineral assemblages chloritoid + kyanite + chlorite + white mica + quartz + rutile/ilmenite + tourmaline, peak PT conditions reached 460-480°C and 6-9 kbar. Triassic carbonates, quartzites and schists exhibit penetrative deformation and metamorphism in the greenschist facies conditions. Metamorphic P-T-t paths are generally "clockwise", in the kyanite stability field. consistent with rapid exhumation related to extension of the overthickened crust. Available Ar-Ar data of around 110 Ma (amphiboles) and 90-80 Ma (micas) record the post-peak cooling ages during the uplift. Intrusion of Cretaceous (81 Ma, U-Pb on zircons) Rochovce granite into the extensional shear zone was accompanied by contact metamorphism and formation of cordierite.

A preliminary model suggests that Alpine Cretaceous metamorphism of the Veporicum was related to neo-Cimmerian collision and crustal thickening after the suturing of the Meliata-Hallstatt oceanic basin. The Veporic unit occupied a lower-plate position and was overthrust by Gemeric, Meliatic and higher units from the south. After the burial. the Veporic unit was uplifted due to the underplating of the buoyant Tatric-Fatric and extensional unroofing. The exhumation of the Veporic core occurred in the overall contractional regime and was followed by superimposed Late Cretaceous - Early Tertiary shortening events.

FORECAST OF ROCKFALLS OCCURRENCES WITHIN CARBONATE ROCKS AT THE CONSTRUCTION OF ROAD-TRANSPORT FACILITIES IN EASTERN SERBIA

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THE PGE RELATED TO TERTIARY PORPHYRY COPPER DEPOSITS OF SE EUROPE

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During the last 30 years numerous porphyry copper prospects have been found in SE Europe. At present there are seven porphyry copper mines in operation in that area /Yugoslavia, Bulgaria and Republic of Macedonia/, as well as several prospects exploited in detail/ Greece, Yugoslavia and Bulgaria/. Small amounts of Pt and Pd are recovered as by products of copper concentrates such as in the Bor Combine in Yugoslavia.

Although Au, Ag and some PGE are recovered from some porphyry copper deposits, mineralogy of the PGE in these deposits genetically associated with the Late Cretaceous. Oligo-Miocene calcalkaline suites, is still poorly known.

Like gold, the PGE concentrations are enriched in some porphyry copper deposits sach as Majdanpek in Yugoslavia, Elacite in Bulgaria, Skuries in Greece, there are several prospects impervished in precious metals such as Au, PGE /i.e. Veliki Krivelj and Cerova in Yugoslavia/.

The PGE are closely associated with native gold- and Ag- tellurides, and selenides. The principal modes and associations of PGE are classified as follows:

/i/ Mineral associations of chalcopyrite and Au- and Ag- tellurides contain sporadically in the Majdanpek deposit high concentration of Pd- tellurides composition of which varies from Pd/Ag/Te to $PdAgTe_2$ /Pavicevic, et al., 1981; Jankovic, 1990). The contents of individual constituents of individual phases are 23.6% Pd, 1.6% Pb, 2.03% Ag, 0.7% Au, 62.3% Te, and 0,65% Sn / local analyses by electron microprobe/.

In such porphyry copper deposits occur Ag - and Cu- tellurides and sellenides. Ag tellurides accompanied by Pb are sporadically associated with lead-zinc sulphides.

The PGE are related with chalcopyrite - bornite association f porphyry copper mineralization and sporadically with the native- and Ag- bearing gold, sylvanite, hessite, stromeyerite and merenskite /i.e. the Skouries deposit of Greece - Tarkian et al., 1991/.

/ii/ Magnetite-bornite-chalcopyrite paregenesis of the Elacite porphyry copper deposit in Bulgaria involves some PGE minerals such merenskyte, palladoarsenate, Pd rammelsbergite and a few unnamed phases, containing 27.38%, 16.5%, and 61.95% Pd, up to 0.39% Pt, 0.1-0.314% Ni, 1.48-16.065 Ag, 1.21-4.55% Cu, 62-65% Te, up to 33% As, up to 0.83% Bi /Petrunov et al., 1992/.

/iii/ Very specific assocation of Pd-bearing gold has been identified in the chalcopyrite of the Buchim deposit of the Republic of Macedonia /Cifliganec et al., 1994/.

Chalcopyrite enriched in gold containing a separate Au-Pd association has been identified in Bucim deposit. The composition of individual phases ranges from 0.29 to 6.48% Au, 0.02 to 7.98 % Pd and up to 0.048% As. Genesis of the PGE occurrences in the porphyry copper deposits of SE Europe has been descussed in the paper.

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DEPOSITS OF LATERAL TURBIDITE APRONS IN THE UPPERMOST PART OF THE CENTRAL-CARPATHIAN PALEOGENE BASIN FILL, WEST CARPATHIANS, SLOVAKIA.

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Most studies about turbidite depositional systems analyse point-sourced turbiditic fans described by classical schemes. Surprisingly, not much is known about linear sourced turbidites often occuring in fault bounded basins. These turbidites, consisting mainly of sandstones, usually form lateral aprons interfingering with the main basin axial depositional system. The study of these systems provides new data about tectonic history of the basin and spatial distribution of sandstone bodies with application to hydrocarbon trap predictions.

The Central-Carpathian Paleogene Basin is a forearc basin developed in the northern part of the Inner West Carpathians. The sedimentary fill of the basin is of the Late Eocene - Early Miocene age. After the initial transgression, recorded by shallow-marine deposits (Borové Formation), an abrupt subsidence of the basin determined deep-water sedimentation. The overall trend of the basin fill is coarsening upward what is clearly emphasized by the uppermost deposits assigned to the Biely Potok Formation (Late Oligocene - Early Miocene). The deposits of this formation have prevailing coarse-grained character (sandstones and pebble sandstones).

The analysis of depositional environments of the Biely Potok Formation deposits, based on facies analysis and palaeocurrent directions, suggests two different depositional systems in the basin. The main deposition occurred in the axial, point-sourced submarine fan and it represents a final stage of the fan grow. This is recorded by channel-and-levee deposits consisting of thick sandstone beds (channel fill) and thin, lateraly inpersistent sandstone and shale beds (levee deposits). The sediment supply was from the south-east toward north-west. The second depositional system is represented by turbiditic aprons entering the basin laterally. The deposits comprising aprons are coarse-grained and they mostly consist of sandstone, pebble sandstone and conglomerate. It is not possible to find any zonation in the apron system (proximal - distal trend). The thickness of apron deposits is maximum 150 m. The typical facies association is represented by five facies: 1) Massive and normally graded, coarse- and medium grained sandstone. The sandstone is poorly sorted. It comprises sharply based, 20 - 50 cm thick beds. Beds are sometimes scoured and amalgamated; 2) Massive and normally, coarse-tail graded pebbly sandstone. The beds are scoured and sharply based, they are often amalgamated; 3) Parallel-laminated pebbly sandstone. The 20 - 50 cm thick beds are sharply based. Pebbles are arranged into parallel laminae, the sandstone matrix is coarse- and medium-grained; 4) Massive, clast-supported conglomerates. The base of beds is sharp; 5) Parallel and ripple cross-laminated medium and fine sandstone. The base of beds is sharp. This facies only occurs very occasionally.

The described facies suggest deposition by hyperconcentrated flows, only facies 5 containing Bouma's $T_{b,c}$ divisions, was probably deposited by diluted turbidity flow. On the basis of palaeocurrent directions, which are perpendicular to the main axial turbidite system, facies associations and lack of zonation we interpret these deposits as lateral aprons entering the basin from the emerging basin margins built up by Outer Flysch Belt in the north-east and Mesozoic and Paleozoic units of Inner West Carpathians in the south. The abrupt emergence of the basin margin rendered high sediment supply and slope morphology necessary for generation of hyperconcentrated flows. Prevailing hyperconcentrated flow deposits suggest relatively short sediment transport with insufficient time for flow dilution.

Criteria for siting hazardous waste disposal facilities in Slovakia

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One of the ways to dispose hazardous waste is to deposit it in natural rock structures. To solve this problem in an optimum way, it was necessary to formulate a complex methodology for the selection of the localities and to define and classify criteria important for the selection process.

Working criteria are usually derived from two groups of factors that have to be considered in the process of site location and selection. Primary factors represent qualitative characteristics of a natural geological barrier and factors of groundwater vulnerability. They include geological, hydrogeological, hydrological and geomorphologic factors. Secondary factors represent conflicting interests from the environmental viewpoint. Among the most significant are legislative factors, mining activities, present land use, infrastructure of the country and other socio-economic factors.

The determination of the criteria is a multi-stage process, beginning with the determination of general criteria, i.e. determination of basic requirements on the evaluated system. They are only descriptive and they are not associated with a concrete locality. General criteria have to be gradually made more specific, taking into account the required host environment and the factors affecting this environment. The results are so-called functional criteria, which may be of semi-quantitative character. The process continues with a detailed analysis of input factors and operational or executive criteria are quantified subsequently. They are defined as the limit (boundary) value of a factor.

After the analysis of factors entering the process and after the determination of the functional criteria, it is necessary to determine the hierarchy of the criteria and degree to which they are obligatory.

According to the degree of restriction, we propose to divide the criteria into three groups: exclusive criteria, limiting (evaluating) criteria and additional (accessory) criteria.

According to these criteria, the procedure of location and selection of sites for hazardous waste disposal was carried out in three stages: regional assessment, assessment of potential sites and preliminary survey of sites.

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EXPLORATION OF COPPER OREBODIES WITH GEOLOGICAL METHODS IN THE VOLCANO - SEDIMENTARY FORMATION OF ALBANIA

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The Triassic - Jurassic vulcano - sedimentary formation consists periphery parts of the Albanian ophiolites. It outcrops in the form of two belts having in general a sub- meridional strike. Important cooper - pyrite sulfide deposits related with this formation such as Rubik, Gjegjani, Porava, Miliska, Geraj, Palaj - Karme, etc have been discovered. This formation consists of hight -Ti basalts of nearly tholeitic composition interbedded with argillaceous shale's and radiolarian chart.

Concerning the relationship of ore and surrounding rocks, two types of mineralizations are distinguished:

1. Stratified type, concordant to the wallrocks
2. Intermittent type, composed of two subtypes:
   - a- hudrothermal metasomatic
   - b- fissure filling vein

Massive ores with almost sharp contacts to the surrounding rocks, disseminated ones (within which small and inconsistent massive lenses) and as well as large alteration zones are some characteristics of copper-sulphide mineralizations.

Massive ore of both types consists mainly of pyrite, chalcopyrite, sphalerite and with subordinate amounts of magnetite and hematite.

Integrated geological-geophysical-geochemical surveys were carried out in nearly all areas where volcano-sedimentary formation outcrops. These survey were mainly applied to the scale 1:5000. The main surveying geological methods was that of induced polarization (IP); sometimes the magnetic method was used.

The applied measurement grid was 50x20m. Numerous anomalies, being in general large in dimensions but of various intensity, were obtained in different sectors.

It is to be emphasized that geochemical survey in soil sediments was carried out parallel with geophysical survey. The geochemical data have led to a more profound interpretation of geophysical anomalies indicating the constituting elements of the mineralizations.

Depending on real geological conditions and especially on the expected mineralization other geophysical methods were applied. Many anomalies were followed up by detailed geological exploration , which has lead to the discovery of several small to medium size copper deposits(with reserves up to 6 million tons and grade of copper over than 2.5%)

Morphological types of these ore deposits (as pipe-like , lens-like, etc.) the application and as well as geological setting of orebodies have conditioned the application of different borehole geophysical methods. The application of these methods has followed up the exploration work. They have contributed to the step by step definition of the strike and depth estimation of orebodies (Palaj-Karme etc.)

Conclusions

1. The geological methods, especially IP method, have given a valuable contribution in searching for copper sulfide mineralization related to volcano-sedimentary formation.
2. Based on new geological concepts, it is necessary to re-evaluate the obtained anomalous systems.

RECENT IMPROVEMENTS IN SLOVENIAN UPPER PALEOGENE AND LOWER MIOCENE TIME-ROCK STRATIGRAPHY

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In the Slovenian Upper Paleogene and the Lower Miocene time-rock stratigraphy high inconsistency had persisted for a century and a half. In attempting to provide a solution the problem-solving approach was adopted which led to an other research methodology. Discoveries, however incomplete they appear to be, have disclosed the tectonostratigraphic structure and suggested new chronostratigraphic relationships among the long known but yet informal lithostratigraphic units. Four Tertiary tectonostratigraphic units (TTU) have been proposed: A1 North of the Periadriatic lineament (PL); A2 between PL and Donat tectonic zone; B1 between Donat t. z. and Celje tectonic zone; B2 south of Celje t. z.. The manifestated structure is due to the tectonical organization along the southern margin (PL) of the extruding ALCAPA crustal wedge under the progressive dextral transpressive regime. The former basin(s) was(were) tectonicaly sliced, lateraly displaced and strongly deformated inside and within shear zones. This Slovenian shear zone continue into the mid-Hungarian zone (Fodor et al., in press). The well known Socka beds are of the Priabonian age (NP18?; NP19-20) and belong to the A2. In others TTUs are of different ages and therefore preliminary named pseudo-Socka beds. The Smrekovec volcanic sequence (SVS) belongs to the B1. Its begining is fixed within the NP23. Oligocene marine marly clay, as it has been previonsly called, is in the A2 of the Priabonian (NP19-20 - early NP21? (P17?)) and of the Karpatian age. In the B1 it is devided by the SVS and the late NP 25 volcanic sequence into the latest Priabonian - Early Rupelian (late NP21 (P18) - early NP23), the Chattian (? latest NP 24 - NP 25), and the Aquitanian (NN 1 - NN 2?) successions. Within the older part equivalents of the Sépvölgy Limestones, Buda Marl, and Tard Clay, and the Eocene/Oligocene transition have been recognized as such. The younger successions are correlable with the ?Kiscell Clay, the Scéczény schlir, the mollusc clay, and the Egerian glauconitic sandstones and conglomerates. This heteropic coarse clastic Govce beds comprises late NP25 and NN1 - NN2?. The Oligocene/Miocene boundary is placed close to the FO of the Helicosphaera carteri (Walich) and of the FO of the form, similar to Sphenolithus belemnos Bramlette et Wilcoxon. The B2 have not been studied yet. Relying on 25±1.0 Ma(2) dated by the $^{40}Ar/^{39}Ar$ techinique the basal development is of late Chattian age (Odin et. al. 1994). Almost in the entire A1 Karpatian beds are overlaying the Pretertiary basement. In the A2 the Karpatian Klanec beds and the Dobrna marl overlie the Priabonian succession while in the B1 and B2 the Badenian succession covers the Aquitanian Govce beds. The Eggenburgian and the Ottnangian strata have not been discovered yet. Unconformities and sedimentary facies distribution in time my imply the Haq's cycles of 3rd order: TA4.2 and/or TA4.3, TA4.4, TB1.1 and/or TB1.2, TB1.3, TB2.2 and TB2.3.

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MINERALOGICAL AND GEOCHEMICAL CHARACTERISTIC OF THE PRODUCTIVE MINERAL PARAGENETIC ASSEMBLAGES OF BANSKÁ ŠTIAVNICA AND HODRUŠA DEPOSITS (SLOVAK REPUBLIC)

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The Banská Štiavnica-Hodruša ore district is one of the largest in the Carpathian arc and has an over thousand-year-long history of exploitation and processing of the precious and base metal ores. It is located in the central upwelled part of the polygenic Štiavnica stratovolcano in Central Slovak Neovolcanics. There are various genetic types of ore mineralization: *intrusion related mineralizations* (magnetite skarn; porphyry/skarn Cu±Mo,Au; stockwork/disseminated base metal; higher temperature (mezothermal?) Au-carbonate-quartz vein system), *high sulphidation epithermal mineralization* (quartz-pyrophyllite-pyrite system), *low sulphidation epithermal mineralizations* (precious and base metal veins hydrothermally metasomatic base metal mineralization; Au-Ag±Hg-Sb-As veins). The precious and base metal vein-type mineralization is the most abundant and economically most important mineralization in this region.
Generally, the hydrothermal precious- and base-metal mineralization originated in the three successive cycles separated each other by temperature inversion and also by a change in other essential parameters along the boundary between the mezothermal(?) and epithermal mineralization

A new type of mezothermal(?) precious metal mineralization (Ist ore-cycle) was found in the last years in the Hodruša ore field, about 500 m under the surface. The earliest mineral assemblage represents mezothermal(?) gold-quartz-carbonate mineralization, accompanied by small amount of pyrite and sphalerite. It was formed at relatively high temperatures (395-230 °C) in acid and subneutral solutions in depth from 2.0 to 1.5 km. Temperature decrease was accompanied by gradual pH increas from 3.6 to 4.5. Salinity of the aqueous solutions ranges from 0.4 to 7.7 wt. % NaCl equiv. and also sporadic presence of carbon dioxide is characteristic. Au was transported in hydrothermal fluids as chloride complexes The $\delta^{34}S$ values in sulphides of this type precious mineralization characterized variability from 1.0 to 6.7 ‰. This isotopic data with $\delta^{34}S \approx 3$ ‰ indicate magmatic source of sulphur that has probably been derived from deeper situated fluids. In the short part of vein filling of the vein system there are several types of structures: asymmetricaly banded, brecciated and massive; fragments of the earlier precious and base metal mineralization in the light grey quartz with banded structure with anhedral leaves of earlier gold, and also with fragments of rhodochrosite are impregnated by milky quartz and transparent crystalline quartz with later disseminated mineralization.
The IIndore-forming cycle (base metal productive only) of the epithermal vein represent following stages: 1th- hematite-quartz (including rhodonite, rhodochrosite), 2nd- sphalerite (incl. galena, chalcopyrite, pyrite, quartz), and 3rd- rhodonite-carbonate-quartz (including adularia). It was formed at temperatures from 380 to 200 °C, pH from 4.7 to 6.0, lg a_{S2} from -11 to -14 and lg a_{O2} from -32 to -41 in depth from 0.75 to 1.60 km.
The IIIrdore-forming cycle represents economically most significant ore-formig cycle from point of concentration of precious- and base metal ores in the steeply dipping fissures. It is characterized by the two stages of mineralization: 4th- galena-chalcopyrite (incl. sphalerite, tetrahedrite, Ag-Cu-Pb-Bi sulphosalts, gold, hematite, scheelite, ferberite, and 5th- sulphosalts-precious metal-barite (incl. quartz, cleiophane, chalcopyrite, pyrite, marcasite, electrum, acanthite, and other Ag minerals). These stages originated at temperatures from 310 to 50 °C, pH from 3.5 to 7.6, lg a_{S2} from -8 to -17 a lg a_{O2} from -30 to -46 in depth from 0.4 to 1.1 km.
The $\delta^{34}S$ values in minerals (pyrite, sphalerite, galena, chalcopyrite, marcasite) from the IInd and IIIrd ore-cycles fluctuate in a relatively broad range from -9.9 to +11.8 ‰ in sulphides and from 17.5 to 22.5 ‰ in barite. The sulphur isotopic data indicate, that $\delta^{34}S$ values of sulphides are generally representative for fluids expelled from the uncontaminated granitic magmas. A portion of the $\delta^{34}S$ values in late sulphides and sulphates might suggest sulphur contamination attributed to leaching the evaporitic sediments.
Oxygen isotopic data $\delta^{18}O$ in barite, quartz, scheelite, hematite (from -4.0 to 13.6 ‰) and carbonates (from 3.5 to 25.1 ‰), as well as the δD values of inclusions fluids in the quartz and sphalerite (from -52 to -71 ‰), and in the OH-group of chlorite and kaolinite (from -75 to -76 ‰) indicate progressively increasing proportion of the meteoritic waters towards later mineralization stages with barite and carbonate (from -94 to -113 ‰).

GOLD MINERALIZATION IN THE WESTERN PART OF THE BOR METALLOGENIC ZONE (EAST SERBIAN SECTOR OF THE CARPATHO-BALKAN METALLOGENIC PROVINCE)

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Several different genetical types of gold mineralizations are known in the western part of the Bor metallogenic zone. They are concentrated within several ore field, belong to different morphostructural types and display diversity in ore paragenesis, associations of minerals and elements. From both geologic and economic point of view, the most important types of deposits and occurrences include: (A) volcanic-hosted epithermal type of deposits, (B) porphyry related type of deposits and (C) quartz-vein type of deposits.

(A) *Volcanic-hosted epithermal type of deposits* (high sulphur /acid sulphate/ system - advanced argillic alteration) are related to calc-alkaline magmatic complex of Laramian age. These deposits can be subdivided into two main subtypes:

Volcanogenous cupriferous (Au) massive pyrite deposits (type: Bor, Central group a.a.). The ore bodies occur in the form of the pipes, lenses and veins. Mineral associations include: high concentrations of pyrite, copper sulphides (chalcocite, covellite, bornite, enargite, and chalcopyrite as the main copper minerals), hematite a.a. The principal hypogene gangue minerals are quartz, occasionally chalcedonic silica, minor barite, widespread anhydrite, and native sulphur which occasionally may form large orebodies. Massive sulphide mineralization grades, both laterally and vertically, into a stockwork and disseminated types. Gold values range between 2.6 and 3.75 g/t. At the top of the system, above the some massive sulphide ore bodies, native gold occurs in a highly silicified cap where gold values range between 1.8 and 18.9 g/t, averaging at 2.3 g/t.

Polymetallic (Zn-Cu±Pb-Au-Ag) massive sulphide deposits (type: Choka Marin) occurs in Upper Cretaceous andesites. The hanging wall consists of a volcano-sedimentary series (hematite pelite, interbedded tuffs and volcanic breccias), with hydrothermally altered andesite and andesitic breccia forming the footwall. Gold occurs in its native state and in association with chalcopyrite, enargite, tennantite, and pyrite. The highest gold concentrations lie between the zone of advanced argillic alteration in the hangingwall, and the silicified, kaolinized and carbonatized andesitic breccia in the footwall. Gold values ranges from 4.6 g/t to 23 g/t (average 13.2 g/t).

(B) *Porphyry related gold mineralization* is geneticaly associated with the porphyry copper systems (type: Majdanpek, Borska Reka, Cerova, Krivelj a.a); gold (native gold, electrum) is primarily associated with chalcopyrite accompanied by calaverite, krenerite, petzite, palladium tellurides, quartz and other minerals. Gold values are relatively low (ranges from 0.15-0.7 g/t)

(C) The *quartz vein type mineralization* is formed in the latest stages of evolutin of the mineralized porphyry system.

The objective of paper is to provide an overview of only the most interesting groups of gold deposits, with empasize on genetic models.

NEW KNOWLEDGE OF THE HYDROGEOLOGY IN THE WEST CARPATHIAN FLYSCH ZONE AND CENTRAL-CARPATHIAN PALEOGENE

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New results of the regional hydrogeological research and the reinterpretation of hydrodynamic tests in the Carpathian Flysch Zone and Central-Carpathian Paleogene in the territory of Slovakia and Moravia have changed or corrected the traditional conceptions of the hydrogeology and hydraulic properties of the flysch rocks. The permeability of flysch rocks is distinctly controlled by the actual depth position below surface. Significant regular decrease of mean permeability in particular formations and regions with depth can be expressed by exponential functions of depth. In most of the flysch formations, the mean permeability decreases on average to 50 - 75 % of the initial value per every 10 m of depth increase. At that, the rate of exponential permeability decrease within different depth intervals diminishes with depth.

A striking dependence between the average permeability of particular lithostratigraphic members in the Flysch Zone and the age of rocks has been observed (permeability decreases with increasing age). Very ambiguous and varied is the relation between the permeability and lithology. In some members and regions, the traditional conception of permeable sandstones and considerably less permeable claystones and siltstones could not be substantiated; consequently, its validity cannnot be treated as general. In some regions even an inverse relation was found: increasing mean permeability with diminishing proportion of sandstones within the tested well intervals. Primary differences in permeability between sandstones and argillaceous rocks fade away as a result of diagenetic changes reducing integranular permeability. Fissure permeability is of decisive importance. The maximum permeability and transmissivity is most often observed in tectonically predisposed joint zones without any unequivocal relation with lithology. In consequence of the described relations, the hydrogeological function of stratiform aquifers and of intergranular permeability in the flysch complex is of rather little importance. The main aquifer is here therefore the near-surface zone of increased permeability in first tens of meters below ground surface. Deeper circulation of groundwater occurs predominantly in joint zones of vertical or steep course.

The superposition of the exponentional decrease of permeability in the near-surface zone with the regular differences in water-table depth between relief depressions and elevations (the minimum depth of groundwater table below surface in valleys) results in regular spatial differentiation of mean transmissivity of the near-surface zone between valleys, slopes and mountain ridges even in quite identical rock environment. In regional assessment of transmissivity, in hydrogeological maps and at practical interpretation and predictions it is necessary to distinguish different categories of transmissivity related to the position in the relief morphology, especially the valley transmissivity (determined usually by aquifer test in wells) and the lower slope transmissivity

SEDIMENTARY MODEL OF THE LATE NEOGENE DACIAN BASIN (ROMANIA)

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Dacian Basin (southern Romania, fig. 1A) may be defined as a piedmont sedimentation model. Within the basin two distinct accumulation areas synchronously functioned as sedimentary fans (fig. 1B). The individuality of the two fans relies on their terrigenous supply coming from separate Carpathian source-areas.

Reflecting the increasingly active role of the northeastern source-area, during the Pontian to Early Quaternary time interval the eastern sediment accumulation area developed into a growing up sediment fan. Aggradation was the dominant character of the eastern sediment fan (fig. 1C). Only the western extremity of the eastern fan was prograding toward the west. An abrupt back stepping of the eastern fan occurred during the Early Quaternary.

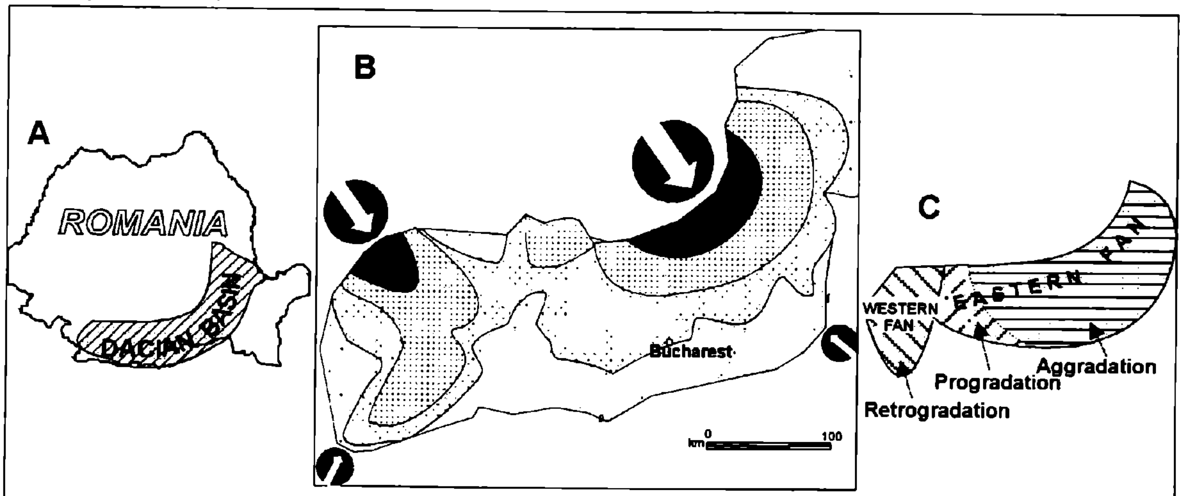

Fig. 1. Main sedimentary features of the Late Neogene Dacian Basin
A. Dacian Basin location. B. Sediment thickness pattern (decreasing thickness values from black to diluted dots signatures) and main source-areas. C. Main sedimentation trends.

The sediment accumulation in the western area continuously diminished through the Pliocene time, due to the decay of the western Carpathian source-area. Reflecting this trend, northward retrogradation marks the evolution of the western sediment fan (fig. 1D). This area does not appear any more as a separate sedimentary unit since Early Quaternary.

The paleo-environmental analysis of the sediments outcropping toward the northern margin of the Dacian Basin indicated that lacustrine littoral sedimentation (beach and delta) characterizes the Pontian to Lower Dacian time. Fluvial sedimentation is replacing the lacustrine environment from the upper part of the Dacian. The general Pontian – Quaternary evolution of the sedimentary processes shows a regressive trend, marking the filling of the Dacian Lake.

THE CONNECTION BETWEEN THE KARST-WATER LEVEL AND THE GEOLOGICAL FACTORS OF THE TRANSDANUBIAN CENTRAL MOUNTAINS IN HUNGARY

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Research of the karswater-bearing formations is a very interesting theoretical and practical question for the Hungarian hydrogeologists. More than 90% of Hungary's drinking water are underground-water, and one third comes from karstic water aquifers. The karstwater is very important as thermal -water, in the world-famous springs of the margines of the mountains - for example thermal-springs of Budapest, Hévíz, Harkány, Miskolctapolca, Eger.

In the last years we have been working first of all about the Transdanubian Central Mountains, because the water supplies stored in the karst rocks of the Transdanubian Central Mountains are one of the 40 main drinking-water bases of the country.

Due to the withdrawal in the area which was applied mainly during the extraction of bauxite and coal situated under the karstwater level and served the dessication of the mining areas, the original karstwater-level and decreased with 100-180 m in the mining areas, and with 30 m in average on the whole area, leading to several problems. The water level has decreased in the fountains, the boggy areas have dried up, and several springs have run dry (f.e the springs of Tata).

The debit of the Lake Hévíz, the worldfamous thermal-spring, situated on the SW border of the Transdanubian Central Mountains has dropped to approx. 300l/ min from the original approx. 600l/ min, while 25-30 km NE from Hévíz, the karstwater-level had been reduced with 120 m in the period between 1960-1990.

The degree of the connection between two facts has become the source of professional debates.

In 1990, after the withdrawal had been stopping, the rehabilitation of the depression had started. The process of refilling made it possible to examine the factors that determine the streams of water.

All geological features of the karstwater aquifers are essential from hydrogeological point of view, as the spacial disposition of the permeable and impermeable rocks, their relation with each other and the- recharge areas, as well as the fissure and cave system of the permeable and impermeable formation were developed partly by the original characteristic of development, and the subsequent tectonic and karstification process.

The examination of the Nyirád cone has demonstrated us clearly the role of the geological factors in the streams of water, and it clarified the relation with he Lake Hévíz.

These geological factors are known all in the Transdanubian Central Range. As a result of the earlier expansive geological works we have enough information in this mountains, so we have possibility extending our research in the whole area.

But the geology and hydrogeology does not know the boundaries and we are interesting to the whole Carpatho-Balkan region.

COEXISTENCE OF PHLOGOPITE AND BIOTITE IN SUBVOLCANIC ROCKS FROM BELI KAMEN, RUDNIK MT., SERBIA, AS EVIDENCE FOR MAGMA MIXING AND MINGLING

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Process of magma mixing and mingling on the example of the subvolcanic body of Beli Kamen, Rudnik Mt. is described. This area is situated within a tectonically complicated part of the Vardar Zone (the central part of Serbia) and is geologicaly related with Borač eruptive complex (23 -12 Ma) of calk-alkaline magmatism.

Investigated outcrop is the apical part of a subvolcanic body which is very specific from petrogenetical point of view and offers a key for understanding of magmatic events in the whole area (Jovanović, 1985). It represents a composite body comprising the minette (central part of body) and the rhyodacite (marginal part of body), with apparent chemical and modal gradation from basic to acid member as an evidence of extensive mingling and mixing of magmas.

Our investigation comprised samples taken through the profile and includes whole rock major and some trace elements analyses, twenty microprobe analyses for phlogopites and biotites and AAS analyses for some trace elements of mineral separates of phlogopites and biotites recovered by standard geochemical separation technique.

Minette is concentrated in the central part of the profile. It is dark-gray porphyritic rock with dominant macrocrysts of golden-yellow and black grains of phlogopite and rare macrocrysts of pyroxene, biotite, quartz and plagioclase and very rare megacrysts of sanidine, in a microcrystalline phlogopite-quartz-feldspathic groundmass. Phlogopite is a dominant mineral and its content is highly variable, ranging from 15 to over 30 percent of the rock volume. It appears both in macrocrystal and groundmass population. Biotite occurs only as idiomorphic macro- to megacrystals. It is often corroded, resorbed and mantled by neophlogopite. Xenocrysts of quartz (up to 3x3 mm) and plagioclase are rounded, embayed, resorbed and sometimes rimmed with alkali feldspar.

Rhyodacite is porphiritic and macrocryst population is composed of (sometime megacrysts) sanidine, plagioclase quartz, biotite and rare micro-phenocrysts of phlogopite, whereas groundmass is composed of phlogopite, biotite, quartz, plagioclase and sanidine.

Regarding the whole rock major and trace element composition, central part of the body is the most primitive, with MgO=5.16 %, SiO_2=52.2 %, Cr=294 ppm, Ni=116 ppm but also high K_2O=7.09 %, Rb=184 ppm and Ba=1010 ppm. Toward the marginal parts of the body, gradual decreasing of MgO, Cr, Ni, TiO_2, V and Ba content, whereas SiO_2 increasing is recognized.

Two generations of phlogopites are recognized, according to their major and trace element chemistry: cores and major parts of macrocrystals have higher mg* (0.85-0.80), content of Cr, F, but lower TFeO, TiO_2, Al_2O_3, and Na_2O compared to the rims of phlogopite macrocrystals, groundmass grains and phlogopitic rims of biotites. Moreover, the evolution trend of minette phlogopites (Mitchel & Bergman, 1991) with increasing content of TiO_2, Al_2O_3 and decreasing mg*, and Cr_2O_3 in both (micro)phenocrysts and groundmass (for core and rims of grains) phlogopite from semilamphrophyre center to rhyodacitic part of body was recognized. Simultaneously, biotite has much invariable chemistry which is less dependent of the position in the body.

The results obtained suggest that central part of the body (minette) represent the remnants of the most primitive (upper mantle) magma contaminated by process of mingling with rhiodacitic magma. On the other hand, rhiodacitic part show features of hybrid magma (Poli et al., 1996) generated by mixing of crustal origin liquid and (parts) of most primitive one (upper mantle).

Existence of composite bodies perfectly indicates contemporate invading of two magmas of very different composition and suggest consanguinity of magmas involved in their genesis. The presented data indicate the important role of primitive component from upper mantle in origin of Tertiary volcanic rocks of the Rudnik area.

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CHANNEL FACIES SEQUENCES ANALYSES OF LOWER TRIASSIC BRAIDED RIVERS DEPOSITS OF CLASTITES KLADNICA FORMATION (W SERBIA)

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Clastites Kladnica Fm. belong to the Continental Red Beds of W Serbia and in geotectonic regionalisation to Drina-Ivanjica Element in which discordantly overlaying the Middle Carboniferous semimetamorphic and metamorphic rocks of Birač Fm. and, in decolmane contact, below the Lower Triassic Bioturbate Fm., Middle and Upper Triassic Formations of Carbonate Platform and Jurassic Diabaz-Chert Fm. Clastites Kladnica Fm. are defined as a channel, bar and overbank facies of, minor part, gravely predominated and, major part, sandy predominated deposits of braided rivers.

In paper are discussed analyses and interpretation of finning upward channel facies sequences in one very well exposed profile of 30m in length and 3-5m in thickness.

According to the complete textural and structural characteristics the channel facies sequences are analysed on graphical drawing in which are defined numberical hierarchy of bounding surfaces and type and vertical and horizontal migrations of lithofacies. These analyses are the base for definition characteristic association of lithofacies and type and geometry of architectural elements. The data of complete analyses and their interpretations are base for definition of type and shape of surfaces, geometry of sedimentary bodies and for reconstruction of direction of transport and direction of bed filling.

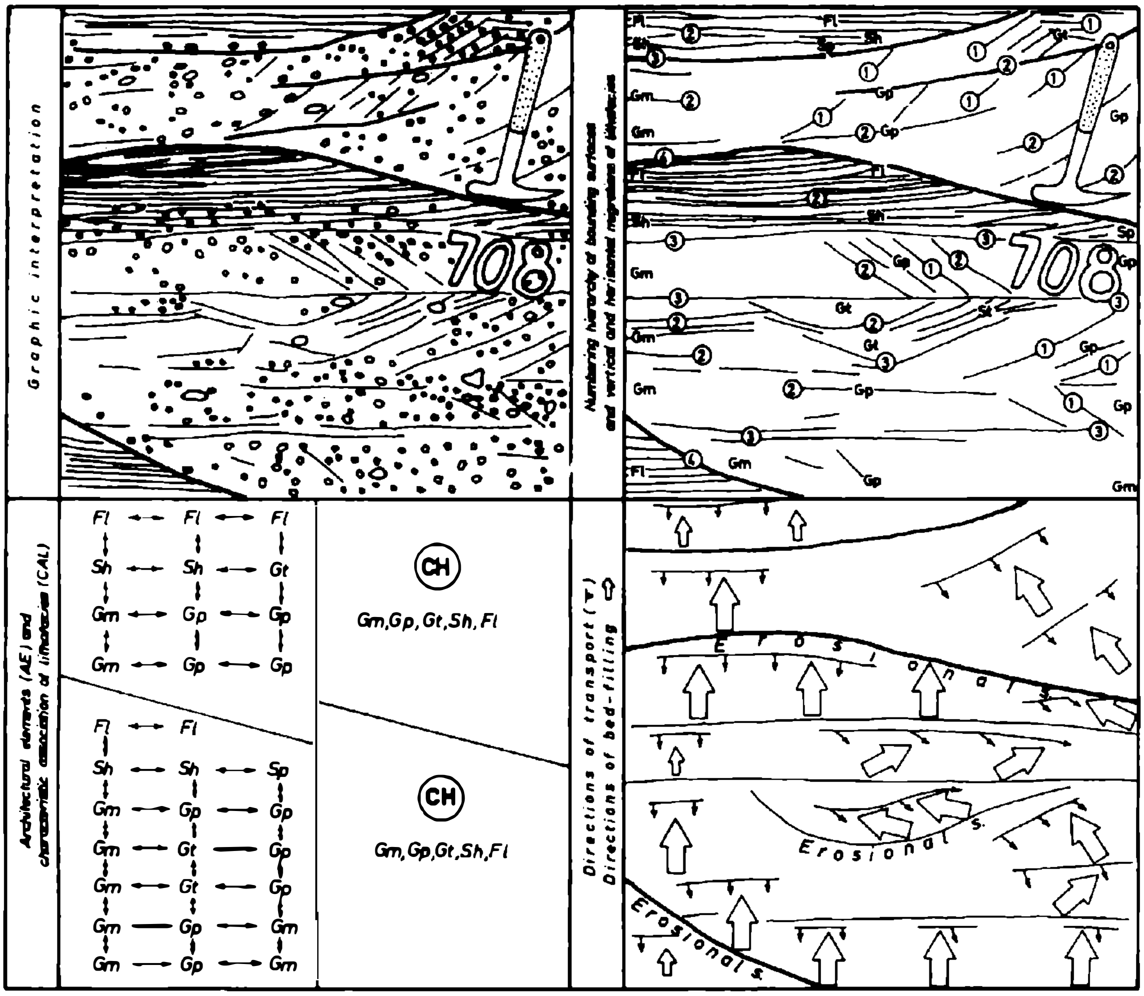

Fig. 1 One detail of channel facies sequences analysis.

A REVIEW OF THE PETROLOGY AND GEOCHEMISTRY OF MESOZOIC OPHIOLITE COMPLEXES IN NE HUNGARY

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Mesozoic (Triassic to middle Jurassic) mafic and ultramafic magmatic products occur sporadically along a WSW-ENE-directed elongated area from Inke through Tóalmás, Darnó Hill, Szarvaskő, Bódva valley to SE Slovakia throughout the whole Igal-Bükk zone.

PETROGRAPHY

In the southwestern part of this zone the borehole **Inke**-I and -9 (In-I, -9) penetrated serpentinite and basalts with variolitic texture. About 250 km northeastward, boreholes **Tóalmás**-2 (Tó-2) and Tóalmás-3 (Tó-3) revealed variolitic basalts and ophitic gabbros. In the northeastern part of the Igal-Bükk zone ophiolitic rocks occur in three main areas. In the **Darnó-Hill** mafic and ultramafic rocks have been described in several outcrops and a number of boreholes (Rm-131, -135 and -136 and Sirok-1) in a few km wide elongated area. Variolitic (partly amygdalodial) to intergranular pillow lava and massive basalt occur here with isotropic gabbro-olivine gabbro and minor wehrlite, which sometimes are penetrated by narrow dolerite dikes. Prehnite-pumpellyite facies ocean floor metamorphism can be detected. Serpentinite has found only as small pebbles in the covering Miocene conglomerate. In the SW-Bükk Mts. around **Szarvaskő**, extrusive rocks are similar to that of Darnó-Hill area. The intrusive formations are represented by a gabbro-microgabbro-dolerite assemblage (dikes and sills) including also ultramafic cumulates (ore peridotite, pyroxenite, hornblendite) and differentiated acid rocks (plagiogranite and albitite). Traces of ocean floor and very low-grade regional metamorphic events are visible. Along the **Bódva valley** several boreholes (Tornakápolna-2 and -3 (Tk-2 and -3), Szin-1, Szögliget-4 (Szö-4), Bódvarákó-4 (Br-4) and Komjáti-11 (Ko-11)) penetrated serpentinite, gabbro and ferrogabbro, massive basalt and pillow lava formations. Traces of picrite were also found. The metagabbro containes minor dolerite and basalt dikes and plagioclasite veins. All these rocks underwent blueschist and later greenschist facies metamorphism.
The main magmatic minerals in the whole study area are plagioclase and augite. Totally serpentinised olivine and albite are also common, fresh olivine and orthopyroxene appear only in cumulates of Szarvaskő. In the same locality extreme high ilmenite and Ti-magnetite content is characteristic. The acidic rocks consist mostly of albite, quartz and minor biotite.

GEOCHEMISTRY AND PETROGENESIS

Major and trace element chemistry of both mafic and evolved rocks show similar compositional variations, although alteration influenced their chemical compositions. The least altered basalts have hypersthene-normative compositions, low K_2O (<0.3 wt%), low P_2O_5 (<0.25 wt%) and low TiO_2 (<1.8 wt%) contents that are consistent with the composition of ocean-floor tholeiites. Nevertheless, the relatively high Na_2O content (3-7 wt%) is remarkable and could be due to sea-floor metasomatism (spilitization). Olivine gabbros from borehole Rm-135 have high MgO (10-16 wt%) in agreement with high olivine content. Ferrogabbros penetrated mainly by borehole Ko-11 are rich in TiO_2 (3-6.1 wt%) and Fe_2O_3t (15-19 wt%). Ultramafic rocks from the deeper part of the intrusive sequence from Szarvaskő also show exceptional high TiO_2 and Fe_2O_3t contents (TiO_2 is up to 20wt% and Fe_2O_3t is up to 45wt%) which can be explained by cumulative separation of Ti-magnetite and ilmenite. Evolved rocks such as quartz-diorite, albitite, plagiogranite are characterized by high concentrations of SiO_2 (up to 75 wt%) and Na_2O (6-9 wt%).
Based on the petrogenetical model calculations relied on REE, most of the basalts from Bódva valley and Szarvaskő originated from a depleted MORB mantle by 10% to 25% of partial melting. Fractionation of basaltic magmas (f=0.8-0.6) gave rise to the formation of various basalts and gabbros. The majority of Darnó Hill basalts could have been formed from a slightly enriched mantle by about 10% to 15% of partial melting. High La/Yb ratios and elevated La contents of some mafic rocks from Darnó Hill and Szarvaskő and also from Tóalmás and Inke are consistent with an evolution from a more enriched mantle reflecting probably a plume component similar to that as the recent Iceland plume. It is also predictable that quartz-diorites and plagiogranites from Szarvaskő (and probably the other acidic evolved rocks) could have derived from basaltic magmas by intensive (f=0.2-0.3) fractional crystallization.

SUMMARY

The Szarvaskő magmatites show back-arc basin basalt affinity, all others has N-MORB and E-MORB character. They can be regarded as parts of a dismembered ophiolite sequence related to a narrow branch of the Neotethyan "Vardar" ocean. In the middle Triassic spreading and generation of MORB-like rocks took place, whereas opening of back-arc basins could haveoccurred in the middle Jurassic.

K/AR AGE DATA OF SPECIAL PEBBLES FROM LOWER MIOCENE CONGLOMERATE IN MECSEK MTS., SOUTH-HUNGARY

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Palaeogeographical-plate tectonical works shows, that the last serious tectonical events with large scale lateral movements, affected in the ALCAPA region, were in upper Oligocene - lower Miocene. These tectonical movements yielded to the formation of great morphological differences, which led to the formation of thick coarse-grained sedimentary sequences. Pebbles of these formations give us good opportunity to trace back the geology of eroded area, and the tectonics after erosion.

The Mecsek Mts. is situated in an inverse tectonical position compared with its pretertiary situation. Lower Miocene, mainly fluvial conglomerates are present in large areas in and around this mountain. This coarse-grained, polymict conglomerate suite contains many exotic rock types, which are not known from the basement of this territory.

These rock types were selected after detailed field and petrographical investigations of coarse-grained material. 25 rock (pebble) sample were selected and sorted into 7 groups, which gave 48 K/Ar data, measured on whole rock and separated mineral fractions.

1. The first group is formed by 5 varieties of leucogranite with two micas and minor andalusite which partly turned into large, fresh Muscovite. K/Ar age of Muscovite (5 of 6) and biotite (3) fractions is about middle Triassic (220-240 Ma). Similar rock might be found only far to the south in the Papuk Mts.

2. Second group contains black contact shales, -silts and chyastoliteschists. Similar noncontact Carboniferous black shales, silts and claystones with sandstones and conglomerates were penetrated by several boreholes close to the south-western part of the Mecsek Mts., which are also present as pebbles in studied conglomerates. The age of strongly contactised varieties (3 pieces) is middle Triassic (~235 Ma). The lesser contactised ones has older K/Ar ages, upper Permian (265 Ma). The contact event could have been caused by granites of the first group.

3. Next group consists of macroscopically well distinctive, special rhyolite pebbles concentrated in a very small area in the northern tectonic unit of Mecsek Mts. K/Ar ages ranges between 122 and 135 Ma, which means lower Cretaceous age of formation. These rocks may represent the unknown, eroded acidic differentiation end-product of lower Cretaceous rift magmatism, which contains differentiation series of alkali basalt - trachybasalt and Na-basanite - phonotephrite - phonolite with similar K/Ar ages.

4. In the same tectonic unit in an also restricted area coarse-grained alkali gabbro occur. Magnetic mineral fractions gave lower Cretaceous age data (117-145 Ma) very similar to the rhyolite group, consequently these rocks are also represent an eroded, until now unknown part of previously mentioned rift magmatism.

5. Two andesites pebbles, known also only from this restricted area of Miocene conglomerate were measured. Strongly altered character suggest older age than measured (77 and 92 Ma), perhaps lower Cretaceous. More data are necessary to make correct evaluation.

6. In this group two metamorphic rock pebbles (garnetiferous amphibolite (probably retrograde eclogite on the base of textural features) and actnolite schist) and an older granitic pebble, separated from a Carboniferous conglomerate pebble from Western Mecsek were analysed. This later gave upper Devonian age (356 Ma), which fits well to the geological situation. The amphibolite pebble from the same locality gave closely similar age (348 Ma). Same rocks were buried by boreholes south and east of Mecsek Mts. The upper Carboniferous K/Ar age (292 Ma) of actnolite schist seems to be younger than the real age of formation. However these few data can serve only as preliminary information.

RECONSTRUCTION OF ALPINE PALAEOSTRESS IN THE HIGH TATRA MOUNTAINS

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The Tatra Mts. represent the northernmost massif of the Inner Carpathians. It is composed of crystalline rocks and a sedimentary cover, thrusted and napped during the Mediterranean orogenic phase (Andrusov 1950).The crystalline core is built of granitoids and metamorphic rocks. In Polish part of Tatra Mts. the granitoid body is Variscan age (according to isotopic data 300 ± 15 Ma - Burchart 1970; 330 Ma - Maluski & al. 1993). Three main tectonic units can be distinguished within the sediment complex: the autochthonous Hightatric sedimentary cover, overthrusted Hightatric units and Subtatric Nappes (Križna and Choč). On the south the Tatra massif is limited by the sub-Tatric fault connected with Neogene uplifting (late Miocene - Kováč & al. 1994, Bac-Moszaszwili 1995). Nummulite Eocene deposits, at present dipping steeply to the north in effect of referenced uplifting, stretch along the northern margin of the Tatra massif.

Several problems exist with the geometrical analysis and reconstruction of stress axes based on structures in nappe units, because most of the fault surfaces are not flat and unmeasurable. Some of them appeared under press dissolution (Jaroszewski 1982). In contrast to overthrusted nappes, the granitoid massif of Tatra Mt. is more isotropic and mesostructure populations are more regular.

Only brittle origin, flat dipping and bearing slickensides faults have been selected to the reconstruction of the alpine stress axes. Slickensided fault-planes are often coated with greenish epidote. Most of them are situated in the highest part of the Tatra Mts., relatively nearby the contact with sedimentary cover. These faults could originate under meridional horizontal compression responsible for thrusting and napping of the sedimentary cover.

The reconstruction of the directions of the three orthogonal principal stresses was prepared using the Angelier method (Angelier 1994). Before the reconstruction, the Tatra Mts. block should be rotated about 40^0 southward to pre-Eocenian position. After rotation the reconstruction of the structural pattern is possible and it appears that the principal axe of compression is not horizontal. The other two axes are neither horizontal nor vertical. It means that before Eocene sedimentation the granitoid block of the Tatra Mts. was rotated about 20^0 northward and about 15^0 eastward, or the stress pattern was not orthorhombic but of tricline symmetry. In both case most of faults became transformed from normal to reverse ones. Is any possibility to reconcile compressional tectonic of granitoid massif and gravity gliding emplacement mechanism in the cover nappes - that is the question (cf. Plašienka 1996).

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DEVELOPMENT OF MORAVA ZONE IN HERCYNIAN CYCLE

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According to previous investigators, Morava zone contains metamorphic and anhimetamorphic rocks of the Proterozoic and Paleozoic age, exposed on Juzna and Velika Morava stream. Eastern boundary of Morava zone is represented by Morava dislocation while, going northwardly, Morava zone prolongates on Suprageticum unit (Romania).

During Caledonian tectomagmatic cycle Morava zone was rifted when basic magmas were extruded. More acidic rocks, which also were noticed, could be produced by differentiation of primary basic magmas, although we should consider possibility that completely new magmatic cycle existed. It is important to stress that metamorphic and sincollision processes as well were very intense. The inplacement of S-type granites along Vrvi Kobila-Dusanovo-Vrsacke planine dislocation was following sincollision processes at the time.

At the middle of Silurian, intensive tectonic activity stops. By the end of Silurian and beginning of Devonian rifting processes started again and they were followed by sedimentation and magmatism of the new tectomagmatic cycle.

In last few years some extended petrological and paleontological investigations were done in eastern parts of Morava zone. Silurian and Devonian quartz-metaconglomerates and quarzites, as products of coastline clastic systems, were investigated. They can be traced over hundreds of kilometers and their thickness is variable. Presence of magmatic rocks between several levels of metaclastites indicates that quartz-metaconglomerates and quarzites are typical rift sequences. According to palinological association investigated metaclastic rocks were deposited in marine environment at the end of Silurian and beginning of Devonian. Protolithes were dated using different groups of palinomorphes. Earlier mentioned magmatic rocks which belong to Hercynian cycle, are represented by spilites, diabases, gabrodiabases, basaltes which occur in sills and dikes of several meters of thickness. They are (as well as metaclastic rocks) metamorphosed at the end of Hercynian cycle under the greenschist facies conditions, quartz-albite-muskovite-chlorite subfacies. They show blastoophitic and blastoprphyritic textures, while mineral association is characteristic one for low PT conditions (albite, actinolite, zoizite, epidote, chlorite, calcite, quartz,etc). In small amount, some more acidic rocks like keratophyres and quartz-keratophyres are present, too. They occur in sills and veins. Textures are blastoporphyritic. Chemical investigations on basic and intermediate magmatic rocks show their toleitic caracter. According to chemical data and petrological investigations seem that primary basic magmas were inplaced in non-typical continental crust. More detail investigations on this subject will go on.

In most eastern parts of Morava zone, in a bit deeper marine environment clastic, chemical and organic sediments were deposited. They were, also, followed with basic lawa flows. Relation of sediments to its older basis is not confirmed, while age is dated using graptholits and conodonts. Sediments and basic magmatic rocks are metamorphosed in lowest stage of greenschist facies.

At the end of Carboniferous and during the Permian Morava zone is lifted-up and caused deposition of molasse sediments.

FLUID INCLUSIONS RESEARCH AS A BASIS FOR GENETIC CLASSIFICATION OF GOLD DEPOSITS IN THE UKRAINIAN CARPATHIANS

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The Carpatho-Balkan region is rather rich in gold deposits and prospects: Romania, Ukraine, Poland, Bulgaria, Chekh Republic, Slovakia, Austria, Hungary. The mineral-forming systems and typomorphic features of gold-bearing parageneses of gold deposits in the Ukraine have been investigated. These results comprise for the first time the principal basis for further genetic classification of the gold deposits in the Ukraine.

The deposits of Beregovo ore district, which is located in Inner-Carpathian volcanic belt belong, to volcanogenic-hydrothermal, low pressure type of gold deposits. The ore field is complicated by faults with vertical displacement of blocks about 50-80 m. The favourable temperature interval of gold-polymetallic ore deposition is estimated as 250-200°C; sulphide deposition in general is characterized by wider interval of 350-150°C. The shallow conditions and active tectonics caused continuous boiling and degassing of hydrotherms. So, fluids were undersaturated oy gases, and (H_2O>CO_2) vapours prevail in the gas inclusions of heterogeneous origin. The vertical range of zone, favourable for ore deposition was about 800-1000 m. The breccia zones and jointing of highest number of mineral associations of different age coupled with evidences for active boiling of fluids are regarded as most suitable ones for gold deposition.

In ancient metamorphic units (Late-Riphean Delovetska Suite) of the north-western edge of the Marmarosh Massif numerous sites of endogenous mineralization are known. Gold mineralization of the Delovetskiy Nappe comprises quartz, quartz-sulphide and quartz-carbonate beds in metamorphic schists. As revealed from investigations of fluid inclusions in minerals, in the temperature-dropping environments (320-250-150°C) distinct fluid evolution has been observed: from chloride-sodium to chloride-sodium-potassium and hydrocarbonate-potassium-sodium. The latters characterize actually barren fluids. Potassium-bearing solutions appear to have been responsible for the formation of hydrothermal mineralization in the Carpathian ore-bearing region. Fluids vapour phase has been enriched in carbon-bearing components. Carbon dioxide and methane are continuously presented. Furthermore, while the initial phases of the ore-forming process are characterized by carbon dioxide predominance, at the final evolution stages hydrocarbons have been appeared. Taking into account the importance of metamorphism and hydrothermal patterns of the fluids we are going to suppose the ore mineralization is polygenic in nature (metamorphic-hydrothermal).

Studies of the fluids formed Au-Pb-Zn mineralization of the Inner Carpathian basin suggest for some applied regularities that can be summarized as follows. Rising concentration of the Mg, Ca, sulphate-ion and hydrocarbonate-ion are typomorphic for Pb-Zn mineralization in different geological environments and regions. Some vapour compounds of the fluids also have been observed as typomorphic. For example, for gold mineralization, express determination of carbon dioxide (IV) contents in mineral-forming system relicts (fluid inclusions in minerals) has been suggested, and for Pb-Zn mineralization the same procedure could be proposed for methane content estimation in gaseous phase.

WEST RHODOPES MAGMATISM: PETROLOGICAL AND GEOCHEMICAL EVOLUTION

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We present here our recent data concerning the granitoids of the Rila-West Rhodope Batholith. The studied plutonites (West Rhodopes, Bellmeken, Grantsharitza and Gargalitza bodies) were emplaced within metamorphic sequences of still unclear age. We assign the rocks to three types, according to their fabric, petrographical, geochemical and probably isotopic data. Type 1 is depicted as coarse-grained, inequigranular, sometimes porphyritic, melanocratic, mainly hornblende-biotite granodiorites and rarely granites. They have clearly noticeable imposed plastic deformations - a metamorphic foliation and a mineral lineation. Type 2 is a equigranular in texture, mesocratic and medium-grained, mostly biotite granite and rarely muscovite-biotite leucogranite. The overprinted anysotropic fabric features are less pronounced, but they have the same orientation as in the type 1 and generally they are in line with the schistosity of the country rocks. Type 3 are fine-grained, leucocratic, biotite-muscovite granites occurring as small stocks or vein type aplitoid granites.

Plagioclase crystallized in three generations. Alkali feldspars of the type 1 consist of high and interim orthoclases and microclines. Almost all K-feldspars of the type 2 are triclinic microclines. K-feldspars of type 3 granites are microperthites and perthites. Amphiboles are ferroedenitic-, ferroan pargasitic hornblende and ferroan pargasite. The compositional evolution of the biotites delineates three distinctive fields corresponding to the granitoid types given above. The location of these fields exclude the possibility the types 2 and 3 granitoids to be derived out of type 1 in a common differentiation process. The calc-alkaline affinity of type 1 granodiorites and the prealuminous one for the type 2 are confirmed on some discrimination plots for the studied biotites. Harker and other geochemical diagrammes reveal two different trends. The first one is a typical calc-alkaline (type 1) and the second one is a high-potassium calc-alkaline (types 2 and 3). Fractional crystallization of the type 1 magma is limitted by hornblende and plagioclase control mainly. Trace element modelling clearly indicates the involvement of K-feldspar and plagioclase mainly and biotite to some extent for the parental magma evolution of types 2 and 3 granitoids. Tectonic discriminations are not unequivocal, but they provide some further evidence for settings - subduction-related for type 1 and mixed, but mainly collision-related for type 2 and 3 granitoids.

The new Rb-Sr data enabled definitely dating only of the granitoids of type 3. A whole rock acceptable isochrone is constructed for type 3 granitoids yielding age of T=36.4 ± 0.59 Ma with initial $^{87}Sr/^{86}Sr$ =0.7079 ± 0.0014. U-Pb data on zircons from type 1 yield age of around 80 Ma and the same method applied to zircons from type 2 direct to the probable age of around 45 Ma. Geochemical features, unequivocal tectonic discrimination (similar to those of arc-related suites and at the same time close to the post-orogenic affinity) might reflect involvement of mantle sources, modified by previous subduction process. Geological and tectonic evidences, as well as the newly obtained timing of the intrusions, indicate that the acid plutonites are related mostly to the late/post orogenic lithospheric extension. Therefore, the calc-alkaline affinity and isotopic data of the granitods of type 1 (Grantscharitza body) demonstrate crust-contaminated mantle-derived composition, which in age and petrological characteristics is a separate older (Upper Cteraceous) fragment of a synmetamorphic pluton. Type 2 and type 3 granitoids are genetically linked in between phases of an much younger in age (40-35 Ma) postmetamorphic pluton. Isotopically they show mixed mantle-crust features, but were with a significantly higher involvement of crust material. Two-staged model is proposed for their formation. In the first-stage mantle-derived magmas obtained much of their hybrid character at a melting and mixing zone near the base of the continental crust through a complex interplay of recharge, assimilation and fractional crystallization. The second stage is an intracrustal process dominated by fractional crystallization, associated with limitted assimilation of crustal materials. The revealed genetical trends of the geochemical and mineralogical features of types 2 and 3 are in line with such a speculation. Further isotopic constraints are needed to support the model and we hope our on-going investigations will try to substantiate it or refute it.

The Trypali carbonate unit of western Crete (Greece): an evaporite formation transformed into solution collapse breccias

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The Trypali carbonate unit known only in western Crete (Creutzburg and Seidel, 1975), occurs between the parautochtonous series (Plattenkalk or Talea Ori-Ida series = metamorphic Ionian series) and the Tripolis nappe s.l. (carbonate Tripolis nappe and underlying Phyllite-Quartzite nappe). It consists of an interbedded sequence of dolomitized cryptalgal laminites, foraminiferal, pelletoidal and oolitic packstones/grainstones, deposited in a lagoonal-peritidal invironment.

Along several horizons a strong in-situ brecciation, is observed. Detailed sedimentological study carried out along five stratigraphic sections proved that the observed breccias are of solution-collapse origin, resulted after removal of intrastratal evaporite beds. Pseudomorphs after evaporites have been recognized in the cementing the breccias carbonate material. Further internal brecciation of the coarser clasts results in a "terra rossa –like paleosol" microclastic matrix.

Several contrasting paleogeographical interpretations have been proposed for the Trypali unit (in Karakitsios, 1987). The sedimentological study of the Trypali carbonate unit implies its similarities to the Triassic solution-collapse breccias of the Ionian zone of Greek mainland (Pomoni-Papaioannou, 1980; Karakitsios and Pomoni-Papaioannou, 1988) and reinforces the hypothesis that Trypali unit represents (Karakitsios, 1987) overthrust slices from the evaporitic base of the parautochtonous series (metamorphic Ionian series) dragged away during the overthrusting of the Tripolis nappe s.l. These evaporitic overthrust slices were subsequently transformed into solution collapse breccias.

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MESOZOIC OCEANIC REALMS IN THE RECENT FRAMEWORK OF THE BALKAN PENINSULA

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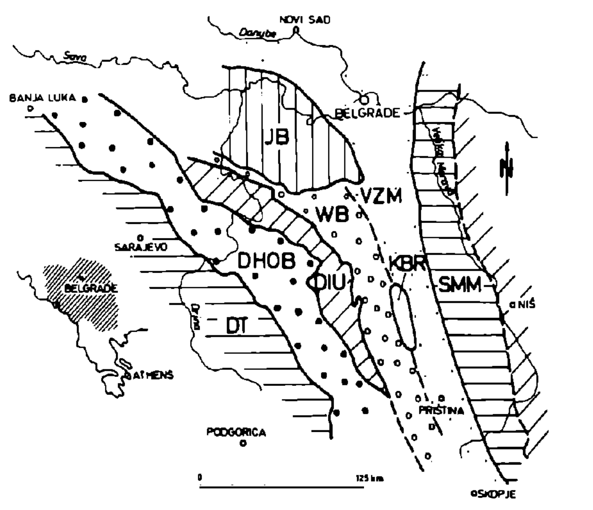
In the Balkan peninsula two, or the most probably three ophiolitic belts of Mesozoic age can be recognized, representing the suture zones or remnants of ocenic areas (Fig.). These are (1) the Vardar zone, embracing the relicts of probably two basins - the main ocenic basin (VZM; 1.1), and the western belt (WB; 1.2); (2) the Dinaridic-Hellenidic Ophiolite Belt (DHOB); and (3) the Civcin-Severin basin situated at the east. Those basins were connected in some periods. They differ, however, in many points, especially in composition and conditions of their development.



The Mesozoic oceanic realms in the Central part of the Balkan Peninsula. Abrevations are given in the text.

l.a. The central part of the Vardar Zone (VZM) represents the relict of the main Vardar Oceanic basin. This oceanic realm existed from the Early Paleozoic as the successor of the former ocean between the northern continental blocks and Gondvana. During the Mesozoic this basin was situated between the Serbian-Macedonian mass (SMM) at the east, and (up to the Middle or Upper Triasssic) the Drina-Ivanjica unit (DIU), later (from early Upper Triassic) the Kopaonik block ridge (KBR) at the west. The oceanic realm closed in the Upper Jurassic, with the collision metamorphism at the eastern and especially southeastern margin, intrusions of S-granites, fringe of Tithonian reef limestones, and Lower Cretaceous paraflysch over the ophiolitic sequence. Large lenses of the Veles-series metamorphics (Devonain ?-) Carboniferrous in age occur in the domain. In the olistostrome formed in the subduction trough basaltic and gabbroic rocks are the main constituents, together with blocks of turbitic greywackes, silicious siltstone, gray and black limestone of unknown origin, red radiolarites and very rare Tithonian limestones.

1.2. The Western part of the Vardar zone (WB) is situated between the ridge marked by the Kopaonik block (KBR) at east and the Drina-Ivanjica unit + Studenica slice (DIU) at the east. The oldest inclusions in the olistostrome in this zone are of (Carnian?-) Norian age and the youngest ones are Lower Senonian. The main constituents of the olistostrome are sandstones; subordinate are cherts, basaltic rocks, gabbros, and very rare Triassic and Cretaceous limestones, together with low-grade and ophiolite-connected metamorphics. This oceanic basin existed from the Upper Triassic to the middle of Senonian. It probably represented a marginal (back-arc) basin before the Upper Jurassic, locally connected with the main oceanic realm. The closing of this basin began in Middle/Upper Jurassic, with the closure in the Senonian.

2. The Dinaridic-Hellenidic Ophiolite Belt (DHOB) represents the remnant of an oceanic realm which existed from the beginning of the Upper Triassic to the uppermost Jurassic. It was opened between the Drina-Ivanjica unit (DIU) and the main Dinaridic trunc (DT). The oldest inclusions in the olistostrome in this zone are limestones and granites of Carboniferous age, and the youngest are Kimmeridgian cherts. The sandstone blocks are the most frequent in the siltstone matrix, accompanied by cherts of Carnian - Norian, as well as of Upper Jurasic age, basaltic rocks (frequently pillowed), gabbros, Triassic and Jurassic limestones, and (late)Middle/(early)Upper Jurassic metamorphics associated with the ophiolite emplacement. In this assemblage abundant are large Triassic and Jurassic gravity slices and obducted ultramafic plates. The Tithonian (lovermost Cretaceous?) Pogari series ovelies the olistostrome. The belt probably represents a marginal (back-arc) basin, which was locally and temporary connected with the western Vardar zone basin.

3. At the east of the Serbian-Macedoinian mass the Civcin-Severin oceanic realm existed probably even from the Jurassic to the Upper Cretaceous. Its suture zone is covered by the huge nappes of the Southern Carpathians.

The age and the compositions of the olistostromes and surrounding formations of the suture zones presented show that these were distinct basins with different geotectonic significance and development.

SEDIMENTOLOGICAL CHARACTERISTICS OF ALEKSINAC AND SENJE-RESAVICA LACUSTRINE BASINS – SIMILARITIES AND DIFFERENCES

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During Oligocene-Miocene (Egerian) on the territory of Serbia within the Velika Morava trench (connected on the North with Panonian sea) i.e. on Južna Morava and Velika Morava depression, numerous lacustrine basins were formed. The beginning of the formation of lacustrine basins is connected with intensive tectonic activity on the area of Carpathian-Balkan and Serbian-Macedonian Mass, and forming of the Velika Morava trench (Obradović et al., 1997). Lacustrine basins that were formed then, during their evolution were more or less connected.

Studying the territorial distribution of most important lake basins from south to north, one can distinguish Aleksinac lacustrine basin on the south, and northward Ražanj, Popovac and Senje-Resavica lacustrine basins. All these basins have similar evolution, but also are different. The earlier investigators separated in Egerian, Eggenburgian-Ottnangian and Karpathian several series, characteristic for all basins, which indicate the new sedimentary cycles (Anđelković et al., 1991).

Similarities and differences in the evolution of lake basins within the Velika Morava trench will be shown on the example of Aleksinac and Senje-Resavica lacustrine basins. The common, important feature of these two basins is economically remarkable brown coal appearance, which is nowadays still exploited. Aleksinac basin contains hard brown coal, with predominant clarite, humus gel and humus detritus. The content of moisture is up to 24%, ash from 15 to 19%, sulfur 4%, with DTE Kcal up to 5000. In the Senje-Resavica basin typical brown coal is present, petrographically belonging in durains, of humus origin with moisture content up to 22%, ash up to 18%, sulfur 1%, with DTE Kcal 3700-4400.

Sedimentary facies and their distribution within the two basins is similar, but with significant differences. Alluvial-lake, marginal-lake with swamp facies and intrabasinal facies are distinguished in both of the basins. First two facies, of which the former is more developed in the Aleksinac basin, are characterized by appearance of the red clastic series, mostly coarse- to middle-grained, discordantly lying over the older basement.

Marginal-lake facies is connected with swamp facies in which the coal was formed. One of the most significant differences between the two basins is shown in the lithological composition of marginal-lake facies in both of the basins. In the Senje-Resavica basin, it is represented only with clastics, while in the Aleksinac basin, beside the clastics, appear also oil shale. It is also important to mention that oil shale appear not only in overlying series of coal but in the underlying too. Oil shale beneath the coal alternate with coaly clay and siliceous rocks, while those over the coal with clay and dolomite.

Intrabasinal facies in the case of both of the basins is represented with marly sediments. In the Aleksinac basin, beside marl, appear also tuffs and tuffaceous-marly sediments with analcime, which is not the case with the Senje-Resavica basin. Isotopic composition of dolomite from the Aleksinac basin indicates the open lake system, with the water temperature of approximately 25^0 C. The same investigations done on the marls from the Senje-Resavica basin indicate the conditions of the closed lake, with the same water temperature.

For the explanation of the existing differences between the two investigated basins, which were in the certain periods (but not all the time) connected, most acceptable hypothesis is that the conditions at the time of deposition of (especially) marginal-lake facies were different, i.e., in the Aleksinac basin were highly appropriate for the development of algae, which later gave the organic matter, necessary for the oil shale forming. Nevertheless, it can not be excluded for sure the possibility that in the Senje-Resavica basin oil shale series was also developed, but later overthrust, or eroded during dry periods.

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NEW GEOLOGICAL IDEAS ON THE ALPS-CUKALI RELATIONSHIP AND THE ORE-BEARING PERSPECTIVE

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ABSTRACT--- Existing ideas on the relationship of the Albanian Alps with Cukali are given in this paper *(Aubouin J. et al 1965; Grillo V. et al, 1983; ISPGJ, ING, 1983; ISPGJ, ING, 1990; Kici V. 1988; Nopcsa Fr. 1929)*. Some facts and interpretations are given afterwards, leading to a new geological imagination and opening the perspective to explore for polymetals. It results that the Albanian Alps have not been thrusted southwards over Cukali. The deep tectonic fault between the Albanian Alps and Cukali has no surface outcrop. The tectonic fault is a normal fault and continues in Pec-Mitrovica region. It is covered discordantly by Xhani shists *(Gjani Schiefer after Nopcsa Fr., 1929)*. Mesozoic limestones in both side of faults represent interes for polymetalic ore mineralization. Cukali does not represent a tectonic window. It is related to the Albanian Alps zone. Its northern part belong to the Valbona subzone.

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LATE OROGENIC EXTENSION IN OROGENIC BELTS: THE HELLENIDES

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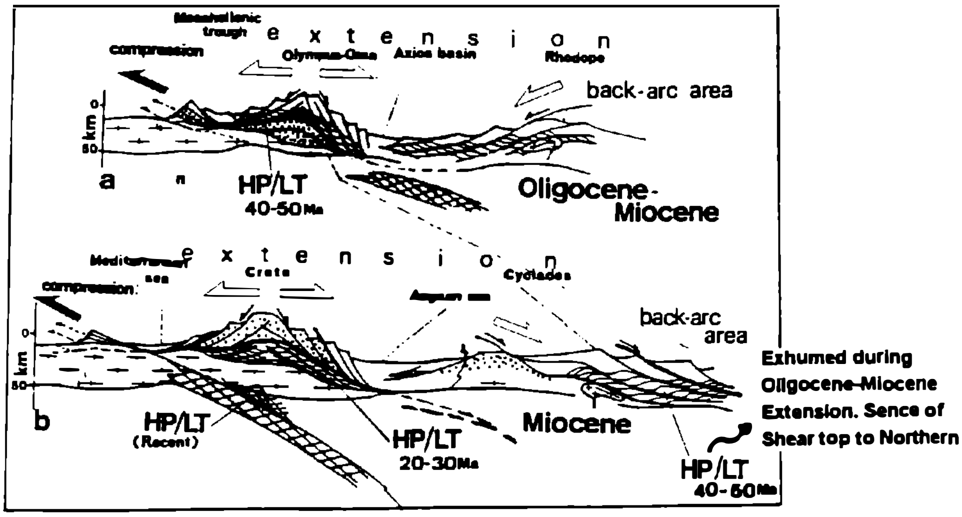
Orogenic collapse and stretching follow the orogene crustal thickening caused during plate convergence and subduction processes. Late orogenic extension results in the exhumation of deep crustal metamorphic rocks. Two mainly uplift mechanisms of deep crustal metamorphic rocks are proposed: Asymmetric translation of the overlying continental parts along a low angle normal shear zone and symmetric dawnwards detachment of the overlying plate along two low angle shear zones with opposite sense of shear at both flanks of the uplifted deep crustal metramorphic rocks. In the Hellenic orogen both typs of late orogenic extension are recognized. In the areas of Olympos-Ossa and Pelion Mts in Northern Greece, as well as in Krete island in Southern Greece a bivergent late orogenic extension dominates. On the contrary, in the Rhodope and Cyclades areas an asymmetric extension is suggested. A common feature of the three first areas is the good preservation of the high pressure assemplages in the exhumed deep crustal metamorphic rocks. Stretching and nappes collapse took place immediately above the cold accretionary wedge while compression was active at depth. In the Rhodope and Cyclades areas extensional exhumation of deep crustal rocks took place in the high thermal flow back-arc region and the high pressure metamoprhic rocks are highly overprinted by greenschist to amphibolite facies metamorphism. Partial melting and granitioids intrusions associated the high grade metamorphic reworking of the rocks.



Crustal extension above the cold Olympos-Ossa-Pelion or krete accretionary prisms, during Oligocene-Miocene and Miocene respectively, favours the symmetric collapse of the overthickened continental crust, probably due to an inrease of the upward pressure that is produced from the underplated continental slab beneath the accretionary wedge. Increase of the upward pressure of the untrplated plate and stretching of the thickened wedge could was caused due to a rate change of the plate convergence. Furthermore, if the high potential energy of the overthickened crust can by not counteracted by continuing subduction processes, the symmetric collapse of the orogenic belt seems to be favoured (Olympos-Ossa-Pelion areas).
Back-arc extension in the Cycladic Archipelago was developed simultaneously with the Oligocene-Miocene subduction processes and southward nappes stacking wich took place further southern at the front of the deformed plate. The high potential energy of the prior to the extension overthickened crust was counteracted by the northward continuing subduction. These conditions allowed the asymmetric top to the N-NNE extension of the inner back-arc region and the unroofing and finally exhumation of the high grade deep crustal parts. In the Rhodope massif the Oligocene-Miocene non-coaxial southwestward extensional shear zone is possibly a part of a bulk coaxial deformation wich affected the whole orogenic belt in the Northern Greece.

CRYSTALLINE SCHISTS OF RESERVOIR "TUS" AS THE HYDROCARBON RESERVOIR ROCKS

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In this paper the basic petrological, petrophysical and chemical characteristics of reservoir rocks in the "Tus" oil reservoir have been presented as the basis for the future exploration, reservoir engineering and exploitation of such types of reservoirs. The area "Tus" far about 25 km northern from Novi Sad (middle part of Vojvodina, territory southern Backa).

Reservoir rocks of oil reservoir "Tus" is represented by the crystalline schists and products of cataclastic metamorphism: tectonic breccias, different types of cataclasis and mylonites. Crystalline schists are gray to grayish-green in color, of schistose, banded and folded texture, and cataclastic, lepidoblastic, nematoblastic and porphyroblastic structure.

A large number of variety of crystalline schists has been picked out based on the mineralogy composition and divided into two groups:

1. Rock with sericite: sericite-albite-chlorite schist, albite-sericite-amphibole schist, albite-biotite-garnete schist and albite-biotite-sericite schist, and
2. Rocks without sericite: amphibole schist and albite-biotite-chlorite schist.

According to the chemical composition and calculated norme composition of the rocks of the first group - rocks with sericite, originated from tuffs of basic character, and rocks without sericite, originated from basic magmatic rocks of basalt character. Mineral associations show that these rocks are formed at the temperature of $420°C \pm 10°C$ and pressures from 4-6 Kbars.
Early tectonic movements have created the cracking, faulting and cataclasting of crystalline schists. Tectonic movements have made the schists turn into reservoir rocks and bearers of hydrocarbons. Hydrocarbons are found in between the blocks of schists in the mm-, cm- or m-scale. Accumulation and communication of hydrocarbon in between the block of schists is bound to the porosity which is represented by the cavities, fissures and microfissures. These petrophysical characteristics are grouping the crystalline schists into fractured type of reservoir rocks with secondary porosity. Cavities and fissures in this type of reservoir rocks are of open type, partialy closed to closed type and microfissures.

THE ZONING CONCEPT IN ENGINIEERING GEOLOGICAL MAPPING. EXAMPLE FROM ÖK 52 ST. PETER IN DER AU

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Wat should be shown on an engineering geological map depends largely on why the map is being produced, in other word ist purpose.

It is in the tipe of iformation that need to be shown, and in how the information is presented, that an engineering geological map differs from a conventional geological map.

Here are decribed the standart methods for preparing engineering map, bat the way should be left open for developments in mapping techniques both in methods of data acquisition and in final presentation on the map sheet.

Engineering geological mapping involvs lines (ARCS) on a map around areas (POLYGONS) homogeneous units. Each map units comprises in general terms a zone an acceptable concept for an encloed area. Homogeneity is related to particular geological conditions or engineering properties (INFO) and the concept may be applied to all maps csales.

The zoning concept has bin developed into a hierarchy:

region
area
zone
district,

each appropriate to particular map scales. Zoning has been applied to delemit different types of engineering geological areas and zones. Zones are delimited on the basis of the general character and structural arrangement of engineering formations.

Geological, hydrogeological and present geodynamic conditions are listed for each zone together with general estimations of engineering geological conditions for construction purposes.

Engineering geological zones of the north part of ÖK 52 St. Peter in der Au are discriminated on

a) general uniformity of lithological character
b) the arrangement of engineering formations in the uper most 10m below the ground surface.

Engineering geological zones are subdividet into subzones on the bases of sequence and thecknesses of individual soil and rock types. Conditions in the subzones are represented by chematic cross-sections of the soils and rocks. Individual zones are indicated by symbols expressing both the genesis and lithology of roks and soils involved.

As a supporting tool for engineering geological maps und zoning concept has been used the GIS-ARC/INFO.The major advantage of a ARC/INFO is that it allows as to identify the special reltionship betwen eningeering geological map features like hydrogeological conditions and geodynamic processes(landslides, gully erosion etc.)

ON THE GENESIS AND THE EVOLUTION OF THE ALBANIAN OPHIOLITES

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During the Mesozoic, Albania's areas were related to the Eastern edge of Adria plate. Through the Permian-Verfenian and Anisian, an intensive detachment faulting activity affected the Eastern margins of ADRIA plate. The extensional tectonic regime defined the installation of several intracontinental rift basins where typical rift assemblages and the volcanic activity of WPB geochemical nature were developed.

During the Ladinian to the Early Lias was installed the huge graben structure of MIRDITA with two platform units in both sides (HAJMELI and GJALLICA) and, between them, thin continental crust Basin of QERRET-MILISKA. Just in center of the QERRET-MILISKA Basin started the installation of the MIRDITA oceanic crust Basin In the Ladinian-Early Lias, the continental break-up was completed and the sea floor spreading began. The installation of MIRDITA OQEANIC BASIN, definitively has separated the KORABI-PELAGONIAN microblock in the East from ADRIA plate in the West.

In the Middle Lias to Dogger, HAJMELI and GJALLICA platforms were gradually subsided, while within the MIRDITA graben, in the tilted fault blocks condensed red limestones with manganese-phosphate nodules were deposited. This essential moment, registered into the passive continental margins seems to correspond to the onset of the sea floor spreading. Two main stages have accompanied the oceanic crust generation. Firstly, it is inferred a slow to moderate oceanic spreading with implication of longitudinal and cross-cutting segmentations. In the earlier phase, MORB-type ophiolites are produced. Secondly, during the oceanic stretching stage, an important longitudinal transform fault led to the subsidence of oceanic crust followed by the intraoceanic subduction. It is supposed that the subducted oceanic lithosphere experienced an intensive hydration and modification. On the top of the suprasubduction zone forearc spreading centers seems to be installed and diverse type ophiolites of IAT, BSV (Boninite suite volcanics), MORB affinity are generated.

Isotopic studies argue the Middle Jurassic age (Bajocian to Early Callovian) of the ophiolites and their metamorphic soles. Of the same age are the radiolarian cherts found among the basalts of ophiolites and as the primary sedimentary cover of ophiolites.

The contractional episode, started during the Middle Jurassic, caused the subduction and introceanic thrusts. It continued to be strong even during the Late Jurassic culminating with ophiolite/volcano-sedimentary series obduction onto the continental margins. The intraoceanic thrusting of ophiolite massifs on volcano-sedimentary series is of the double vergency style. The same character shows the ophiolite/volcano-sedimentary obduction on the continental margins. This double vergency displays a Eastward and Westward emplacement. The Late Jurassic obduction is registered with Upper Tithonian-Upper Valanginian flysch sedimentation.

THE GEOCHEMICAL AND ISOTOPIC CHARACTERISTIC OF THE HERCYNIAN GRANITOID ROCKS OF THE WESTERN CARPATHIANS - SLOVAKIA: EVIDENCES FOR CRUSTAL RECYCLING

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Granitoid magmatism dominated the Hercynian orogen in the Western Carpathians over the time interval 100 million's years (360 - 250 Ma). The oldest event 360 – 340 Ma, have been produced mainly S-type granitoids, while the middle event 310 – 300 Ma is dominated by I-type tonalite and /or granodiorite. The youngest event 290 – 250 Ma generated A-type granites and ore-bearing S-type granites. Accessory minerals (magnetite + allanite and monazite + ilmenite) show in Carpathians granite plutons dichotomy and/or antagonism, which permits distinguishing two granite groups I & S (Petrík and Broska, 1994), while presence of garnet for Permian A/S granites is typical. The occurrences of the mafic microgranular enclaves (MME) in the magnetite-bearing granites and presence of the host (metamorphic) rocks xenoliths in the magnetite-free granites support this division. Fractionated A/S granites are rather homogeneous, than rich in xenolithes or enclaves. The silica contents of S-type granitic rocks vary in a range ca. 61 - 75 wt.%, for I-type granitoids vary in a range 58.5 - 71 wt.%, and SiO_2 of A/S granites is varying from 69.5 to 77.5 wt.%. Carpathians granitoids represent low- to high-potassium calk-alkaline (trondhjemite - monzonite) series of magmatic rocks in general. S-type granitoids are mainly peraluminous (ASI = 0.9 - 1.5), metaluminous to peraluminous character of I-type tonalites is reflected by ASI = 0.8 - 1.2 and A/S granites have ASI = 0.9 - 1.4 suggesting peraluminous compositions. The Rb/Sr ratios range of 0.07 - 2.5 and 0.05 - 1.5 for S and I-type respectively, indicating mixed lower crustal and mantle component and/or Rb-poor crustal source, what support initial strontium ratios I_{Sr} = 0.706 - 0.708 and 0.704 - 0.706. The I_{Sr} = 0.711 - 0.720, rarely extending up to 0.734 and Rb/Sr = 1.6 - 10 for A/S-type granites call for a pure (supra)crustal origin. The $\varepsilon Nd_{(0)}$ values for S-type granitoids vary from -4.8 to -9.9, while I-type tonalites have these values similar to others European infracrustal granites -2,3 to -6,1 and A/S granites show lower crustal character as well with $\varepsilon Nd_{(0)}$ = -3,9 to -5,3. There is a fairly large range in oxygen isotope results in S-type granites ($\delta^{18}O$ = 8.8 - 11.7 ‰ SMOW), suggesting country rock assimilation, rather than an indication of peraluminous and/or metasedimentary provenance of magmas. Particularly low $\delta^{18}O$ values of I-type (7.6 - 9.9 ‰) and A/S- type (7.9 - 9.9 ‰) granites are more consistent with infracrustal metaluminous whole-rock chemistry. However, there is none isotopic proof for a direct input of juvenile products of a mantle magma, which could possibly trigger anatectic and/or differentiation processes during Hercynian orogen in the Western Carpathians. Apparent (Nd) crustal residence ages t_{DM} = 0.9 - 3.1 Ga indicate mainly recycling of Proterozoic precursors. Suitable source rocks of the Western Carpathians granitoids could have been for: the S-type granitoids - supracrustal reduced granulite facies rocks with minor addition of basic component, the I-type group - old metaigneous rocks in interaction with underplated basaltic crust, the A-type group - granulite and/or tonalite crust, and the S-type granites - matured recycled sedimentary supracrustal rocks.

THE CRUSTAL GROWTH OF THE PRE-MESOZOIC BASEMENT OF THE WESTERN CARPATHIANS (SLOVAKIA).

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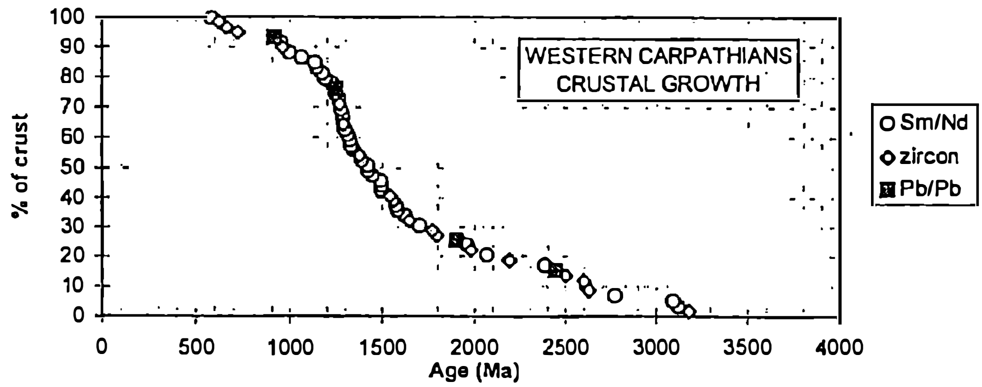
The Western Carpathians create the direct eastern continuation of the Alps. Similarly to the Pyrenees, Alps and/or Himalaya, the Carpathian mountain chain is typical Alpine collisional fold belt. The Pre-Alpine (Pre-Mesozoic) crystalline basement is exposed discontinuously, mainly in the Central Western Carpathians (CWC), the heart of the Western Carpathians, consisting of three principal crustal-scale superunit: the Tatricum, Veporicum and Gemericum. The crystalline complexes are formed by exclusively autochthonous and/or para-autochthonous units in the sense of the Alpine tectonics in CWC.

As for almost all European basement territory, the Hercynian orogeny is dominant in the Western Carpathians crystalline areas in the present erosion level. Available isotope data (U-Pb; Rb-Sr and Ar-Ar) support mainly the event between 360 and 340 Ma. The HT/MP metamorphism with concomitant widespread granitoid magmatism were responsible for potential resetting of the precursor/source rocks. There are only scarce U-Pb zircon data indicating older events, in the Gemeric unit - 403 Ma age of porphyroid rocks. In the Tatric unit, an orthogneiss precursor of age 380 - 405 Ma and/or 500 Ma old metamorphic event from gneissic rocks of the lower unit (Todt et al. 1998), has been documented.

During the last years, increased amount of modern isotope data, suggesting continental crust formation and/or old crust evolution from various Hercynian crustal rocks in the Western Carpathians has been obtained. Sm-Nd model ages $T_{(DM)}$, upper intercept ages from conventional and single grain U-Pb zircon dating, as well as Pb-Pb isochrons of leached samples were used to derive semi-quantitative estimates on crustal growth rates (see Fig.). The Hercynian crust of the Western Carpathians predominatingly consists of reworked - recycled Proterozoic crust. There is only a minor evidence that 10% of the Archean rocks was recycled. The Western Carpathians crustal growth was continuous during the Proterozoic period, which is



more consistent with the growth of the supercontinent Laurasia, than of Gondwana - showing an episodic character. The CWC average crustal age is 1590 Ma, which is younger than in other segments of the European Hercynides. During Hercynian orogeny mainly Middle Proterozoic rocks of crustal origin were influenced by collision. This is in accord with new Pb-Pb whole rock isotope studies from the Tatra Mts., where rocks gave a secondary isochron with the age of 1200 Ma and $\mu = 8,2$ and/or $\kappa = 3,8$ - typical for crustal source of the precursor (Todt et al. 1998).

Todt, W., Poller, U., Kohút, M. & Janák, M. 1998: The 9[th] ICOG conference, Abstract Volume, Beijing.

Dismembered ultramafic ophiolites from the Avren region, Eastern Rhodopes (Bulgaria)

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Dismembered ultramafic ophiolite blocks from the region of Avren, Eastern Rhodopes have been investigated for establishing their stratigraphic position in the general ophiolite section.

The investigated ultramafic bodies are formed mainly by serpentinized harzburgites, and partly by dunites and wherlites. Part of the blocks are fonned by massive tectonized peridotites. For the other part remarkable layered structures are characteristic. Coarse grained harzburgites with bastite or tremolite and fine grained to dense dunite have been identified in the massive ultramafics. The mineralogical and chemical composition of the separate layers in most of the layered bodies do not differ considerably. An exception is Avren$_{\square}$ where the differenciation resulted in separation of layers with harzburgite, lherzolite, and vehrlite composition. In the massive and widely layered harzburgites X_{Cr} in the spinels is with values, typical for considerably depleted tectonites. The spinels of the fine layered ultramafics from Avren$_{\square}$ with their lower X_{Cr}, and their values of Fe^{3+}, are characteristic for the cumulates.

The partly preserved textural and structural properties of the rocks, the variation in the chemistry of their relic minerals (olivines, spinels, orthopyroxenes, clinopyroxenes, amphiboles) as well as the bulk chemical composition of the different rock types have been investigated to understand the character of their protolith, and their metamorphism. The results indicate that most of the bodies of the region are fonned by tectonized peridotites. A part of the layered bodies are also formed by tectonized peridotites. The only layered body, which is assigned to the lower part of the cumulate unit is Avren$_{\square}$.

The presence of cumulates in the Avren region is an important feature for the comparison between the ophiolites from this region and those from the neighboring Bela reka rise. The ophiolites from the rise contain eclogites which may be regarded as plagioclase containing metabasalts. The latter is considered as an indication of the correlation between the ophiolites from both regions.

The almost complete serpentinization of the harzburgites and dunites as well as the disintegration of the spinels show that the included in the continental crust ophiolites were retrograde metamorphosed reaching the conditions of green schist facies (T<500°).

BESSARABIAN FORAMINIFERAL LIMESTONES (GRAINSTONES) FROM NORTH-EASTERN BULGARIA

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Until recently in the Bulgarian geological literature a part of the Bessarabian limestones from the Odurtsi Formation (North-Eastern Bulgaria) were described as oolitic and shell limestones (Popov, Kojumdgieva, 1987). The last microscopical observations in thin-sections show that these limestones contain about 40% foraminifers and they are related to foraminiferal limestones (Koleva-Rekalova, 1997). Microfaunal determination of the foraminiferal species are made in the present study.

Two outcrops around the village of Odurtsi and Kamen bryag are studied in detail. The colour of the foraminiferal limestones varies from white to yellowish. The bed thickness is about 10-15cm. The limestones consist mainly of fossil allochems - foraminifers about 40% and mollusks 10-15%, rarely contain oolites. The sparry calcite cement is less than 50%. The limestones are typical grainstones and are deposited in moderately agitated water (Koleva-Rekalova, 1997).

The Middle Sarmatian (Bessarabian) sediments from North-Eastern Bulgaria are rich in foraminiferal benthos (Darakchieva, 1989, 1990). The limestones as a rocky variety are not suitable for foraminiferal extraction. The observations of the biocomponents in thin-sections are in addition to the foraminiferal determinations.

The following foraminifers are isolated: *Varidentella reusii* (Bogd.), *V.sarmatica* (Karrer), *V.volynica* (Didk.), *V.complanata* (Gerke et Issaeva), *Flintinella tutkowskii* (Bogd.), *Elphidium crispum* (Linne), *E.macellum* (Fichtel et Moll), *E.rugosum* (d'Orbigny), *E.reginum* (d'Orbigny), *E.aculeatum* (d'Orbigny), *Articulina sarmatica* (Kerrer), *A.problema* (Bogd.), *Pseudotriloculina consorbrina* (d'Orbigny), *Gribroelphidium subgranosum* (Egger), *Gr.aragvinesis* (D.Djan), *Gr.hyalinum* (Bogd.), *Gr.martkobii* (Bogd.), *Nonion bogdanowichi* (Wolosh.), *Affinetrina voloshinovae* (Bogd.) and Miliolidae. In thin-sections are observed cross-cuts of Triloculina, Quinqueloculina, Flintinella, Nonion, Miliolidae.

The present fauna is concerned to the foraminiferal zone *Flintina tutkowskii* (Darakchieva, 1989) and molluskan zone *Cerastoderma fittoni* (Popov, Kojumdgieva, 1987). The abundant benthos (mainly from Milliolidae) shows that the foraminifers are basic components in the studied limestones.

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TECTONO-METAMORPHIC EVOLUTION OF THE PENNINIC UNITS OF THE EASTERN ALPS

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The Penninic unit occur in the Eastern Alps only in form of tectonic windows, starting from the west they are the Lower Engadine Window (LEW), the large Tauern Window (TW)in the central part, and in the east several small windows forming the Rechnitz Window Group (RWG).

Two metamorphic events are recognizable in all windows where the older is regarded as a HP/LT metamorphism and the younger of Barrovian type. Only in the TW an earlier eclogite metamorphism is recorded with an retrograde evolution path entirely different from the rest of the Penninic metamorphics.

The eclogitized metabasics and metasediments passed through a mantle/crust (?) segment in a depth of 70 km. With Tmax around 600° C they formed in an array of a very low geothermal gradient of 7 - 9° C/km typical for subduction zones. The eclogite formation has to be earlier than the Eocene/Oligocene boundary. Ar/Ar data suggest for the blueschist event an age of late Eocene - early Oligocene. For the eclogitic rocks the HP/LT event is a stage of cooling and uplift from 70 - 85 km to 35 - 40 km. This corresponds to the subduction of other sediments and metavolcanics structurally above the eclogite zone to the same depth and an according heating to 400 - 450° C. Again the low thermal gradient of 10 - 13° C/km suggests a subduction zone environment.

The HP/LT remnants in the LEW and RWG record somewhat lower pressure and lower temperature compared with the TW but indicate also an subduction zone along the same low thermal gradient around 10 12° C/km. In the LEW mostly the deeper parts (North Penninic metasediments) are metamorphosed in blueschist facies, for the ophiolites a proof of a HP/LT metamorphism is missing. In the RWG the ophiolites indicate clearly the blueschist event, the metasediments below and above the ophiolites are not investigated.

The subsequent greenschist to amphibolite facies event has its lowest Tmax with 350° C in the LEW. In the RWG a Tmax of 450° C is recorded and in the TW between 500 - 600° C. Tmax is combined with a pressure of 2 - 4 kbar in the LEW, 3 - 4 kbar in the RWG and 5 - 7 kbar in the TW approaching a geothermal gradient of 20 - 35° C/km, typical for a Barrovian type metamorphism. This metamorphic stage was reached shortly after 30 Ma and is further recorded by cooling ages down to 16 Ma. Similar cooling ages are reported from the RGW, the scarce data from the LEW record probably the onset of the low grade metamorphism. The cooling and exhumation in the TW and RWG can be followed through fission track studies of apatites down to 5 and 7 Ma respectively.

THERMOBARIC CONDITIONS AT GREAT DEPTHS IN CARPATHIAN OIL- AND GAS-BEARING PROVINCE

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The Carpathian oil- and gas-bearing province covers the Pre-Carpathian oil- and gas-bearing area in the limits of the Boryslav-Pokutsk (Internal zone of Pre-Carpathian foredeep) and the Bilche-Volytsa oil- and gas-bearing zones (External zone of Pre-Carpathian foredeep), the perspective oil- and gas bea-ring zone of the Folded Carpathian and the Trans-Carpathian gas-bearing area (Trans-Carpathian depression). The main oil and gas fields are connected with the Neogene and the Mesozoic deposits of the Bilche-Volytsa oil- and gas bea-ring and with the Cretaceous-Paleogene flysh deposits of the Boryslav-Pokutsk oil- and gas bearing zone.

Within all tectonic elements of the Carpathian oil- and gas bearing province there are the supra-hydrostatic reservoir pressures. The reservoir pressures with $K_{sh} = P_{res}/P_{hyd}$ more than 1.21-1.23 belong to them. Supra-hydrostatic reservoir pressures are most widely developed in the Bilche-Volytsa and Boryslav-Pokutsk oil- and gas bearing zone, within the last - in the Truskavets, Pokutsk covers and in the para-autohthon. Supra-hydrostatic reservoir pressure are peculiar to water bearing and oil-satureted beds. Values of supra- hydrostatic reservoir pressure increase with the depth and from the Boryslav cover to the para-autohthon (Table).

Table. The medium values of K_{sh} in the covers of the Folded Carpathian and Boryslav-Pokutsk oil bearing areas

Covers\ oil deposits	Urozh	Huta	Popeli	Novo Skhid-nyca	Zavo-da	Oriv	Iva-nyky	Semy hy-niv	Ta-niava	Spas	Shev-che-nko	South Mona sty-rec
Berehovyj			0,89	0,98		1,03			1,08	1,08	1,05	
Boryslav	1,08		1,04	1,17	1,14	1,14		1,14	1,05	0,95	-	1,11
Truskavets	1.61	1,27	1,11		1,21	1,32	1,20	1,57		-		1,41
Pokutsk	-					-		-		1,54		
Para-autoh-ton		1,36			1,21		1,36		1,45		1,55	

In the Folded Carpathian the supra-hydrostatic reservoir pressures are found in the deposits of the Skyba zone moved up to the Boryslav-Pokutsk oil- and gas bearing zone and in the zone of Krosno. The Miocene deposits of the Trans-Carpathian depression are characterized mainly by the hydrostatic pressures. There are different reasons of supra-hydrostatic reservoir pressures creating. These are condensation of clay thicknesses, geodynamic stresses, dehydratation of sedimentary rocks at great depths and vertical moving of fluids by breaks. The most quantity of oil deposits drawns towards the zones with reservoir pressures which are close to the hydrostatic pressures, but the industrial flows of oil were obtained under the conditions of supra-hydrostatic reservoir pressures.

The geotemperature field of the Carpathian oil- and gas bearing province is essentially differentiated at the depth of 4000 m. There are such fluctuations of the temperature in its different parts: in the Bilche-Volytsa oil- and gas bearing zone the highest temperatures reach 150 °C in the nothern west, the other maximum is in the southern east. The zone of temperatures of 80-90 °C is between them. The Boryslav-Pokutsk oil- and gas bearing zone and the Folded Carpathian are less heated - to 80-100 °C. Temperatures increases most essentially to the southern west from the Central-Carpathian deep-seated break reaching 90-110 °C, and in the zone of the Trans-Carpathian deep-seated break, reaching 140-150 °C and more. Oil deposits are characterized at the depths between 4000 and 5000 m by temperatures from 98 to 123 °C. At the field Pivnichna Zavoda the oil flow with the temperature of 147 °C has been obtained. Layer temperatures and K_{sh} a connected by the direct proportional in many cases.

THRUST-RELATED PETROLEUM GENERATION IN OUTER TECTONIC UNITS OF THE UKRAINIAN CARPATHIANS

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The Ukrainian Carpathians represent the north-eastern segment of the Carpathian arc and extend between the Poland and Romania. The main oil fields occur here in the Paleogene flysch sequence of the Boryslav-Pokuttia unit, which constitutes the frontal unit of the Flysch belt. It is made up of folded Upper Cretaceous to Lower Miocene flysch strata, which form suitable structural traps sealed by the Miocene molasse series.

Two organic-rich episodes are recorded in the Cretaceous to Neogene sequence of the flysch belt: 1) Lower Cretaceous series at the base (Shypot and Spas formations); and 2) Oligocene-Lower Miocene series at the top (Menilite formation). Both Lower Cretaceous and Oligocene organic-rich strata display a basin scale distribution. They occur at different depths within most of the flysch belt and constitute the main potential source rock levels in the region. TOC content in the black shales of the Menilite Formation within outer tectonic units exceeds locally 20%, but the average is comprised between 4 and 8%. The rocks contain type II kerogen with a good to excellent petroleum potential. Black shales of the Shypot and Spas formations contain up to 8% of TOC, but the usual values range from 2 to 4%, type II and III kerogen , with a fair to good petroleum potential.

The concentration of oil fields in the Borysiav-Pokuttia unit can be explained by two reasons: 1) the frontal part of the flysch belt is also the main area where the Menilite formation occurs. Thus, it contains most source rock deposits of the Ukrainian Carpathians; 2) The Boryslav-Pokuttia unit represents a complex stack of duplexes, usually involving the Menilite series. As a result the latter occur within a great interval of depths from the surface to more than 8-10km, covering a wide range of thermal maturity. Hence the tectonic burial and coeval maturation history of the Menilite series account for the petroleum generation in the Boryslav-Pokuttia unit. The computed Time-Temperature Index and the measured Rock-Eval pyrolysis Tmax parameter and vitrinite reflectance were used as independent thermal maturity parameters for the Menilite samples, collected at different depths in a number of wells of the Boryslav-Pokuttia unit. All parameters have a similar trend of depth-related thermal maturation, showing that the oil window is situated within the depth range from 4.5 to 6km.

The advanced maturation level of Oligocene potential source rocks is observed towards the internal tectonic units of the flysch belt. The thickness and quality of the Oligocene organic-rich rocks decreases southwestward. However, even in the internal tectonic units of the flysch belt, they also should be considered as potential source rocks. Lower Cretaceous organic-rich rocks keep their thickness and petroleum potential relatively uniform all over the area of the Carpathian flysch belt and should be accounted for as a significant potential source rock level.

The burial history of the Carpathian flysch sequence comprises two main stages: 1) a passive margin stage and 2) a synkinematic stage. The pre-orogenic burial was controlled only by the sedimentary thickness and subsidence rate and was relatively uniform throughout the basin. In contrast, tectonic burial developed during the orogenic stage, being highly variable among the different nappes and individual folds, as it reflects complex interactions between footwall and hanging wall blocks during thrusting and erosion events. Maturation history of Lower Cretaceous and Oligocene potential source rocks since the beginning of deformations evolved in connection with the tectonic emplacement of individual nappes. All the organic rich sequences of the Ukrainian Carpathians remained immature until the onset of thrusting. The main part of the maturation history and the consequent petroleum generation relate to Miocene overthrusting events. Maturation level of Oligocene rocks within the Boryslav-Pokuttia unit allows to assume that its tectonic burial was balanced by coeval overthrusting and erosion of the Skiba nappe. Hence, the thrust slices of Boryslav-Pokuttia unit, which were tectonically buried during the thrust emplacement of the Skiba nappe reached their maximum maturation level only recently. The post-overthrusting erosion and uplift become more evident southwestward, in the internal tectonic units (Krosno, Chornogora), where the organic-rich rocks display high maturity rates at much less depth, being in places overmature even at the surface.

GROUND WATERS WITHIN INTERGRANULAR FORMATIONS OF THE TERRITORY OF YUGOSLAVIA

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In the territory of Yugoslavia, in the northern and central part of Serbia predominantly, ground waters at Quaternary-Mio-Pliocenous units are widely distributed. They are the main aquifers, included in municipal and industrial water supply with approximately 60%.

In the paper, after the short review of hydrogeological conditions of the territory, questions of further development of exploration, rational management and protection of existent and potential water sources are analyzed.

SOURCES OF CONTAMINATION AND GROUNDWATER QUALITY IN THE COASTAL REGION OF THE YUGOSLAV PART OF THE DANUBE

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In order to assess the vulnerability and risk of the aquifer system in the Yugoslav part of the Danube, as the primary source of drinking water for a numerically substantial community, industrial purposes and irrigation, as well as a high concentration of civil, industrial and agricultural activities (hence, a potential source of pollution for the groundwater resources through land occupation and use as well as the disposal of solid and liquid wastes), a great hydrogeophysical exploration was performed. Within the lower part of the plain, exploratory test site Salinac field, near Smederevo town, was particularly investigated. The reason why is because that part is also an area of the mouth of the Velika Morava into the Danube, where Djerdap reservoir is located. Task of complex exploration was to delineate the aquifer, obtain appropriate parameters (groundwater level, groundwater chemistry, clay content, filtration characteristics and physical parameters of geological functions), as well as to map the aquifer vulnerability, in order to prevent and moderate a harmful influence of the performed reservoir on the environment (increased groundwater infiltration from the reservoir into surrounding rocks, permanent groundwater level raising, etc.). Based on the results, zoning of the study area according to the aquifer vulnerability has been done. Then, land-use planning and development of strategy for groundwater protection and management was possible.

In the paper, not only sources of contamination, characteristics of pollutants and their influence on the groundwater quality are presented, but also content of organic metters, phosphates and nitrogen compounds, etc. Further, measures of protection and management are discussed, as well as the appropriate legal regulations.

Earthquake Generation Mechanism for the Territory of Carpatho-Balkanides in Yugoslavia

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As the whole Mediterranean area, the territory of the Eastern Serbia (Yugoslavia) is characterized by a significant seismic activity. The main cause is intensive compression and tectonic stresses generation within geotectonic junction: Europe - Africa - Arabia. Along African - Euroasian plate contact, coinciding with the Adriatic coast, Dinnarides (as the edge of Euroasian plate) are pushed by "Adriatic mass" (as the most extended part of the African plate). Stresses generated in such way are transferred along the fault systems.

As a consequence of the tectonic stresses accumulating at the Euroasian - African plate boundary, energy in the form of seismic waves is released and earthquakes occur. The old fault structures serve for seismic energy conduction directioning, while the young ones transect the complex seismogenous systems and in that manner present the areas for seismic energy generating. So, for the southern part of the Adriatic sea, it is assumed that initial tectonic movements are carried out in the sub-sea, under the Moho-discontinuity and diagonally to the Dinnarides spread direction. Adriatic mass is drifting to the land (in NW direction), causing rock compression parallely with reverse fault zones and earthquake occurrence. Under the surface, reaction in the form of blocks horizontal sliding with opposite direction appeared, and again - new events.

In the paper, for a discussion on seismotectonic relationship, various geophysical methods are used: deep seismic soundings, regression planes, gravity, magnetic and geoelectric measurements and geodetic method.

NEW PROGRESSIVE GEOCHEMICAL METHODS OF PROSPECTING ORE AND NON-METALLIC MINERALS

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The need to solve geological problems associated with prospecting results in the application of new methods. In the last decade new technical means and methods of prospecting and evaluating mineral deposit based on the behavior, transformation and distribution in ore bodies and host rock of various forms of occurrence of elements termed geoelectrochemical have been developed. The first group of methods, based on the extraction and analysis of elements in easily mobile forms of occurrence, within which they are able to migrate for large distances, makes it possible to reveal and trace deep-seated and overlapped ore objects. This type of method includes: methods of prospecting based on metalloorganic compounds (MPF), the thermomagnetic geochemical method (TMGM), and the method of diffuse extraction of metal under the action of electrical current (CHIM). These methods may be used at all the stages of geochemical prospecting work. Geochemical zonality is one of the most outstanding features of the primary geochemical haloes of ore and non-metallic deposits in general and hydrothermal and metamorphic ones in particular. The oxial geochemical zonality of the primary haloes of deposits is universal: that is to say there is an ordered distribution of element haloes up the dip of ore bodies from Ni at the bottom to Hg and Ba at the top. The established universal geochemical zonality of the primary haloes is expressed by the following sequential series of the most widespread indicator elements of the deposits (up the dip of the ore bodies): Ni-Co-Cr-Cu-Ti- W-Sn-Mo-Bi-Zn-Pb-Ag-Sb-Ba-Hg-F-Cl-Br—I. Halogens can serve as direct indicators in the location of ore and non-metallic minerals if they are part of veins and minerals, or indirect ones, when they take part in the ore-forming or secondary process and are not part of the ore minerals. The geochemical method of prospecting by the superimposed haloes of halogens (fluorine, iodine) makes it possible to discover some non-metallic deposits. Cl and F are universal indicators of practically all types of epigenetic deposits. In the universal zonality of primary aureoles, iodine and bromine take a marginal (extreme) position far from the ore bodies. This determines the significance of primary aureoles of iodine and bromine in the search for deep-bedded, closed deposits. Mercury aureoles have been located around mineralization of many type deposits. Several temperature forms of mercury are usually present in ore bodies. The following intervals of the mercury-bearing components of thermal decomposition are clearly distinguished in thermograms: 1-190-230^0 C, 2-260-280^0 C, 3-320-340^0 C, 4-400-440^0 C, 5-550-620^0 C, which can testify to the presence of mercury in mineralized racks in various forms, mercury-bearing minerals and isomorphic admixtures included. There are a greater number of forms of mercury and its thermal spectrum is wider in the supra-ore part of deposits in comparison with the sub-ore part.

The method is based on the application of artificial sorbents and successfully combines the possibilities of hydrogeochemical and sorption methods of prospecting. It makes it possible to fix the mobile form of many sought elements, and estimate it more confidently when using ion-exchange resin kationites and anionites. In order to accumulate a significant quantity of migration elements and to obtain them in the form of substances with a definite chemical composition, synthetic ion exchange resins as well as other sorbents were used as their concentrators. The positive characteristics of the method are also the possibilities of applying a great number of elements.

The use of the methods of radiation mineralogy in the analysis of geological phenomena indicates their great potential in the solving of scientific and practical problems: (1) The vertical evolution of hydrothermal solutions is established from results of mineral irradiation and color generation. The length of the unopened or annihilated part of the ore zone, the level of intrusion of the vein bodies, can be determined in such a way. (2) It is established that the minerals, which concentrated different defects in the field of radioactive irradiation, are the indicator of migration and redistribution of radioactive elements in the concrete zones of geological space. The economic aspects of a deposit are to a considerable extent determined by the depth of its weathering zone. Ionizing radiation and infrared spectroscopy help to obtain rather objective information on the level of weathering in ore bodies. Hydrogen is more mobile than the alkali elements; acid components and lithium as high volatile are accumulated in the upper horizons of the deposits.
This methods of prospecting for deposits (including weakly eroded ones) by their primary geochemical haloes, geoelectrochemical methods of prospecting, the methods of the application of artificial sorbents, temperature of the forms of mercury, applications of methods radiation mineralogy developed the author and Scientists from various countries (Grigorian, Sobolev, Safronov, Solovov, Saukov, Tauson, Ginsburg, Ovchinnikov, Beus, Perelman, and Lukashev) have been highly appraised of many experts. The high efficiency of these methods has proved very successful, resulting in the discovery of many ore bodies both in the Ukraine, Russia and Canada.

THE PELITIC SEDIMENTATION PECULIARITIES IN MIOCENE BASINS OF SUBCARPATHIAN FOREDEEP.

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It was settled on the base of roentgenostructural investigations that clayey fraction in rocks of molasse thickness of Subcarpathian foredeep is represented by hydromica, montmorillonite, kaolinite, chlorite; guartz, feldspar, halite, carbonates are present as admixtures. Clay minerals are forming certain associations that are distinguished both by qualitative and quantitative composition. The hydromica-chlorite, hydromica-caolinite-chlorite, hydromica-chlorite-kaolinite, kaolinite-hydromica-chlorite, hydromica-montmorillonite-chlorite, montmorillonite-hydromica, montmorillonite-hydromica-chlorite associations are the most typical for lower-molasse complex deposits formed in neutral marine conditions, during Poljanitza, Vorotyshche and Stebnik period of time. The hydromica- chlorite association prevails in lagoonal basins of Vorotyshche and Balitzky time; it is conditioned by physico-chemical peculiarities of evaporite basins by halogenesis process monotony. Hydromica prevails among clay minerals in rocks of lover-molasse thickness, kaolinite occures episodical in cement of sandy rocks, mainly; montmorillonite is concentrated in clayey rocks. The montmorillonite-hydromica, montmorillonite-hydromica-chlorite, montmorillonite-kaolinite-hydromica, hydromica-montmorillonite-chlorite, hydromica-chlorite associations are the most typical for the rocks of lower-molasse thickness and terrigenous deposits of balitzkaja suite (upper part of lower-molasse complex section). It should be noted, that montmorillonite is becoming the principal clay mineral in upper-molasse deposits. Montmorillonite transforms into hydromica through mixed-layered phase in molasse complex deposits in deep submersion zones (2800 - 3000 m). On the base of chemical composition investigations of clayey constituent in rocks from Miocene thickness we come to conclusion that these data come to an agreement with data of roentgenostructural investigation and conform the gradual change of primary hydromicaceous association by montmorillonite one in the section. Electronic-microscopic investigations confirmed the polymineral composition of clayey fraction in rocks from Miocene thickness of Subcarpathian. The majority of hydromicas look like isometric plates with smooth surfaces and broken edges, their size is average 1,5x1,5m. Sometimes Hydromicas occur of elongated and lamellar form (size - 2x1,5 mm). Chlorites are present as lumpy formations. Montmorillonites have knobby surface. Kaolinite occurs as fragments with flattening edges. Square measure measuring of clayey fraction constituents by argon heat desorption method give a chance to discribe the degree of these constituents dispersity in different parts of molasse thickness section. It was determined, that dispersity increases both up mards the Miocene deposits section (from 25 m2/g in the rocks of poljanitzkaja suite to 60 m2/g in the rocks of dashavskaja suite) and on lateral of Miocene sedimentary basins (for example - from 25 to 60 m2/g in stebnic basin).

Data of roentgenospectral, chemical and electronic-microscopic analysis of clayey fraction and squere specific measure measuring of clay minerals from the rocks of molasse deposits gave a chance to do some conclusions. The leading mechanism of clay-generation in neutral marine environment of Poljanitza, Vorotyshche and Stebnic time was mechanism of terrigenous clayey material inheritance. In the course of upper-molasse thickness formation wide spreading became the process of montmorillonite formation at the expense of volcanic material decomposition. Transformation of montmorillonite and kaolinite into hydromica and chlorite took place in alcaline environment when potassium and magnesium excess in evaporite basins of Vorotyshche, Balitzky and Tirassky time; hydromicas with open crystalline lattice aggradation took p ace by means of potassium fixation too. Clay minerals distribution on lateral of Miocene sedimentary basibs took place according to peculiarities of mechanical and physico-chamical differentiation. Montmorillonite and disordered hydromicas had been accumulated in the first place in the most remote from off-shore areas. Kaolinite and hydromicas had been accumulated mainly in the sediments of deltaic and coastal facial zones.

DEEP-CRUSTAL FRACTIONATION OF ALKALINE BASALTS IN NORTHERN PANNONIAN BASIN

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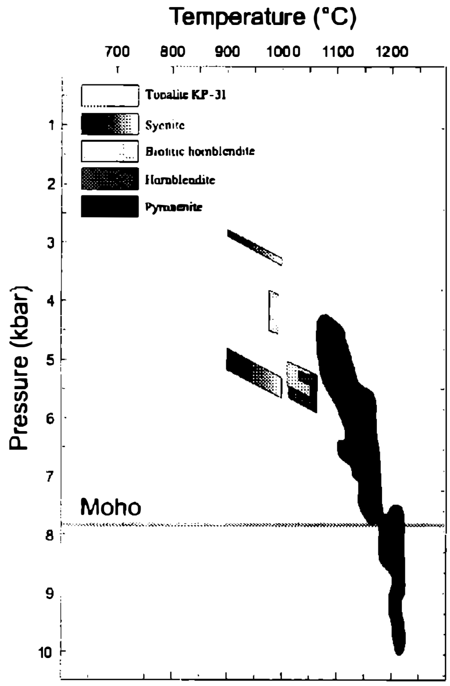
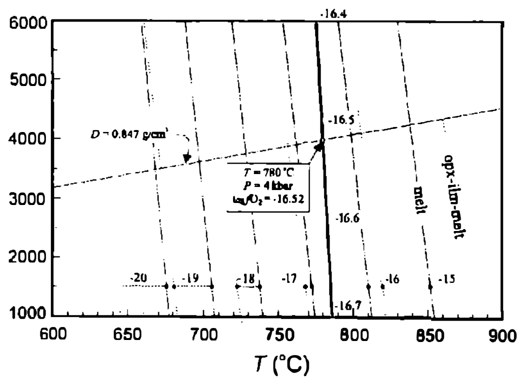
Igneous xenoliths have been revealed in maars, diatremes and lava flows of the Pliocene-to-Pleistocene alkali basalt volcanic field extending over the area of 20 km^2 in the Lučenec Basin and Cerová Highlands. Gabbroic xenoliths are typical cumulates and can be assigned to clinopyroxenite and hornblendite according to prevailing mineral phase. Additional minerals comprise olivine, spinel, Ca-plagioclase (An_{50}-$_{60}$), and rare biotite. Salic xenoliths can be subdivided into syenite (anorthoclasite) and tonalite (qtz + An_{30} plg). Preliminary mineral composition, fluid inclusion (Huraiová et al. 1996), trace elements and stable isotope data (Hurai et al. 1998) from the Pinciná locality (suggest a genetic link of the gabbroic rocks and syenites with fractionating alkaline basalt. The tonalites are interpreted to represent the mixture of partial melts derived from the crustal material and residual melts derived from the alkali basalts.



Cpx-thermobarometry indicate upper mantle origin of the pyroxene (and coeval olivine) and their re-equlibration and/or final growth at lower crustal *PT* conditions at depths > 16 km. Postcumulate phases (Ca-plg, hbl) have equilibrated at depths 15-20 km. Two horizons of the hornblendite rocks are indicated by distinct inclusion CO_2 densities (0.75-0.81 and 0.85-0.87 g/cm^3) and mineralogy (biotite-absent, 19-20 km, and biotite-present, 15-17 km). Similarly, two horizons of syenites are indicated by inclusion CO_2 densities clustering around 0.66-0.68 and 0.87-0.90 g/cm^3 in four samples studied. Corresponding depths are 12-13 and 18-19 km, respectively, assuming a lithostatic load and crystallization *T* around 900°C indicated by simple zircon morphology. Crystallisation *P-T-fO₂* conditions of one tonalite xenolith have been recalculated from orthopyroxene-ilmenite-melt thermobarometry combined with density of the CO_2 inclusions (Fig. 2.).



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PALEOVOLCANIC RECONSTRUCTION AND EVOLUTION OF THE CENTRAL SLOVAKIA NEOGENE VOLCANIC FIELD

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The Central Slovakia Volcanic Field (CSVF), of the Badenian to Pannonian age (16,5 - 8,5 Ma), is a part of the Carpathian volcanic arc. Volcanism coincided with evolution of a horst and graben structure induced by backarc extension. Composition of lavas varies from basalts to rhyolites, however, andesites dominate. Variable viscosity and explosivity of magmas gave rise to almost complete set of volcanic forms. Further modifications arise from a variable terrestrial (northern part) and shallow marine (southern part) environment.

Initial Early Badenian hb-px±bi±ga andesite volcanic activity (16.5 - 16,3 Ma) is represented by scattered extrusive domes, with aprons of coarse breccias in the proximal zone and fluvial conglomerates and sandstones in the distal zone. In the shallow marine environment extrusive domes are extensively brecciated, and coarse hyaloclastite breccias accumulate around domes in a large volume. Gravity driven sliding created extensive submarine breccia flow / slump breccia deposits. In the distal zone these deposits alternate with marine epiclastic volcanic conglomerates and sandstones.

Two px andesite pyroclastic volcanoes formed in the SE part, while large px and hb-px andesite stratovolcanoes were build in the remaining parts of the CSVF during the Early to Middle Badenian time (16,3 - 15,5 Ma). Dominantly pyroclastic volcanoes (Čelovce, Lysec) are in the central zone formed of pyroclastic breccias, agglomerates, rare tuffs and horizons of scree. Block and ash pyroclastic and debris flow deposits dominate in the proximal zone. Rare breccias and dominant marine epiclastic volcanic conglomerates and sandstones are in the distal zone. Large stratovolcanoes (Javorie, Pol'ana, Štiavnica, Kremnica) are dominantly effusive with periods of pyroclastic flow activity. Their central zones are eroded to subvolcanic levels - late stage andesite porphyry sills and laccoliths are exposed. Lava flows (± extrusive domes), hyaloclastite breccias or block and ash pyroclastic flow deposits, and coarse mudflow and debris flow deposits dominate in the wide proximal zone. Epiclastic volcanic conglomerates and sandstones laid down in the ephemeral stream, fluvial and/or marine environment dominate in the distal zone, grading outward into volcanosedimentary complexes.

During the Middle to Late Badenian time (15,8 - 14,5 Ma) evolution of large stratovolcanoes continued by subsidence of grabens and calderas, associated with activity of both - mafic undifferentiated rocks and differentiated intrusive and volcanic rocks. At the Javorie stratovolcano the graben subsidence was accompanied first by basalts to px andesites, forming a complex of lava flows and hyaloclastite breccias, later by a formation of px-hb andesite dome-flow complex and emplacement of diorite stocks. Rhyodacite domes and related pumice tuffs are characteristic of the Pol'ana stratovolcano. At the Štiavnica stratovolcano caldera was filled by a bi-hb andesite to dacite dome-flow complex. An extensive subvolcanic intrusive complex of diorite, granodiorite, and their porphyries was emplaced by underground cauldron subsidence. Kremnica graben was filled first by basalts to px andesites, forming a complex of lava flows, hyaloclastite breccias, and phreatomagmatic pyroclastics including reworked facies, later by hb-px andesites forming a thick effusive complex.

Renewed activity of less differentiated andesites during the Sarmatian time (14.5 12,5 Ma) formed discontinuous complexes on the slopes of older stratovolcanoes at the south - variably there are present effusive complexes ± hyaloclastite breccias and complexes dominated by explosive activity with ignimbrites, pumice flows, fall tuffs, and reworked tuffs, grading southward into marine volcanosedimentary complex. It formed new volcanoes in the northern part of the CSVF, with centers situated on marginal faults of grabens. Dominantly pyroclastic volcanoes , mixed type stratovolcanoes and effusive stratovolcanoes are present, with a variable proportion of agglomerates, tuffs, pyroclastic flow deposits and lava flows in the central and proximal zones. Epiclastic volcanic breccias, conglomerates and sandstones make up the distal zone of these volcanoes.

An extensive Middle to Late Sarmatian rhyolite volcanic activity (13 - 10.7 Ma) gave rise to a dome/flow complex and related volcanoclastic rocks in the western part of the CSVF, along the N-S to NE-SW trending fault system. In most volcanic centers early phreato-magmatic and/or Plinian eruptions, forming tuff cones and rings, were succeeded by growth of extrusive domes and dome-flows. Reworked pumiceous tuffs and epiclastic volcanic breccias, conglomerates and sandstones make up the outer proximal and distal zones.

A small Early Pannonian age basalt /basaltic andesite stratovolcano at the North is represented by remnants of volcanic cone - agglomerates, agglutinates, thin aa-type lava flows, and surrounding effusive plateau. Scattered basalt /basaltic dykes, sills, lava flows and remnants of a phreatic tuff-ring in the central part of the CSVF are the latest products of the calc-alkali volcanism. Scarce nepheline basanite / trachybasalt volcanic activity took place during the Pliocene - represented by two lava necks and a small effusive plateau and Quaternary - represented by one cinder cone with related lava flows.

CONTACT METAMORPHISM BENEATH AND AROUND THE ULTRAMAFIC MASSIFS OF WESTERN SERBIA: ZONALITY, PHASE RELATIONS AND P-T ESTIMATES OF THE PROGRADE STATE

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Fragments of narrow metamorphic aureoles (150-250 m wide) formed in the contacts of large ultramafic massifs were found in many places of the Dinaride ophiolite belt in Western Serbia. Contact metamorphic rocks occur beneath ultramafic plates (Zlatibor, Tara, Brezovica), around them (Ozren), or as isolated blocks in the melange (e.g. Bistrica). As the best examples for the first two cases those of Zlatibor (south of Užice) and of Ozren (southwest of Sjenica) were studied.

The **Zlatibor** zonal contact aureole (about 250m wide) is displayed beneath the ultramafic plate. It is mostly reduced by later tectonics, but here and there metamorphic rocks (metabasites and metagraywackes) retain in a primary position with the overlaying ultramafics and the underlaying melange rocks.Within the aureole following prograde changes in metabasites occur **Zone I** - the prehnite-pumpellyite-actinolite association (with preserved augite relicts). **Zone II**: in initial part (**IIa**) – ass. Act (2-5 wt% Al_2O_3) + Ab + Chl + Ep is stable; in the higher part (**IIb**) – ass. homogenous blue-green Hbl (often with pale-green Act-like cores) + Ab (or zonal Ab-Olg with 8-25 %An) + Chl + Ep. **Zone III** – ass. Hbl (green) + Ep + Pl (up to 50 %An); Cpx (with 3-7 %Jd) appears in this ass. in 15-25 m from the contact. Metamorphics originated from sandstones and shales occur in all zones with metamorphic mineral ass. corresponding to the P-T conditions. Temperature interval estimates from 300 °C (zone I) to 620-650 °C (zone III) according to Hbl-Pl and Grt-Bt (for metasandstones) geothermometers.

Around the **Ozren** ultramafic diapire contact metamorphic rocks: metabasites, with subordinate metashales and metasandstones in outhern zones, originated from the oceanic crust rocks formerly overlaying the ultramafics. Approaching the contact in the up to 200 m wide contact aureole, the following 4 zones are developed. **Zone I** – with preserved primary textures, not examined, probably corresponding to the prehnite-pumpellyite-actinolite subfacies. **Zone II**: in the initial part (**IIa**) – ass. Act (often surrounded by prograde Hbl rims) + Ab (with Olg rims) + Chl + Ep; in the higher part (**IIb**) – sharply zonal Amph (Act core and Hbl rims), or homogenous Hb + Olg + Chl + Ep. **Zone III** – ass. Hbl (green) + Pl (up to 80 %An) + Ep +/- Cpx +/- Chl_{Mg}. **Zone IV**: (10-15 m from the contact) Grt (about 40 % Prp) + Ti-rich Hbl (brown-green or red-brown) + Cpx (2-9 %Jd) + Czo + Pl. In the Ozren aureole towards ultramafic contact the following sequence of metamorphic isogrades in Qtz-free metabasites was found: Hbl (rim around Act) – in, Olg (rims around Ab) – in, Cpx – in, Pl (90 %An) – in, Chl_{Mg} – out, Grt – in. With T icreasing composition of Ca-amphiboles changes in the sequence: Act (zonal in zone II) → Hbl →Ti-rich tschermakite (zone IV). Temperature towards the contact increases from 300 to 750 °C (Hbl-Pl and Grt-Cpx thermometry). Based on low Jd-content in Cpx, and high Prp content in Grt, pressure of the metamorphism is roughly estimated at 5-6 kb.

The presented results, considered together with the results of the study of metamorphic rocks beneath the ultramafic plate at Brezovica, where bellow its eastern furthest transported parts the conditions of metamorphism at the immediate contact were about 550-600 °C and 6-7 kb, and beneath the western (distance 12 km) least transported ones about 700°C and 8 kb indicate that the ultramafic masses of the Dinaride ophiolite belt in Western Serbia at the time of emplacement were at temperatures ranging from more than 1000°C and therefore internally mobile (Ozren and the western part of the Brezovica plate) to rigid at around 900 °C (eastern parts of the Brezovica plate and the Zlatibore ultramafics).

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CRETACEOUS COLLISIONAL LOW- TO VERY LOW-GRADE METAMORPHISM OF THE TATRO-VEPORIC COVER COMPLEXES (W. CARPATHIANS): PHASE RELATIONS AND P-T CONDITIONS

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The degree of Early Alpine metamorphism in the cover complexes of the Western Carpathians varies in the distinctive tectonic zones. Metasediments and metavolcanics of the Infratatric (Male Karpaty, Povazsky Inovec Mts.), and the Supratatric (Tribec and Ciema Hora Mts., and the Velky Bok cover sequences) domains were recrystallized under anchimetamorphic (anchi- or epizone) conditions. The authigenic illites of the anchizone contain 0.7-0.9 K in f.u., its Kubler index equals 7.5-4. The rocks also contain mixed-layer authigenic Ms-Pg micas. The clastogenic Bt either retains its primary, unaltered high-temperature composition, or is replaced by brown nearly isotropic metastable "Ti-rich Phn" or "Ti-rich Chl" micas, whose Ti contents correspond to those of the replaced biotite. The clastogenic Ms preserves its primary composition. Under epizone conditions (270-300°C), the K content of the illite-muscovite increases to 0.85-1.0 f.u., and the Kubler index is less than 4. Mixed-layered micas disappear, the clastogenic Bt is fully replaced by "Ti-rich Phn" and "Ti-rich Chl",or by stable association the light Chl+light Phn+Leuc. The clastogenic Ms retains its primary composition.

The metamorphic degree of the Early Alpine cover complexes of the Veporic and Norh-Gemeric domains is higher, and varies from the Chl-Ser to Grt subfacies. Under **Chl-Ser subfacies** conditions (300-340°C), the Permian-Triassic cover of the Lubietova zone contains authigenic Ms-Phn with 0.9-1.0 K in f.u. The metastable "Ti-rich micas" (pseudomorphs after clastogenic Bt) are fully replaced by assemblages of normal Ms-Phn + Chl + Leuc. The compositional differences between clastogenic Ms and authigenic Phn remain. The index paragenesis is Chl + Ms-Phn + Kfs with the maximum Si content of Phn is 3.46 in f.u. Under **biotite subfacies** conditions (340-390°C) in the South- Veporic Permian-Triassic rocks of the Foederata series, the North-Gemeric Upper Carboniferous Ochtina-type rocks, part of the Late Paleozoic Kraklova formation, and the Permian Predna Hola Complex early biotite appears first in metarhyodacites and acid metatuffs in the Bt + Kfs + Phn assemblage and then, as the temperature further increases, also in the metapsammites and schists. Clastogenic Ms completely dissolves in the Ms-Phn mesostasis. The Si content in Phn in the Phn + Bt + Kfs assemblage reaches as high as 3.45 f.u., a fact pointing to pressures of 9-10 kbar (according to the phengite barometer). Lower-grade conditions of the **Grt subfacies** (390-440°C) were detected in rocks of the Kraklova formation in the North-Veporic domain, in which the Ca-poor phyllites contain Ca-rich Grs-Sps-Alm garnet (Alm 57-77, Grs 12-30, Sps 4-18, Prp 3-6). The coexisting Grt and Ab in their contacts are typical of a prograde metamorphic zonation. The garnet has rims depleted in Ca, whereas the outermost Ab rims are slightly enriched in Ca (up to 12-15% An). Metamorphism in the Late Paleozoic-Mesozoic cover of the Central Veporic did not attain higher temperatures, and the pressure varied in distinct complexes from 7 to 10 kbar (Phn barometer).

Microfabric studies and ductile tectonic evolution in the low grade metamorphic Paleozoic of Szendrõ and Uppony Mts., NE Hungary

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The Szendrõ and Uppony Mts. in NE Hungary form two smaller, pre-Tertiary basement exposures in the so-called Gemer-Bükk region which comprises the innermost tectonic units of the Western Carpathians. Both units were previously considered as parts of the "Bükkium" forming a segment of the southern continental margin of the Meliata-Hallstatt ocean (eg. Kovács, 1984).

The known stratigraphic range of these Early Paleozoic sequences extends from the Middle Devonian to the Middle Carboniferous including mostly platform and pelagic carbonates and a flysch-like sequence, furthermore clastic rocks of unknown age (Ord-Sil?) and strongly altered, basic volcanics (Kovács, 1992). They suffered low grade metamorphism (Árkai, 1983). K-Ar ages (in the range of 130-110 Ma) indicate Eoalpine metamorphism (Árkai et al., 1995). Until now there is no evidence of a pre-Alpine metamorphic event.

In this poster results of the microtectonic investigations will be presented suggesting the following ductile deformation sequence (Tertiary, brittle phases are not considered here):
(1) D_1: Formation of ca. bedding-paralell foliation (S_{0-1}). An associated stretching (and/or mineral) lineation (lin_{str}) often can be observed but its formation may be partly related to a later deformation event.
(2) D_2: The first foliation (S_{0-1}) is folded into asymmetric, subhorizontal to gently plunging, open to close folds producing an axial plane foliation (S_2) and an intersection lineation (lin_i) of S_{0-1} and S_2.
Microtectonic observations suggest strong strain partitioning between carbonates and siliciclastic rock types in the Szendrõ Mts. Siliciclastic rocks show practically no stretching or mineral lineation in the foliation planes. They are chararterized on microscale by a well-developed crenulation clevage (S_2). In the case of carbonate rocks stretching lineation can be visualized in the foliation planes, shear sense indicators (S-C structure, shape preferred orientation, δ- and σ-clasts, intrafolial folds) in the X-Z sections show top-to-the-N tectonic transport. Microstructures indicate that pressure solution was a very important deformation mechanism in all lithologies. (3) D_3: Formation of small-scaled kink bands mostly with steep fold-axes which fold all previous structures.

The strongly deformed Paleozoic sequence of the Szendrõ and Uppony Mts. most probably form thin-skinned tectonic units also suggested by geophysical measurements supporting a shallow detachment horizon.

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HYDROCARBON POTENTIAL OF THE MALM-VALANGINIAN CARBONATES IN THE TRANSITIONAL ZONE (PLATFORM-PERIPLATFORM) FROM THE CENTRAL PARTS OF NORTHERN BULGARIA

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The Malm-Valanginian carbonates are wide spread on the whole territory of Northern Bulgaria and they form a regionally permeable complex. In the studied area this complex is composed by pure limestones, dolomites and their varieties of Pleven, Kaspichan and Drinovo Formations. The Upper Jurassic carbonates of Yavoretz and Glozhene Formations as well as the Lower Cretaceous ones of Ticha and Salash Formations are permeable in some places, too. The thickness of this complex ranges from 700 to 1,500 m. It is aged as Upper Callovian-Hauterivian.

The Malm-Valanginian carbonates are deposited under the conditions of shallow marine basin. They are poor of organic matter. Subsequently, they are fractured, stylolitized and karstified.

The carbonates of Kaspichan, Drinovo and Pleven Formations are almost entirely permeable with fine reservoir qualitics. The maximum of their porosity reaches up to 25% (including cavities). The type of reservoir is fractured-porous-cavernous. Oil flows had been obtained during testing of wells near Krushovitza, Goren Dabnik and Gradina. Oil shows (droplets and spots) had been observed in the core of wells near Dolen Dabnik and Gorsko Slivovo. The oil of these shows is presented by heavy fractions, enriched of asphaltenes. There is a tendency of localization of these oil shows at the top of carbonate complex, right beneath the Hauterivian-Barremian marl seal. Tectonically these oil shows are connected with the southern margin of Iskar-Yantra Step.

The Upper Jurassic-Lower Cretaceous carbonate reservoir is isolated from above and laterally by the clayey limestones and marls of Salash and Gorna Oryakhovitza Formations (Hauterivian-Barremian-Aptian).

Bioherm limestones (coral, algal) are presented at the upper parts of the carbonate complex. The organogenic build-ups as well as the sub-reefal bodies, established on the edge of the carbonate platform, are prospective for hydrocarbon entrapment. Several local anticline prospects are outlined through seismic.

The Malm-Valanginian carbonate reservoir has not only good hydrocarbon potential but also good hydrogeothermal one. In the studied region there are all preconditions for an effective utilization of the hydrogeothermal resources of Malm-Valanginian aquifer.

ALKALI FELDSPARS OF THE PEGMATITES FROM THE HIGH TATRA MTS (S POLAND)

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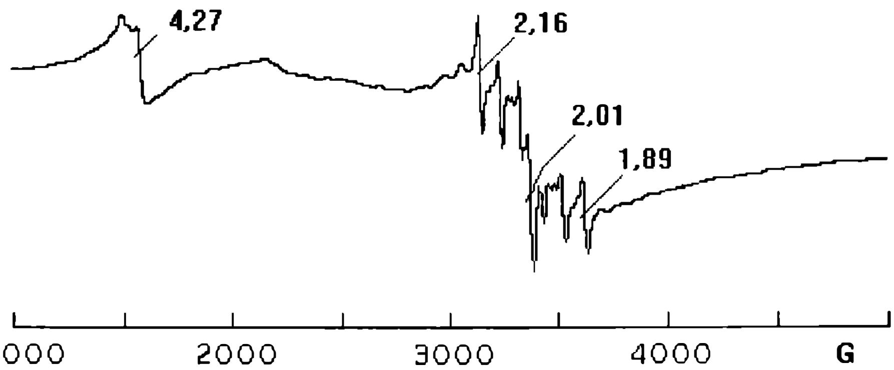
Alkali feldspars are present in various types of feldspar-quartz-muscovite pegmatites and pegmatite granitoids occurring in the peripheral zone of the Tatra crystalline core.

This investigation deals with pink alkali feldspars in pegmatites from six different localities in the High Tatra Mts. which range in the intensity of colour from pale pink to pinkish-red. The pegmatites are massive rocks with no cavities, consequently the feldspars do not form automorphic crystals and they are often intergrown with quartz. They are microcline with the characteristic cross-hatch twinning and perthitic textures in the form of stringlets and rods. Both, X-ray and infrared spectroscopic (IR) investigation show that these feldspars are maximum microclines with high triclinity (Δ = 0.74-0.90) and a high degree of spectroscopic order (ΘIR = 0.92-1.06). EDS and X-ray analyses confirmed the presence of Ab as a distinct mineralogical phase (perthites) occurring in different amounts. The alkali feldspars contain small amounts of Fe and Mn. EDS study displayed that these elements are unequally distributed and occur mainly on cleavage surfaces, where their content is up to 2.5 wt % Fe_2O_{3tot} and up to 0.5 wt % MnO.
EPR spectra of the feldspars were recorded at room and at liquid nitrogen temperature using an X-band frequency spectrometer. The spectra of all samples exhibit lines due to the presence of Fe^{+3} and Mn^{+2} ions: as a single resonance line at g_{eff} = 4.3 and a group of lines near g_{eff} = 2.0 (broad resonance line, a single line and a sextet of resonances overlapping with the broad line) - see fig.



The sextet of lines is attributed to presence of Mn^{+2} The other lines are attributed to isolated Fe^{+3} ions replacing Al^{+3} ions in the crystal lattice and to interacting Fe^{+3}- O -Fe^{+3} ions in clusters forming a distinct impurity phase.

EPR and EDS investigation, suggest that the admixture of Fe^{+3} and Mn^{+2} ions can occur in two ways: as substitution for the main ions inside the crystal lattices of the feldspars or outside the feldspar lattices as an impurity, oxide phase.

SECONDARY MINERALS OF THE HYDROTALCITE-MANASSEITE GROUP FROM METASOMATISED DEVONIAN CARBONATES IN THE ZAWIERCIE REGION (S-POLAND)

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Minerals of the hydrotalcite-manasseite group arc identified for the first time in Poland, in samples from two borehols in Zawiercie (northwest of Krakow). They occur in calciphire bodies and in a small metasomatic veinlet within mid-Devonian dolomites. The calciphire and the veinlet are genetically connected with garnet-pyroxene skarn associated with Cu-mineralization situated in deeply buried, Kaledonian transpressional orogen (the "Krakowidy").

Minerals of the hydrotalcite-manasseite group have thc general composition: $[Mg_{1-x}Al_x(OH)_2]^{x+}[(CO_3)_{x/2}\, n\, H_2O]^{x-}$ and occur in two politypic modyfications. The value of "x" in the formula ranges from 0,25 to 0,33 (Drits et al., 1987). The crystal structure of minerals in this group is that of octahedral brucite-type layers, containing cations and hydroxyl $(OH)^-$ ions, whereas $(CO_3)^{-2}$ anions and H_2O molecules are located in between the layers (Arakcheeva et al., 1987).

The minerals were identyfied by X-ray diffraction analyses. Estimated d-values indicate that they are a mixture of hydrotalcite and manasseite. EDS analyses reveal that Mg:Al ratio ranges from 2:1 to 3:1. A variable content of Fe from $(Mg_6Al_{2,98}Fe_{0,06})$ to $(Mg_6Al_{1,66}Fe_{0,7})$ was also recorded.

The minerals in calciphires form fine grained aggregates which, in association with chlorite, serpentine and small amounts of brucite, surround spinel crystals. The minerals in the veinlet are associated with vein-filling flaky chlorite, forsterite and minerals of the humite group and ore minerals: magnetite, pyrite and chalcopyrite. In both the calciphires and in the veinlet they form plates up to 0,01 mm in size and show weakly visible hexagonal habit. Moreover, in the veinlet a Mg-Fe mineral containing Cl is also recognized. Its composition is similar to that of iowaite which also belongs to the hydrotalcite-manasseite group. The crystalographic form of this mineral is a combination of short hexagonal prism and pinacoid from 6 to 18 μ m in size and is often intergrown with serpentine.

The minerals within the calciphires appear to be alteration products after spinels. In the veinlet they could represent a secondary phase in the proces of serpentinization of forsterite or of the minerals of the humite group (in which Al and Fe ions were present).

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TUFFACEOUS INTERCALATIONS WITHIN THE MIDDLE TRIASSIC CARBONATES OF THE HRONICUM UNIT IN THE WESTERN TATRA MTS., POLAND.

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Volcanogenic intercalations are very common in Triassic sequences in the Alps, where they reach several tens of meters in thickness. By way at contrast, in the Western Tatra Mts., Triassic pyroclastics appear very rare.

During recent sedimentological studies of the Middle Triassic dolomites and limestones from the westernTatra Mts., several pyroclastic horizons have been found in the so called the Hronicum Unit (Wielkie Koryciska Valley). Tuffites of "pietra verde" type form thin (up to 10 cm), sharply bounded horizons within thin-bedded dolomites representing a mid-to-outer platform setting (Ramsan Beds) and in basinal flaser and nodular limestones (Reifling Beds). In contrast to the host carbonate sediments rich in forams and skeletal debris, micro- and macro-fossils are completely lacking in the tuffites.

The tuffites are plastic deposits, green to grey in colour, composed mostly of clay minerals with subordinate carbonate extraclasts derived from the adjacent sediments; the others consist of a mixture of clay minerals and carbonates. In thin sections examined in transmittent light the clay horizons display subtle lenticular lamination. This primary structure is often highly contorted since plastic tuffites served as easy-slip horizons during Alpine tectonic movements in the region. X-ray study indicates that the non-swelling 10 Å-dioctahedral mineral of the illite-type dominates in all the samples but small amounts of chlorite and vermiculite were found in some of them, too. EDS-study indicates the presence of Mg- and Fe-rich illite minerals (Fe_2O_3 $_{Tot.}$ + MgO up to 8-10 wt %) with Mg/Fe atomic ratio ranging between 2:1 and 7:1. TiO_2 contents are up to 0,5-0,8 wt %. Non-clay minerals in the tuffites are represented by extraclastic carbonates (dolomite, calcite) and authigenic pyrite, which forms euhedral crystals or small, oval aggregates. Other accessory components are very fine (<0,6 mm), angular quartz grains. The results of 12-elements chemical analyses plotted in TAS and K_2O -SiO_2 diagrams place the tuffites in the basaltic trachyandesite field. The REE patterns indicate that the primary magma of the tuffites studied could be of basaltic composition (diagram Ti/100-Zr-Nb*10 and diagram Zr/TiO_2-Nb/Y).

Preliminary results indicate that Middle Triassic trachyandesitic volcanism has taken place in the Tatra basement within the province of the western Tethyan rift belt. Since the tuffites are composed of extremely fine fractions of volcanic ashes without any admixture of coarser pyroclasts and phenocrysts, it is supposed that the Tatra basin was situated far from the eruption area. Conodont stratigraphy from carbonates indicates, that the volcanism was of the late Anisian-early Ladinian age like in other Alpine basins.

LACUSTRINE DEPOSITS IN THE TATRA MOUNTAINS AS EVIDENCE OF LATE VISTULIAN AND HOLOCENE EVENTS RELATED TO GLOBAL CLIMATE CHANGE

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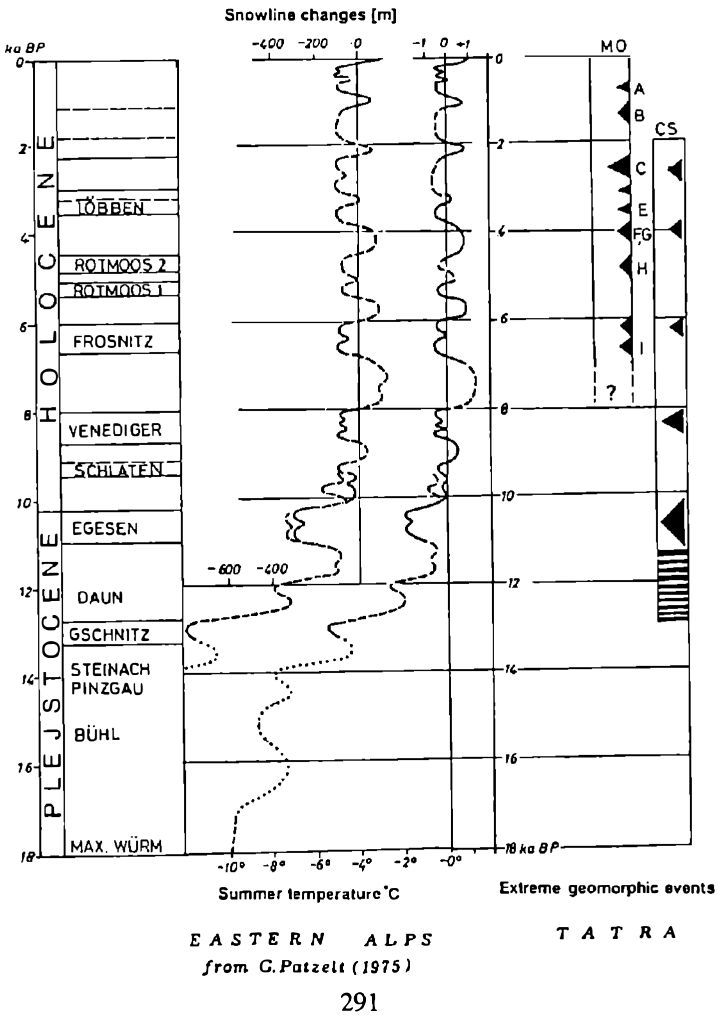
In the high-mountain areas of thc Tatra Mountains glaciers melted completely by the end of the Vistulian or in the carly phases of thc Holoccnc. In cirque lakes located at high elevations, above present upper timberline (i.e. above 1550 m.), and often having amphitheatre-like shape lacustrine sediments provide evidencc of non-glacial changcs in thc cnvironment which was under the influence of periglacial climate. Paraglacial and periglacial geomorphic processes are registred in lacustrine sediments. The high energy, short-lasting, yet often catastrophic geomorphic proccsses, such as debris flows, debris avalanches, rockfalls and rockslides supply to the lakes sandy, silty material including even pieces of fine gravel material. In contrary, organic gyttjas have formed in the Tatra lakes during calm sedimentation.

The analysis of Late Vistulian and Holocene cores sampled in the Tatra Mountains show that calm, slow sedimentation of organic silts predominated in the first phase of the Holocene preceding the radiocarbon date c. 8300 BP (Preboreal and Boreal). Massive mineral sediments were formed during Younger Dryas (Egesen), and in the period correlated with Venediger. The Subboreal and Subatlantic periods are manifested in a more vigorous dynamics of the Tatra environment in comparison with Atlantic. Large scale re-activation of the processes occurred during the Little Ice Age. Simplified scheme showing the main phases of high-energy geomorphic events related to climatic instability of the environment is included in the abstract. Black triangles mark such events in two lakes: (MO) Morskie Oko Lakc, 1395 m. a.s.l. and (CS) Czarny Staw Gąsienicowy Lake located at an altitude of 1620 m. Laminatcd sediments in Czarny Staw Gąsienicowy Lake were deposited during pre-Younger Dryas period. According to lithology it is possible to distinguish alternation of fine laminated silts and more massivc fine sand and silt layers. These Late Vistulian series have organic matter content 2-5%, while Holocenc gyttjas are more organic (25-30%). Laminated deposits are similar to varve deposits, but are rather thin, and microskopic analysis demonstrate that more dark laminae consist a few sedimentation events and bright laminae represent more coarse-grain deposits. Radiocarbon data 12,500 BP indicate age of these deposits. Palynological data (Obidowicz 1993) confirm cold and warm oscillations before the Younger Dryas.



EASTERN ALPS
from G. Patzelt (1975)

TATRA

ILLITE/SMECTITE DIAGENESIS IN KRAKÓW-ZAKOPANE CROSS-SECTION OF THE OUTER CARPATHIANS AND THE PODHALE BASIN (POLAND)

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This paper presents results of the XRD studies of the evolution of mixed-layer illite/smectite in shales from boreholes situated along Kraków-Zakopane cross-section (Outer Carpathians and Podhale basin, Western Carpathians, Poland) (Fig.1). XRD data are supplemented by K-Ar dating of illite/smectite from bentonites from the Podhale basin.

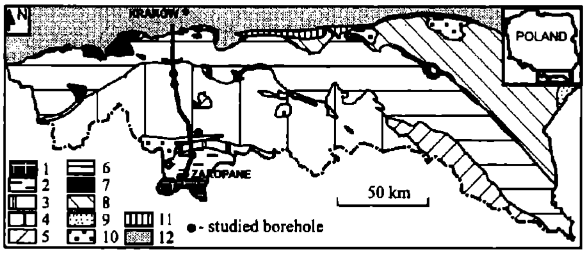

Fig.1. Tectonical sketch-map of the Polish Carpathians: 1 Tatra Mountains, 2 Podhale flysch, 3 Pieniny Klippen Belt, 4 - Magura nappe, 5 - Dukla nappe and equivalent units, 6 - Silesian nappe, 7 - Subsilesian nappe, 8 - Skole nappe, 9 - Stebnik unit, 10 - Neogene rocks laying on flysch, 11 folded Neogene rocks of the Carpathian Foredeep, 12 - unfolded Neogene rocks of the Carpathian Foredeep.

Mixed-layer illite/smectite (I/S) is a clay mineral commonly occurring in <0.2 μm fraction of shales together with discrete illite, chlorite and/or kaolinite. It constitutes the intermediate stage in diagenetic smectite-to-illite reaction and is characterized by the decreasing percentage of smectite (%S) and the increasing degree of ordering (from random R0, through R1 to R>1) in the course of diagenesis. The reaction appears to be sensitive to the bulk rock chemical composition and the maximum temperature.

The illitization in the northern part of the Magura nappe (Outer Carpathians, boreholes: Trzebunia IG1, Tokarnia IG1) is advanced. Only ordered (R1, R>1) I/S is present and %S changes irregularly in 30-10%S range, down to about 2900-3000 m, where the randomly interstratified I/S (R0, 40-50%S) is observed in the underlying Miocene strata. A different situation is noted in the southern part of the Magura nappe (borehole Nowy Targ PIG1), where the illitization profile starts with randomly interstratified I/S. %S regularly decreases from 73%S to 22%S between 1000 m and 2500 m and ordering (R1) appears at about 1800 m. The deepest samples from 3300-3750 m are the highest ordered (R>1) and contain <15%S.

The diagenesis of the Podhale flysch in the boreholes Bańska IG1 (the northern part of the Podhale basin, Szaflary and Zakopane beds) and Skocznia IG1 (the southern part of the Podhale basin, Zakopane beds) is advanced. In Bańska IG1, ordered I/S (R1) changes irregularly in 34-21%S range down to about 2500 m. In Skocznia IG1, %S decreases gradually from 26%S to 12%S over 500 m from the top of the borehole. Preliminary results from the borehole Chochołów PIG1 (the western part of the Podhale basin) indicate randomly interstratified I/S (R0, 55-64%S) in younger strata of the Podhale flysch (Chochołów beds).

K-Ar dates were obtained for 0.1-0.2 μm, 0.05-0.1 μm, 0.05-0.02 μm and <0.02 μm fractions of fundamental particles of I/S separated by ultracentrifugation from two bentonites from the Podhale basin (from Zakopane and Chochołów beds). The illitization occured at the same time in both samples, giving the diagenetic age (17.4-20.8 Ma) younger than the stratigraphic age (23.8-33.7 Ma). The more illitizated sample was found in older strata and it gave more accurate results due to higher K_2O content. The thinnest fundamental particles are ca. 0.5 Ma older than the thickest ones. This age difference corresponds to the duration of the illitization event.

XRD characteristics of I/S yield the information of the evolution on sedimentary basins and the transitions through subsequent degrees of ordering are useful for determining the maximum paleotemperature. XRD data obtained for the northern part of the Magura nappe imply that the illitization profile has been established before the thrusting of the Outer Carpathian flysch over the Miocene strata. The degree of ordering and %S suggest higher temperatures than noted in boreholes today. The advanced diagenesis observed in the northern and the southern part of the Podhale flysch also indicates higher than present temperatures. K-Ar ages from bentonites are younger than the youngest known flysch strata from that basin. Assuming constant geothermal gradient, these data correspond to the maximum burial period and imply that massive erosion must have started later. If the geothermal gradient was changing, the bentonite illitization is dating the period of maximum heat flow.

ORGANIC AND ILLITE-SMECTITE DIAGENESIS OF THE CENTRAL CARPATHIAN PALEOGENE BASIN: IMPLICATIONS FOR THERMAL HISTORY.

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Levoča Basin represents the largest accumulation space of Paleogene sediments in the Central Carpathian Paleogene basinal system. This fore-arc basin was formed above the southwestward subducting oceanic slab attached to the European Platform. The basin-fill sequence comprises of: 1. Late Eocene Šambron Beds (synrift deposits of claystones, muddy turbidites and scarp breccias); 2. Lower Oligocene mud-rich subflysch formation; and 3. Upper Oligocene deep-sea fan sandy-rich deposits. The last known formations have Uppermost Oligocene - Lower Miocene age.

Clay-mineral assemblages and vitrinite reflectance (VR) data have been applied to determine post-sedimentary alteration of the Paleogene flysch formations, using shales and siltstones from ca. 60 outcrops and 7 deep drill-holes. The clay mineral assemblages (<2µm-size-fractions) are mainly composed of discrete illite, mixed-layer illite/smectite (I/S), kaolinite, chlorite and mixed-layer chlorite/smectite. The most notable diagenetic reaction is smectite-to-illite transition. With increasing stratigraphic age and burial temperature the proportion of smectite layers in I/S decreases and progressive change of R0 to R3 ordering takes place. The smectite-rich I/S (≈70-45%S) with random ordering was found in the youngest, Uppermost Oligocene - Lower Miocene rocks. The underlying Lower to Upper Oligocene formations are characterized by R1 I/S (≈45-20%S), and R3 I/S (≤15%S) was encountered mainly in oldest, Late Eocene strata. These depth-related changes are accompanied by gradual diminution of kaolinite, while the proportion of chlorite increases. Correlation with VR data can be approximated as follows: R0 to R1 transition occurs at R_o≈0.5%, and R1 to R3 transition at R_o≈0.8%. Observed data indicate burial temperatures between ≈70°C (Lower Miocene rocks) up to at least 150°C (Late Eocene rocks). None of the flysch formations studied reached the anchimetamorphic temperature conditions (highest IC=0.65°Δ2θ, R_o=1.5%).

A geographical distribution of individual types of I/S phases as well as VR data mostly reflect a present day bottom configuration of the Levoèa Basin or level of erosion and no regular pattern was observed. Rocks with R0 I/S are preserved only in depressional parts (Poprad and Chmiòany Depressions), while shales containing R3 I/S were found above elevations (e.g. Vikartovce-Klèov and Bajerovce Elevations). Situation is even more complicated in the Periklippen area which is caused by strong tectonic deformations. However, due to prevalence of the Late Eocene Šambron Beds, shales with most advanced illitization (R3 I/S) predominate in this part of basin. It is necessary to point out that presented diagenetic model is schematic and generalized. A significant deviation was recorded in the central part of Levoča Basin where the youngest known Lower Miocene flysch formations display more advanced illitization (R1 I/S with 35%S) and VR (R_o=0.6%) than rocks of similar age in the other parts of basin. Taking into account the range of paleothermal gradients 50 - 30°C/km and normal heat flow, this observation implies, that ca. 2 - 3 km thick sequence of sedimentary rocks has been removed after the Miocene uplift.

PALEOGEOGRAPHIC CHANGES AS A RESULT OF INTERACTION OF TECTONIC EVENTS AND RELATIVE SEA LEVEL OSCILLATIONS (NEOGENE, WESTERN CARPATHIANS)

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Interaction of tectonic events and sea level changes had an important influence on the paleogeography and paleoenvironment of the Central Western Carpathian basins. The depth and the shape of the basins were influenced by the main tectonic events, what led to changes of the sedimentary environment. The eustatic oscillations are reflected in the coastal onlaps. The relative sea level rises or falls were defined by paleoecological study on foraminiferal associations in the offshore deposits. The correlation of the constructed curves for the environment coastal onlap and paleodepth with global reference curves (Haq. et al. 1991) shows some discrepancies, mostly caused by tectonic events during the basins development.

In contradiction to the Burdigalian continuous relative sea level rise in the Mediterranean TB1.5, the paleoenvironment of the Central Western Carpathian basins has been changed from deep water high-energy to shallow water low-energy due to the compressive collision tectonics in the frontal and central parts of the orogen.

The Eggenburgian transgression was followed by deepening of the sedimentary environment. Latter on, during the Ottnangian, a brackish paleoenvironment has been developed in the Vienna Basin. In the East Slovakian Basin the uplift was associated with hiatus. The marine ingressions observed in the back arc Novohrad - Nógrad Basin can be related only to relative sea level rise in this time.

The Karpatian transgression can be correlated with the global sea level rise TB2.2 but the Intra Karpatian sea level oscillations have a regional character and were tectonically controlled. They are marked for example by salinity crisis in the East Slovakian Basin.

The Langhian - Early Badenian relative sea level rise TB2.3 is well observed in the Vienna, Danube and East Slovakian Basins and it was followed by relative sea level fall during the Middle Badenian Early Serravalian. The Upper Badenian relative sea level rise and coastal onlap are the last well observed Serravalian global sea level oscillations in the sedimentary record of the Western Carpathian basins.

The Sarmatian gradual shallowing or local sea level falls or rises were mainly controlled by synsedimentary tectonics during the development of the basins. However, the relative sea level fall at the begin of the Sarmatian is present in the Vienna, Danube and East Slovakian Basins in the simultaneously.

The Tortonian and Messinian - Pannonian and Pontian local and global relative sea level oscillation cannot by correlated in the Western Carpathian basins due to the lack of the paleontological data.

MIOCENE PALEOGEOGRAPHY AND PALINSPASTIC RECONSTRUCTION OF THE EAST ALPINE - CARPATHIAN - PANNONIAN REGION.

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The evolution of the Carpathian-Pannonian region, composed of the northern Alcapa and the southern Tisza-Dacia microplates (lithospheric fragments), was influenced by four important geotectonic events during the Neogene.

The Oligocene-Early Miocene collision of the Alpine - Carpathian chain with the North European platform led to an extrusion of the Alcapa microplate from the East Alpine domain. This process has been associated with compressional tectonics in front of the moving plate, accompanied by total subduction of the thinned crust north and south of the Pieniny Klippen Belt and folding of the Outer Western Carpathians accretionary prism. In the contact zone between the two twisting microplates an overthrusting of the Szolnok flysch sediments onto the Tisza-Dacia microplate took place during the Eggenburgian and Ottnangian.

Extrusion of the Alcapa superunit continued by the activation of sinistral displacement zone on the East Alpine - Western Carpathian boundary (opening of the Vienna Basin), being accompanied by the counterclockwise rotation of the microplate. The rotation of the semirigid superunit was accommodated by the dextral shear along the Pieniny Klippen Belt eastern part (opening of the East Slovakian Basin in the Transcarpathian depression). Subduction pull in front of the Carpathians led to extension of the overriding superunits and was followed by wide rifting period in the back - arc domain. After the Karpatian the development of western part of the Outer Carpathians accretionary prism was finished.

The Middle Miocene active elongation of the Alcapa and Tisza-Dacia microplates, due to subduction retreat in the northern and eastern front of the orogen, led to a subsidence of individual basins in the back - arc basin system. The Danube and Great Hungarian Plain Basins have been opened, subsidence continued in the Vienna, Transcarpathian and Transylvanian Basins. The Badenian and Sarmatian basin development in the western and central part of the back - arc region (e.g. Vienna, Danube, Zala, Járság, etc.) was controlled by updoming of mantle masses which generated NW-SE extension in the crust. The basins in the eastern part of the back - arc area (Transcarpathian and Transylvanian) were indirectly influenced by subduction process and show a NE - SW to E-W extension in this time. The basin evolution was accompanied with voluminous acid and calc-alkaline volcanism. During the Sarmatian the development of northern part of the Outer Carpathian accretionary prism has been finished.

The Upper Miocene back - arc extension was induced by the Eastern Carpathian subduction pull and/or thermal postrift subsidence in the Pannonian domain. Rapid sedimentation occurred in the Danube and Great Hungarian Plain Basins. During the Pannonian and Pontian only the formation of the southeastern part of the Eastern Outer Carpathian accretionary prism continued.

During the Quaternary a tectonic inversion is observed around the whole Alpine-Carpathian-Pannonian region. Only some depocenters in the Vienna, Danube and Great Hungarian Plain Basins are still subsiding.

CHARACTERISTICS OF GEOCHEMICAL BARRIER FOR URANIUM IN PERMO-TRIASSIC SEDIMENTS OF STARA PLANINA

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The Stara Planina mountain is situated in eastern Serbia at the Yugoslav-Bulgarian frontier. By complex investigations of Permian-Triassic sediments of Stara Planina a tract of land is delineated where uranium has been fixed, during its precipitation from solutions (Fig. 1.). By synthesis of all relevant data, in Varigated sandstones of Stara Planina a zone has been distinguished, which corresponds, according to its characteristics, to the tract with favorable conditions for concentration of uranium mineralization which is featured by specific lithology of sediments (composition, color, porosity, grain size etc.), then by lithofacial (offshore shallow facies), chemical properties (Eh and pH) etc.

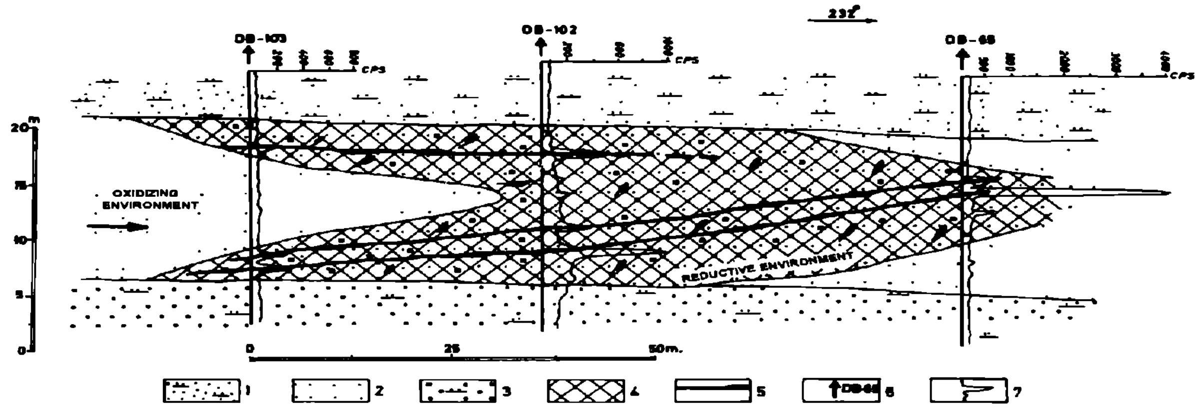

Fig. 1. Position and shape of mineralised lenses in a part of geochemical barrier in the Permian-Triassic sediments of Stara Planina.

1. Red siltstones and fine-grained sandstones (roof); 2. gray and reddish sandstones and siltstones; 3. red coarsegrained sandstones and siltstones (floor); 4. geochemical barrier (gray sandstones with organic material, sulphides and clay minerals); 5. uranium mineralization; 6. completed drillhole; 7. diagram of radioactivity.

All these specifities caused changes of geochemical, hydro geochemical, mineralogical, geophysical and other parameters in a very short distance, where differences in uranium concentration and other trace elements in front of and behind the barrier are evident.

Deposition of uranium is done in a reductive environment, i. e. after alternation of oxidizing and reductive conditions. The major uranium reductors are organic matter, then the iron compounds and clay minerals. In the zone of geochemical barrier the pH values are about 7, and Eh around 140 mV.

From the mineralizing solutions running through the oxidizing zone, when contacting the zone of partial oxidation, the first is deposited selenium, then in the reductive environment the uranium deposition took place, and to the end molybdenum is concentrated. Such a zonality points out the direction of running of uranium bearing solutions.

The increased. uranium concentrations are constantly accompanied by augmented contents of pyrite, sulphides of copper, molybdenum and selenium and a little lead.

The zone of geochemical barrier is, as a whole, of relatively simple shape, but by detailed investigations it is observable that in some parts it is of a very complex shape, as the mineralised lenses in it. This indicates the frequent changes of sedimentation conditions, involving the unequalised. intensity of concentration of organic material, clay minerals and other substances, serving as reductors.

TRIASSIC EVOLUTION OF A NEOTETHYAN CONTINENTAL MARGIN SEGMENT, THE AGGTELEK–RUDABÁNYA MTS., NE HUNGARY

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The units of the Aggtelek–Rudabánya Mts. forming the lower-rank Aggtelekia composite terrane, are located in the NE part of the large Pelsonia Composite Terrane. As recent structural reambulation shows, the non-metamorphosed upper nappe complex is characterized by an older, south-vergent folded – thrusted structure, with superimposed younger, northvergent ones. This nappe complex is detached from its Pre-Alpine basement and is dissected by strike-slip and thrust-faults into severeal units: the Aggtelek–Alsóhegy and Derenk units in the Aggtelek Mts. s.s. and the Bódva–Szőlősardó units in the Rudabánya Mts. Inspite of this dissectment, the steps of formation and evolution of the distal part of a continental margin (or at least the margin of a microcontinent) can be well reconstructed from the Triassic successions of these units.

The Alpine sedimentary cycle began in the Late Permian, when deposition in coastal sabkha environments represented the initial stage of transgression. By the earliest Triassic a wave- and storm-dominated homoclinal ramp environment was formed with siliciclastic sedimentation. Later in the Early Triassic the environment gradually changed into distally steepened, low-energy ramp with mixed siliciclastic–carbonate sedimentation. This ramp was exposed to a southerly lying open marine domain. Due to landward shift of the shoreline and climatic changes, siliciclastic input ceased by the end of the Early Triassic and carbonate ramp environment was formed in the Anisian, first with anoxic (Gutenstein Fm.) conditions. Beginning of rifting resulted in the disrupture of the Steinalm ramp in the Middle Anisian, attenuation of the crust and formation of a margin, with breakdown and rapid subsidence of its distal parts. From this time on, eupelagic conditions prevailed in the Bódva domain, with reddish, cherty, deep-water limestones (Bódvalenke Limestone), locally passing into radiolarite (Szárhegy Radiolarite Fm.) The closely related, minor Szőlősardó Unit (with proven interfingerings between them) represented a gentle slope environment, with varions types of sediment movements (Nádaska Limestone).

Rapid breakdown during the Middle to Late Anisian also resulted in the appearence of first rimmed margins (Late Anisian to Early Ladinian reefs in the Aggtelek Unit) and formation of carbonate platform environments (Ladinian – early Late Carnian Wetterstein Fm.). Contemporaneously, pelagic basinal sedimentation prevailed in the Derenk Unit with a special type (syndiagenetically brecciated) Hallstatt Limestone (Derenk Limestone). Siliciclastic input during the Middle Carnian "Raibl event" interrupted carbonate sedimentation in the Szőlősardó Unit (Szőlősardó Marl, representing a submarine fan). Its distal equivalents in the Bódva Unit are a few m thick purplisch red shale intercalations. On the other hand, there is no sign of siliciclastic input in the Derenk Unit, recalling, that in the original setting of the units the source area could be westerly located. In the early Late Carnian, the outer shelf environment of the Aggtelek – Alsóhegy units broke down and pelagic Hallstatt Limestone was deposited till Late Norian, without resedimentation. The same Hallstatt (and partly Pötschen) Limestone characterizes the Derenk Unit, which represents the northernmost environment in "Euhallstatt" setting, e.g. in which the Middle Triassic basin was not overgrown by a prograding platform, of paleogeographic importance is, that it is overthrust from the N by the southward rimmed Carnian Wetterstein ("Waxeneck") Limestone platform of the Alsóhegy Unit. Coevally with this breakdown, the slope setting of the Szőlősardó Unit ceased and Pötschen Limestone was deposited, also without resedimentation. On the other hand, frequent resedimentation phenomena charcterize the Hallstatt limestones, witnessing the inherited earlier dissected bottom topography.

Another event without siliciclastic input near to the end of the Triassic ("Zlambach-type" marls) terminated the carbonate sedimentation. The southward deepening tendency of the non-metamorphosed units of the Aggtelek–Rudabánya Mts., together with its stuctural style, bears evidence, that these were parts of the northern margin of a southerly existing eupelagic domain (according to present coordinates) during the Triassic.

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Influence of sedimentary kinetics on gold concentration in sedimentary deposits of the Carpathian region and northern part of Para-Tethys.

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Among the endogenic gold in rocks of Carpathian region side by side with coarse grains the gold grains 0,01 - 0,2 mm of size are often found and even prevailed in some ore-manifestations.

Gold nodules size from sedimentary formations of this region are varying within the wide limits - from 0,01 to 6,0 mm; gold nodules 0,1 - 0,2 mm of size prevail.

Sampling procedure for sedimentary complexes had been oriented on the gold placers discovery of coarse granulometric classes, in gravel-pebble beds mainly.

In consequence of simplified sampliry technique the sedimentary deposits of fine-sandy and aleuritic dimension had been practically not sampled for gold; fine classes of gold nodules (0,1 mm and less) were practically not settled. The semblanu of irregular metal distribution in sedimentary complexes of Ukraine was created and its content was understated. At the same time the gold of these granulometric classes is mobil in water flow principal factors for golg 0,1 mm and less of size, determined its migration are physico-chemical, chemical and biochemical processes. This gold is able to be carried on considerable distances by favourable paleogeographical situations and to accumulate in different facies conditions (fluvial, channal shoal, fload plain, oxbow-lake, coastal facies). In addition of granulometric class, gold mobility in water flow is determined by presence of gold growth with some minerals and fragments, by presence of gold, associated with clayey clods and pellets, and by gold flatness.

The principal role in gold transportation belongs to water flow energy and depends on its character, velocity, viscosity and density.

The latter two characteristics depend on volume and clayiness of terrigenous material, which is coming into water flow. These high-dense flows are able to transfer gold nodules at unlimited distance out of depending on their granulometry. High clayiness of water flow (at the expence of chemical weathering crusts erosion) not only favourse the metal transportation at long distances, but also retains gold in sediment after its accumulation.

Analysis of geological situation and auriferity of sedimentary complexes of investigated region showed, that some of them had been formed as a result of high dense flows action. In the end the auriferity contour of these sedimentary complexes was displaced up the section. High-clayey fine-sandly lithofacies are characterized by heightened auriferity and by absence of clastic material grading.

Gold concentration in sediments where the gravitational differentiation processes of sedimentary material were badly manifested are comparable and in some cases most bigger, that in slight-clayey well graded gravel-pebble bed deposits of fluvial facies. Thus, taking into account the specificity of endogenic oregenesis, which supplied to supergene zone fine, aleuritic and disperesive gold mainly and specific paleogeographical situation, it is necessary to direct subsequent geological works on discovery of gold placers of fine classes in high-clayey badly graded deposits (channal shoal, flood plain, oxbow-lake and coastal facies).

PROBABLE SOURCE AND USAGE PECULIARITIES OF CLINOPTILOLITE FROM ZEOLITE-CONTAINING DEPOSITS OF TRANSCARPATHIANS TROUGH

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Zeolites comprise a group of lattice water-alumosilicate calcium, sodium and potassium minerals, of which are known around 30 varieties.

There is widely widespread felsic volcanism of Alpine cycle in the Carpathian Inner Trough. Among volcanic units liparite-dacite tuff horizons are of specific position. Tuff horizons of sufficient thickness that are often intercalated with sedimentary rocks are known from Beregovo Hill-Land, Vigorlat-Gutin Range and other areas. Zeolites have been found in Upper-Tortonian Nankivska Sub-Suite of Teresvinska Suite beds.

These tuff horizons affected by kaolinization and zeolitization. Most thickness-persistent zeolite horizon occur at Sokirnitsa village of Khust Region. Zeolite comprised by Na-Ca-K-bearing variety - clinoptilolite.

Studies of the chemical composition of zeolite tuffs in Sokirnitske deposit have allowed to determine their clear similarity to virtually mono-mineral clinoptilolite samples from Ay-Dag (Azerbaidjan) and to clinoptilolite from Genter deposit (USA). Spectral studies of the zeolite-bearing units of Sokirnitske deposit have shown they are broadly similar by compounds composition and their qualitative parameters. Silver content of order of p.p.m. is characteristic. Silver cations increase zeolite sorption properties when this mineral capture hydrocarbons (C_2H_6) and carbon dioxide (IV).

In quartz phenocrysts from liparite tuffs inclusions of mineral-forming liquids and post-magmatic solutions are found. Thermometric studies suggest for two-phase (glass+gas) inclusions are homogenized at 1355°C. By means of micro-spectral analysis of inclusion glass from quartz crystals that were carried out using laser microspectral analyser Si, Al, Fe, Cu, Mg, Ca, Mn, Zn have been determined. Later-secondary vapour-solution inclusions in quartz from liparite tuffs are homogenized into liquid phase at 240-210°C temperatures. By water extractions from liparite tuffs can be expected increased concentrations of Na, K, Ca, Mg in the mineral-forming fluids. Entire salt concentration in solution of about 1-3 wt.% NaCl equiv. were determined by cryometric studies.

Accounting the data mentioned above we suggest the clinoptilolite in Sokirnitske deposit has been formed at the expense of felsic tuffaceous volcanic glass (composition inheritance). Zeolitization process was rather complicated. Volcanic ashes interaction with sea water could be expected first (early diagenesis), then low-temperature, low-salinity fluids from endogenous source have been introduced (late diagenesis) caused formation of the main zeolite volumes. Therefore, Sokirnitske zeolite deposit has a polygenous nature and has been formed due to endo- and exogenic processes cooperative action.

Clinoptilolite usage is rather wide. This mineral enable to adsorb strontium and other elements. Usage of clinoptilolite in this way is known as from theoretical published sources as from existed world-wide experience. Zeolites are used as sorbent for human-water cleaning. For the environmental aims zeolites are useful in term of oxides, carbon dioxide, nitrogen, sulfur removing. In industry, zeolites are used for natural gas cleaning and as forcing agent in technological processes.

It is reasonable to use zeolites of the Sokirnitske deposit in agriculture works, both in plant and animal ones. Mineral fertilizators equipped with zeolites could sufficiently enhance the ground patterns since the zeolites would fix microelements and bring them to plants. In cattle breading zeolites could facilitate combi-food properties.

AN EAST HUNGARIAN CITY - DEBRECEN - GEOPOTENTIAL AND ENVIRONMENTAL GEOLOGICAL PROBLEMS

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The second largest city of Hungary with a population of 220 000 is a lowland city in such a disadvantegeous state, where there is urbanogenic, technogenic, agrogenic and environment close to nature as well. Its market-town character had been developing from the Turkish wars up to the first quarter of our century. Then, because of the changing of the fontiers after the First World War, its geopolitical importance has changed. The industrializing politicies of the 50s , and the city developmental processes thereafter hardly took into consideration the geological fundamentals, the contamination of near-surface layers and the principles of long term environment management. All these have given rise to a hardly managable complex of threatening problems.

Because of its low build-up densiti, the city has an extensive area at the edge of the Pleistocene blown sand region of Nyírség and margin of Hajdúhát loess region. The region is dissected from the shallow geological and agrogeological point of view into Eastern and Western parts and a foreland.

The structure of the subsurface geological basement, the tectonic activity, the geothermal fundamentals and the changing stratigraphic character give reasons for the separation of the Northern and Southern zones. The industrial area was built at the edge of the Eastern-Northeastern part of the city, which is the most endangered place from the point of view of water conservancy. No enviromental- and engineering geologically oriented mapping of the superficial geological formations has been performed up till now neither has shallow hydrogeological monitoring been elaborated yet. The length of the joint drainge system is 180 km on 1836 hectares, while the length of the separated system is hardly more than 20 kms.

The unified geodatabase, which would make possible the optimal coordination of the area and ensure problem management taking geological regards into consideration, has not yet been established for the environs of the city.

The geopotential value of the city is based on geotermal and hidrogeological potential, however, remarkable are of its agrogeological and engineering geological possibilities and the seismical stability, which are not negligable either. The Hungarian Geological Survey tries to establish the geodatabase according to its possibilities so as to help the functioning of the development and damage prevention programmes of the region.

VOLCANOLOGY AND GEOCHRONOLOGY OF EAST BORSOD BASIN

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The volcanism of Cainozoic basin structure, recently forming the hilly eastern foreland of the Bükk mountains (East Borsod Basin), forms the perfect reconstructional model of East Hungarian neogenic volcanism, which is covered by young sediments.

The less known prepaleogenic base of the area is formed by paleozoic clastic and carbonate metasediments, which show imbricated strucure with NW vergence and in the SW marginal part of which there is the reversed fault of Mesozoic carbonate structures of the Bükk mountains. The imbricated system with overthrust fault showing NW vergence is more and more elevated toward the northern part of the area. The initial movements of the imbrication mechanism might start at the begining of the Miocene, causing trough-like transgressions in the area.

The deep faults with NE-SW strike reached the upper mantle and strongly fragmented even the lower crust. The anomalies in pressure of the upper mantle caused the development of magma chambers and, in this way, the forming of differenciated dacitic-rhyolitic volcanic activity in the southern foreland of the Bükk mountains along the compression belt.

However, in the eastern foreland of the Bükk mountains the dominant structural factors are the distensional transverse faults, along which the less differentiated basaltic-andesitic neutral magmatic masses could come to the surface. The basic-neutral magma outcropping along narrow volcanic veins is only slightly contamined. The lava intruding into the unconsolidated Miocene sediment series, which was formed from wet clastic sediments, rapidly cooled and brought about shallow extrusive volcanic masses, lava breccias. The tuff lava margins contain strongly transvaporised, finally contaminated light rock types with destroyed texture. There are also apophyses and stratiform intrusions in the area.

According to K/Ar radiometric analyses the paroxism of the basaltic-andesitic neutral magmatic process took plate in the Sarmatian-Pannonian age. Taking into consideration the results of the stratigraphic, lithological, micromineralogical and X-ray analyses of embedding correlative sediments (pebble, sand and pelitic formations) we could demonstrate that the magmatic development (naturally with lower intensity) started in the lowest Ottnangian and might have continued till the Pliocene age.

STRUCTURAL DEVELOPMENT OF THE CARPATHIAN BASIN

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The complicated character of the Carpathian system is due to the joint effects of several factors. The internalt part of the Carpathian Basin was formed by a poligenic part of the earth crust, which presents marks of tectogenic-orogenic and magmatic processes of Cadomian, Caledonian, Hercinian and Alpine orogenic developments. During the Alpine orogenic development this area constitutes a marginal, unstable part of the European platform. The divergent and convergent movements of the area are interpretable as generated passive movements, with subordinate activity of the mantle.

The area is a transitional, atypical marginal unit of the European platform, which can behave like either a mobile belt or a rigid mass. Neither its divergent nor its convergent processes were quite dominant. Caused by the marginal position of the area the movements were determined by the effects of continental margins and the preorogenic basal complexes. The nearly parallel structural belts with NE-SW strike form a repeatedly reorganized lamella-system, the slightly divergent and convergent movements of which could cause the different mechanical degradation of the earth crust at different depths.

During the divergent movements long intraplatform basins and embryonal ocean trenches were formed parallc to the structural trends. The deepest firths were situated in the most intensively fragmented tectonic belts and there were continental swells between them. The facies pattern correctly indicates this structural system. Along the tectonic belts, according to their strikes, distant paleogeographic points could be similar caused by the similarity of paleoenvironments and by movements of the ancient fauna. So the postulation of meaningful horizontal movements is unjustified.

The compressional area was determined by two main compressional system, one of which (NNW-SSE) was perpendicular to the main strikes of structural belts whereas the other (NE-SW) was parallel with them. The first was caused by the equatorial rift system of Tethys while the second was generated by the Atlantic - Red-sea - east Carpathian rift-structural system. The asymmetric character of the compressional system was caused by the different size and stability of forelands. There was a passive continental margin in the North but quite a mobile system (Moesia, Trak-Macedon area, Apulia) with different stability in the South.

The rigid collisions, slight sub- and obductions, imbricated margins and local imbrications with double vergence were common in the compressional area. The local vergences of reversed faultings situated along the margin of the European platform indicate outward imbrications caused by the wall-effect of the passive continental margin, however in the inner part of the basin the NNW vergences are common. In the NW foreland of steep reversed faultings flysch (Szolnok-Máramaros flysch belt) and molasse sediment series were accumulated depending on the relative relief energy conditions. The intensity of magmatism in the area depended on the intensity of divergent or convergent movements. The relatively small amount and mixed geodynamic character of magmatic masses indicate the recurrent activity of the uppermost mantle.

THE STRUCTURAL POSITION OF THE BÜKK MOUNTAINS BASED ON TECTONO- AND PEBBLE STRATIGRAPHIC ANALYSES

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The structural and stratigraphical position of the Bükk system is a frequently disputed bit so far unsolved problem, for solving of which there were several atempts in the last few years. These lesarches are based on paleontological analogues or on the tectonic analyses of the Mesozoic central mass of the mountains mainly in its the SW part. These researches indicate long horizontal movements with NE trend since the Cretaceous age.

Our model tries to interpret the Bükk system taking into consideration the global development of the Eastern Carpathian Basin and comparing its main characteristics and structural marks with similar imbricated systems existing on the basement of the Great Hungarian Plain and covered with young sediments (e.g. Sáránd, Ebes). We have assigned small model areas to the mountains and have made detailed research of their geological, stucturo-geological characteristics and have drawn up their geological maps and cross sections (around Imó-kő in the SW part of the mountains, around Bél-kő in the West part, in the Northern margin of the mountain, in the Uppony-mountains and in the Eastern foreland of the Bükk mountains which is covered with correlative sediment series).The combined interpretation of these results indicats that the NE movements might have taken place at the end of the Oligocene and subordinately renewed during the Miocene and Pleistocene. But hardly imaginable is the meaningful movement of the Bükk and its allochtonous basement toward NE. But the periodical imbrications with NW trend had to be quite intensive, causing decollement from the basement, imbricational development and reverse fault of the area with NW trend and with back-bending layers.

The tempore reconstruction of the imbricational, reverse faulting development is solvable by researching facies changes in the correlative sediment series accumulated in the foreland basin. The horizons of coarse sediments, the existence of terrestrial facies are well trackable, the rock composition of coarse sediment is comparable with the rock types of the central mass. The textural mineralogical and the geochemical characteristics indicate not only the changes in facies but even the changes in rock composition of the eroded background.

Several Gömörian rock-types indicate the close connection of the area with the Northern foreland at the beginning of the imbricational development, and the early decollement of the Palaeozoic basement (e.g. Nekézseny Formation). Later, the local erosion became dominant, with the resedimentation of material from Miocene volcanic masses.

THE STRUCTURAL DEVELOPMENT BACKGROUND OF COVERED MIOCENE MAGMATISM OF EAST HUNGARY

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Based on data from more than 400, 1000-1400-meter-deep drillings (selected from more than 1400 others) as well as on lithological-geochemical analysis of samples thereof we tried to reconstruct the volcano-tectonical-petrological character of the area East of the Eger-Szolnok-Szeged line. The base of comparison was the superficial volcanic masses of North Hungary and the Slovakian and Romanian areas. Besides, we used the tectonic models, the contour maps of the thickness of Miocene materials and the geophysical data.

The structural belts of earth crust, with NE-SW strike form a mobile system whose main units show imbricated overthrusting caused by the compressional movements with NW trend. Against the pressing force coming from the S-Alpine region with NE trend the structural belts behaved as rigid masses undergoing block-like faulting and vertical dissection.

The dissection of the earth crust generated local increase and decrease in pressure in different points and belts of the upper mantle as well as disturbances of izostatic and energetic equilibrium. These effects gave rise to deep detachment faults, interlamellar semisubductional movements which generated the local and linear development of magma chambers in the uppermost mantle and induced subcrustal erosion. The material of the reactivated uppermost mantle slowly intruded into the thinned, heated continental crust, along the fragmented compression zones of reversed faults. In this way it shows the marks of assimilation contamination, transvaporisation and magmatic differentiation, formed a wide range of neutral-acidic calc-alkaline magmatic masses in connection with the volcanic centres of a centro-labial volcanic system, along the tectono-volcanic structure belts with NE-SW strike. The transverse faults and distensional block margins enabled basic-neutral magma to come to the surface quite rapidly, which frequently transported accidental inclusions from the upper mantle and earth crust. In the differentiated volcanics there the endogenic inclusions originating from the earliest crystallisation of the liquid system are more frequent.

According to sporadic data the Miocene volcanic process, as the paroxysm of Cainozoic synorogenic volcanic activity might have started in the lower Ottnangien, and showed its own paroxysm during the Sarmatian age. Then assuming more and more basic character and lower and lower intensity, the activity continued until the Quaternary period. The largest masses of Miocene volcanics accumulated in the simultaneously subsiding small basin in the NE part of Nyírség. The thickness of this volcanic masses is more than 2-3000 meters. The Szamos Basin formed in the internal foreland of the NE Carpathian range shows close analogy with the Po Basin situated in the foreland of the South Alps (e.g. Periadriatic - Peripannonian fault system, the detachment of the earth crust, the main trends of volcanic activity). The space-time pattern and differentiation trends of volcanic processes seem to be in close connection with the local activity and character of geodynamic movements.

THE PRECAMBRIAN RHODOPE OPHIOLITIC ASSOCIATION

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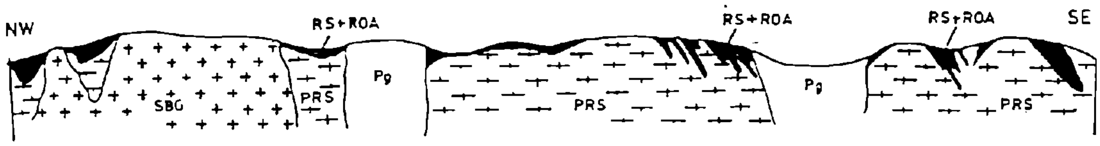
The Rhodope Ophiolitic Association (ROA) is an important part and stratigraphic mark in the metamorphic basement of the Rhodope Massif (RM). It had been obducted as oceanic crust fragments over an ancient continental crust-Prarhodopian Supergroup (PRS) and covered by pelitic-calcareous sediments, containing microfossils of Riphean age. Later they have been metamorphozed in a supracrustal complex - Rhodopian Supergroup (RS), consisting of amphibolites, mica schists, marble and quarztites. The specific position of ROA at the lower parts of RS fixed up a clear stratigraphic level, which was used for reconstruction of the synmetamorphic fold structures. Both RS and ROA occupy closed to tight vertical, inclined or recumbent synclines between domes, built up of migmatic gneisses of PRS (fig.1).

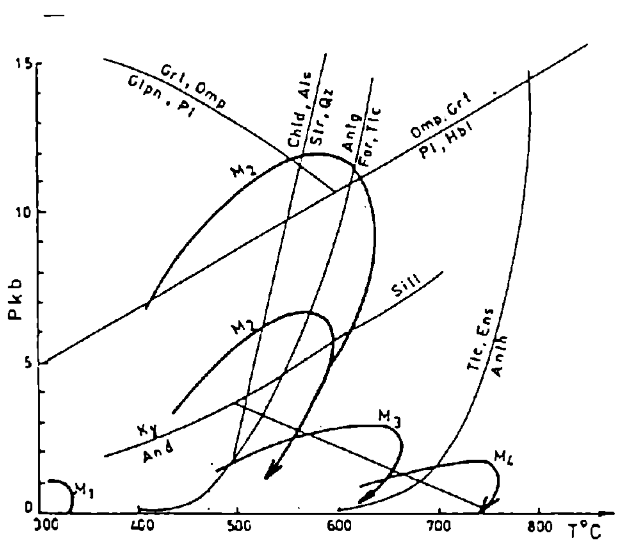


The primary ophiolitic rock - serpentinites, gabbros, gabbronorites, low potassium high magnesium, tholeiites and tuffs, have undergone polymetamorphic alterations in different facies. Several stages of metamorphism have been identified (fig. 2).

Hydrothermal ocean metamorphism (M_1) - lizardite-chrisotile serpentinization of peridotites.

Obduction of ophiolitic fragments over the marginal parts of the Precambrian continent and sedimentation.

Main precambrian regional metamorphism (M_2), generally into amphibolite facies, passed in three syntectonic episodes: **E**$_1$. amphibolitization of basic rocks of ROA, serpentinite bodies have been replaced at their peripheral parts by talc-chlorite-actinolite schists, T - 480-540°C; P 4-6 kb; **E**$_2$. the same processes and practically the same conditions; within some shear zones at lithological contact, a HP-metamorphism had been taken place; formation of garnet-omphacite-rutile eclogites and pyrope-diopside-enstatite-spinel bands at marginal parts of serpentinite bodies between strongly folded layers, T - 450-550°C; P - 9-12 kb; **E**$_3$ partial migmatization in amphibolites and amphibolization of eclogites, T - 560-620°C; P - 3-5 kb.



Posttectonic contact metamorphism (M_3), pegmatitization and partial assimilation of ROA next to the Hercinian granitoid intrusions; formation of metasomatic nondeformed gabbroids and diorites; scarnoid mineral assemblages: zoisite, epidote, plagioclase with variable composition (oligoclase-labradore-anorthite), garnet, actinolite, hastingsite, chlorite: T - 550-650°C; P - 2-3 kb.

Alpine high temperature local hydrothermal and scarnoid metamorphism (M_4); epidote-pyroxene-olivine-garnet crystal aggregates in some open fissures among the amphibolites and corundum-sapphirine mineralization, T 600-800°C; P 1-2 kb and retrograde dynamometamorphism in greenschist facies along some dislocation zones.

PRECAMBRIAN AND PHANEROZOIC DEVELOPMENT OF THE RHODOPE MASSIF METAMORPHIC BASEMENT

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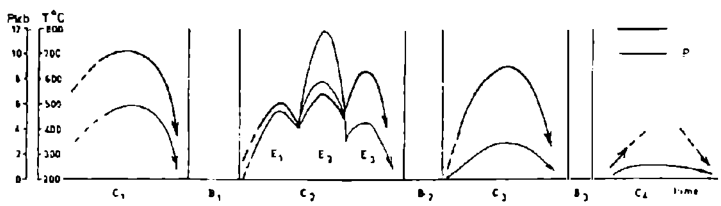
The proposed review of the internal structure and polycyclic metamorphic development of the Rhodope Massif (RM) basement is based chiefly on real established geological data. A complex of reliable criteria have been used to reconstruct primary rocks composition and relationships of the lithostratigraphic units, sequences and features of different metamorphic events, periods of breaking, marked by transgression, igneous intrusions or discordance. Several periods of development of RM basement can be divided (fig):



First Precambrian cycle (C_1):-formation of an infracrustal complex - the Prarodopian Supergroup (PRS), consisting of highly reworked para-and orthometamorphic rocks; metamorphism culminating in the high temperature amphibolite facies with migmatization and probably several stages of aplite-pegmatite or granite segregations; T-600-750°C, P-4-6 kb.

Breaking period (B_1): erosion and weathering of PRS; transgression and obduction of ophiolitic oceanic crust fragments over PRS; pelitic-calcareous sediments, containing microfossils of Riphean age, covering Ophiolites.

Second Precambrian cycle (C_2): regional metamorphism generally into amphibolite facies and synchronous folding of the Rhodopian Supergroup (RS), consisting of amphibolites, mica schists, marbles and quartzites; three syntectonic metamorphic episodes, marked by three consequent mineral assemblages, separated by deformation; increasing temperature and decreasing pressure tendency in RS: mineral indicators: E_1. garnet-staurolite schists , T - 480-540°C; P - 4-6 kb; E_2. garnet-kyanit-chloritoid-phengite schists, T - 480-550°C; P - 4-8 kb; eclogitization in local shear zones in the Ophiolites: omphacite-garnet-rutile eclogites and pyrope-diopside-enstatite spinel segregations in serpentinites, T - 450-550°C; P - 9-12 kb; E_3. biotite-muscovite schists and folded migmatized amphibolites, T - 560-620°C; P - 3-5 kb; complete consolidation of basement in an integral lithological system, consisting of two sequential-stratigraphical units-lower Prarodopian and upper Rhodopian Supergroups, folded together in vertical, inclined or recumbent folds.

Breaking period (B_2): block disintegration before Vendian, because a Vendian-Cambrian diabase-phillitiod complex (570-650 Ma) in greenschist facies covered discordantly peripheral parts of RM.

Hercynian cycle (C_3): igneous activity (340-240 Ma), represented by the so-called Southbulgarian granitoid intrusions, crossing Precambrian fold and block structures; granitization, aplite-pegmatite injections and contact metamorphism in the RS schist, assimilation of ophiolites in the halo around batholits, T - 550-650°C; P - 2-3 kb; partial remobilization in the PRS gneisses (310-320 Ma).

Breaking period (B3): erosion and transgression; Permo-Triassic conglomerates, containing fragments of RS metamorphites and granitoids.

Alpine cycle (C_4): Late Cretaceous (91-85 Ma) collision granitoid magmatism, aplite-pegmatite veins, crossing older metamorphic schistosity; local contact and hydrothermal metamorphism; formation of Paleogene depressions and local decolement thrust along its margins and peripheral slopes of RM; retrograde dynamometamorphism along thrust and fault zones; Paleogene (37-32 Ma) volcanic and subvolcanic bodies, cutting the completely consolidated. basement; partial remobilization of PRS gneisses and effects of reheating on radiogenic systems, more distinctly expressed in Central and West RM.

CITY DUST (PM10) COMPOSITION AS AN IMPORTANT TOOL OF PLANING A TOWNS ENVIRONMENT: MINERALOGY, LEAD-ISOTOPE AND PAH-COMPOSITION IN VIENNA

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The air and the fine dispersed dust particles, with major contributions of the geological environment, are important for the well being and the prosper development of inhabitants of major cities. The knowledge about sources and composition of emitted fine dust are important for planing and sustainable development of larger towns.

Due to improved filtering techniques industry reduced the coarse dust emission considerably in Central Europe, the very fine grained (< 10 μm) and more dangerous dust emission stayed constant or has even increased. Because of their small size as well as their shape, dust particles may be particular harmful to the human respiratory system.

High concentrations of some minerals themselves (asbestos, quartz etc.) or the high heavy metal content as well as carcinogenic organic compounds (PAH's) frequently attached to them have noxious effects.

The most important natural and manmade particle sources in urban environments are materials eroded by wind (soils, construction materials), as well as industrial and traffic emissions. Speculation about their sources has mostly been on the basis of chemical information only. Very little is known about their mineral and organic phases. In order to interpret the physical properties of particles, their environmental behaviour and the health risks they may pose in future, the combined information of chemistry and mineralogy is essential.

Methods

The very fine-grained particles have been collected on "low blank" cellulose nitrate and glassfibre filters in a high volume sampler (Stroehlein) or in a cascade impactor (CMI).

In order to observe long term changes samples have been taken from the filter of an air condition in intervals of 3-5 month from 1991-1995. These samples have been dry-screened < 20 μm in order to make them comparable to the PM10 filter samples. Mineralogical composition was analysed by x-ray diffraction, FTIR and SEM. The trace element and Pb-isotope composition was obtained by dissolving parts of the filters and subsequent analysis with ICP-MS. Glassfibre filters were extracted with supercritical CO_2 and the PAH were analysed with GC-MS.

Results

The dust samples consist of calcite, dolomite, quartz, organic matter (+ soot), and gypsum as major phases, whereas illite-mica, chlorite and feldspar are minor phases (<5%). Magnetite, goethite, brushite and epsomite were detected as well. Winter samples are more enriched in calcite, dolomite and gypsum compared to samples collected during summer. The considerable enrichment in As, Cd, Pb and Zn, compared with the mean crustal composition, as well as the lead isotope-ratios (207/026) indicate a fair mixture of emissions from heating and gasoline combustion during winter and a dominance of the latter during summer. The PAH-pattern support the conclusion drawn from the heavy metal analysis.

The most prominent change during 1991-1995 is the considerable decrease in lead content, due the stop of leaded gasoline during this period.

GROUNDWATER QUALITY IN AUSTRIA
UNIQUE GROUNDWATER MONITORING SYSTEM

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Background

Groundwater is one of the most important drinking water resources in Europe as well as in other parts of the world. The existing European regulations set high priorities to protection of the ground water for drinking water supply (EEC). In Austria more than 99% of the drinking water is abstracted from groundwater. About 50% are supplied from quaternary and tertiary sediments (porous media) and 50% from carbonate and crystalline rocks (Karst and fractured aquifers) of variable ages. The sedimentary basins are densely populated areas with agricultural and industrial use. The Karst and fractured crystalline rocks are mainly in more remote Alpine areas with partly intense touristic use. Due to their particular structure karst aquifers are more vulnerable to pollution than groundwater in porous aquifers. However, the resulting complexity of the properties and the dynamics of various aquifers makes it even more important to run a monitoring system to unravel pollution sources at an early stage in order to give time to set preventive measures.

The Austrian water quality monitoring system (AWQMS)

New legislation and administrative procedures concerning water pollution are the basis for the AWQMS for ground water and running water since 1990. Federal and provincial authorities as well as a large number of private laboratories are involved in the monitoring system itself.
As part of this AWQMS (altogether 2000 sampling sites) for pore-water (1782 groundwater wells) a sampling density of about 10 km^2 per sampling site for most important aquifers is achieved. Monitoring wells, domestic wells, industrial wells and water supplying facilities are used as sampling sites. The density of the sampled springs in karstic and fractured rocks (237 springs) is about 100 km^2 / per sampling site. The selection of the sampling site was based on hydrological, geological and geochemical knowledge of experts.
All wells and springs are generally sampled four times a year since 1991. Special attention is paid to standardisation and analytical quality assurance. Considering the aim of the AWQMS, the design of the monitoring network (e.g. location of the sampling sites) and the administrative framework of the AWQMS integrates elements of background, impact, trends and compliance monitoring.
The private laboratories for the analytical investigations of about 80 physical and chemical parameters per sample are selected on the best offer basis. The quality assurance and control is guaranteed by round robin tests edited by a central laboratory. The total annual costs for sampling and analytical work are about 2.9 Mio ECU. The rapid access to data of every parameter and sampling site is provided by inter-net (**http://www.ubavie.gv.at)** biannual expert reports.

THE AGE OF HYDROTHERMAL ALTERATIONS IN CENTRAL SLOVAKIAN NEOVOLCANITES

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Products of hydrothermal alterations connected with multistage metallogenesis of precious and base metal ores of various genetic types from two main Slovak stratovolcanic structures (Banská Štiavnica and Kremnica) were studied in details by X-ray diffraction (XRD) and K-Ar methods. Hydrothermal clays collected for the study could be assign to advanced argillic alteration, mesothermal and epithermal vein precious and base metal mineralizations and stockwork/disseminated base metal mineralization. The only mineral phase of analyzed alteration products is illite or mixed-layer illite-smectite. Polytype modifications of analyzed illites determined by XRD show differences among the set of studied samples. $2M_1$ polytype was identified only in illitic products of advanced argillic alteration of Banská Štiavnica stratovolcano, mesothermal vein and stockwork/disseminated mineralizations of the same stratovolcanic structure show a mixture of both $2M_1$ and 1M with $2M_1$ dominant. Finally illites of epithermal vein mineralization products have only 1M polyptype. Data obtained by K-Ar analyses are consistent for all samples and show that the time of hydrothermal alterations was about 2 Ma. The oldest is advanced argilic alteration of Banská Štiavnica stravolcano and the youngest is illite-smectite forming alteration connected with epithermal vein mineralization of Kremnica stratovolcano. The most important data are summarized in the following table:

Mineralization	Stratovolcano	Polytype modification	K/Ar age (Ma)
Advanced argillic alteration	BS	$2M_1$	12.4 ± 0.1
Mesothermal vein precious and base metal	BS	$2M_1$ » 1M	11.9 ± 0.3
Stockwork/disseminated base metal	BS	$2M_1$ » 1M	11.5 ± 0.3
Epithermal vein precious and base metal	BS	1M » $2M_1$	11.4 ± 0.2
Epithermal vein precious and base metal	K	1M	11.1 ± 0.1
Epithermal vein precious and base metal	K	1M	11.03 ± 0.1
Epithermal vein precious and base metal	K	1M	10.4 ± 0.2
Epithermal vein precious and base metal	K	1M	10.1 ± 0.2

BS=Banská Štiavniva, K=Kremnica

TIMING OF THE DITRAU ALKALINE INTRUSIVE COMPLEX

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For the emplacement of the Ditrau Alkaline Intrusive Complex (DAIC) the following timing is suggested by available K-Ar and ^{40}Ar- ^{39}Ar ages (BAGDASARIAN, 1972; STRECKEISEN & HUNZIKER, 1974; MÎNZATU et al., 1981, PÁL-MOLNÁR & ÁRVA-SÓS, 1995; DALLMEYER et al., 1997). The proposed scenario fits the actual state in DAIC investigation and regional geology.

c.230 Ma - Carnian *(231-227 Ma ^{40}Ar- ^{39}Ar Hornblende ages and 235-225 Ma overlapping interval for K-Ar hornblende ages of gabbro and hornblendite).* On the South-European passive continental margin, a mantle derived gabbroic magma raised up due to mantle plum activity related to the Middle Triassic extensional stage (DALLMEYER et al., 1997). The ascending magma contained ultramafic mantle xenoliths, represented by olivine bearing pyroxenites. These rocks were accommodated to crustal conditions by metasomatic changes with the gabbroic magma and by partial hydration; they were partially or completely transformed into hornblendites by „amphibolization"

c.215 Ma - Upper Norian *(216-212 Ma overlapping interval for biotite K-Ar ages of granites and hybrid gabbro-diorites, hornblendites).* Emplacement of a crustal syenitic magma. Prevailing foliated syenitic and hybrid rocks suggest deep intrusion level and dynamic regime. Hybridisation by mixing and mingling of the syenite magma with the previous gabbroic intrusion, in a nearly subsolidus stage, produced a suite of foliated, grading to massive, dioritic, monzodioritic and monzonitic rocks. Assimilation of crustal quartz rich rocks near the intrusion level gave gradual transitions to quartz monzonites and quartz syenites. For granitic DAIC rocks formed in this stage a larger crustal assimilation below the intrusion level may be assumed. Veining by granite-aplitic rocks supports this interpretation.

c.160 Ma - Callovian-Oxfordian *(165-155-Ma overlapping interval for biotite K-Ar ages of nepheline-syenites, hornfelses, hybrid foid gabbro-dioritic and hornblenditic rocks, and K-Ar whole rock ages of tinguaites).* A nepheline-syenite intrusion formed a „central stock", but also penetrated laterally towards marginal parts of the massif and veined all previously formed DAIC rocks. In late stages it developed locally to pegmatoid facies. Basic foid-rocks („ditro-essexite") formed by hybridization and partial metasomatic substitution of previous gabbro-dioritic rocks. The magmatic activity ended by late tinguaite veins. The nepheline-syenite event may be correlated with the Jurassic extensional stage that produced the separation of the Bucovino-Getic microplate from the European margin by opening of the Civcin-Severin rift- and spreading-system. The nepheline-syenite emplacement ends subsequent to the earlier Lias alkaline volcanism, that was active more to the south (Holbav).

Cooling up to c.135 Ma - Berriasian *(140-130 Ma frequency peak for biotite, feldspar and whole rock K-Ar ages recorded in prevailing altered nepheline-syenites and syenites, but also in granites, gabbro-diorites, hornblendites and hornfelses).* A cooling period, lasting for about 20-25 Ma, supports the assumption of a deep crustal intrusion level. Late- and post-magmatic hydrothermal-metasomatic alterations produced peculiar varieties of nepheline syenites and pegmatites with cancrinite and sodalite („ditroit").

Nappe transport and uplift up to c.115 Ma - Aptian *(120-110 Ma frequency peak for youngest biotite, feldspar and whole rock K-Ar ages in nepheline-syenites, syenites, granites, hornfelses).* Definitive closing of the Ar-system by cooling below Ar release temperatures is due to tectonic uplift. It may be assumed that hydrothermal alteration (liebneritization) and mineralization still developed up to this time. Meso-Cretaceous uplifting of the DAIC is proved by its uppermost (Bucovinian) position in the pre-Cenomanian nappe pile of the Central East Carpathians.

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TECTONICS AND SOURCE AREAS OF THE CARPATHIAN FLYSH BELT

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The Magura Flysh area is on the contact of the Bohemian Massif and the West Carpathians. The data in this area include results from a number of deep boreholes (up over 6 km deep) and an extensive complex of geophysical measurements. The analysis of frequency characterics of seismic and gravity data will bring the data about composition of density balanced cross-sections of the upper layer of the crust along selected seismic profiles and tracing of tectonic elements.

The impact of the thrusting of the Alpine nappes on the deformation of the crystalline complexes and their sedimentary cover will be studied. Geochemical investigation of rocks is focused to the compounds which give the best evidence of the sedimentary environments and postdepositional alterations under increased temperature and pressure. Organic matter and clay minerals are the most sensitive indicators of these factors. The sedimentological research will include taxonomic detailed research of selected leading and index species and testing their stratigraphic range using planktonic foraminifers and nannofossils. Thanatocenosis of the foraminifers will be used especially for the dating of the paleooceanographic events and for the correlation of the sedimentary areas of the Flysh Belt units. Conglomerate layers of the Magura Flysh contain locally abundant granitoid pebbles. The ages of three granite pebbles were roughly constrained using chemical monazite dating. The ages fit to the Devonian - Carboniferous boundary. The age and geochemistry of the granite pebbles from the Magura flysh are similar to the Variscan I/S transitional granites of the West Carpathians. Several hundreeds of microprobe analyses of detrital garnets were evaluated. Generally great similarity among detrital garnet assemblages of the Upper Viséan graywackes (Moravo-silesian Culm) and of the Paleogene sandstones was observed. A synthesis of new data in a geodynamic model of evolution of the Magura nappe will formulate which will include mechanism of basin opening and filling, orogenesis and formation of nappe structures.

GEOPHYSICAL AND GEOLOGICAL MODEL OF THE CARPATHIAN FLYSH BELT AND ITS SUBSTRATUM

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The Flysh Belt area is on the contact of the Bohemian Massif and the West Carpathians. The data in this area include results from a number of deep boreholes (up over 6 km deep) and an extensive complex of geophysical measurements. The analysis of frequency characterics of seismic and gravity data will bring the data about composition of density balanced cross-sections of the upper layer of the crust along selected seismic profiles and tracing of tectonic elements.

Analysis of the frenquency od seismic and gravity data belongs to recent geophysical research techniques. This technique makes it posible to identify from the seismic and gravity data rather low-amplitude structural-tectonic features. The method is based on combined analyses of the reflectance image of the derived gravity field and of the changes of the seismic echogenity.

Methods: - completion of gravity and derived gravity maps ;
- calculation of Linsser indications of density contacts;
- completion of reflectance images of the gravity field;
- analysis of selected time seismic sections;
- mapping of tectotnic features through combined anlysis of seismic and gravity data;
- examination of the digital model of the topography;
- composition of density balanced cross-sections along selected seismic profiles.

The main aim will be the construction of a model of the geological setting of the Bohemian Massif and the Carpathians contact region and the reconstruction of the development of the whole region in space and time. Especially important we consider a further advancement in the knowledge of the structure and development of the nappe units of the Carpathian flysh belt. The impact of the thrusting of the Alpine nappes on the deformation of the crystalline complexes and their Paleozoic cover at the eastern margin of the Bohemian Massif will be studied. Sorting the Cadomian, Variscan and Alpine structural elements at the eastern margin of the Bohemian Massif adjacent to the West Carpathians and evaluating their importance.

PALAEOECOLOGICAL AND PALAEOBIOGEOGRAPHICAL DISTRIBUTION OF THE TITHONIAN-BERRIASIAN BRACHIOPODS IN THE CARPATHIAN TETHYS

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Tithonian and Berriasian brachiopods which were reported from various calcareous facies of the northern margin of Tethyan basins allow to reconstruct the palaeobiogeography of this area. Their distribution in the individual zones is decisively controlled by environmental-facial and bathymetric factors.

Latitudinal facies zones of the Pieniny Klippen Belt Basin (PKBB) (Inner Carpathians), which correspond to the recently distinguished successions, include both the shallow- and deep-water limestones. In the shallowest, northern part of the PKBB the submarine Czorsztyn Ridge (Czorsztyn Succession), includes ammonitic-brachiopodal coquinas and organodetritic limestones with very abundant brachiopods (dominated by *Zittelina* and representatives of *Pygope* and *Nucleata*). Simultaneously, in the axial part of the PKBB typically basinal sediments of the Maiolica facies (widespread in the Tethyan area) have been deposited and are characterized by the paucity of macrofossils from which only single examples of *Pygope* were found. Pygopids are usually interpreted as deep-water organisms even considered as characteristic for poorly oxygenated bottom. Their deep-water preference, could be indicative of colder rather than warmer waters, e.g. in the upwelling zones. Another possibility is that they inhabited shallow zones of seamounts. An upwelling mechanism at the Jurassic/Cretaceous transition to explain wealth of animal life in the Czorsztyn Succession at that time. Mass occurrence of brachiopods in this succession was probably controlled by upwelling-induced trophic relationships which resulted in the intense growth of benthic organisms. At the same time, great changes occurred in oceanic water circulation in the Western Tethys caused by reorganisation of the Eastern Tethys, which resulted i.a. in mass appearance of calcareous nannoplankton that gave rise to the Maiolica facies.

On the other hand, the qualitative and quantitative composition of isochronous brachiopod assemblages and their diversity indicate different bathymetric ranges of species. In this sense the representatives of *Pygope* were eurybathic organisms, opportunistic r-selected taxa widespread in the whole Western Tethys, which could inhabit both shallow (e.g. ammonite-brachiopod coquinas, and brachiopodal limestones), deeper environments (e.g. red nodular limestones of Ammonitico Rosso facies) and deepest ones (e.g. cherty limestones of Maiolica-type facies). The remaining, more or less stenobathic species, equilibrium K-selected ones (*Monticlarella*, *Karadagithyris*, *Lacunosella* and *Dictyothyropsis*), showed much more restricted depth range in the PKBB. The rarity of *Nucleata* and *Monticlarella* in the Ammonitico Rosso facies seems reflect proximity of the lower limit of their bathymetric range. For most of brachiopods the appearance of „barriers" - e.g. depth of the basin, continents (cordilleras) and/or unfavourable sea-floor type hampered their migration to the other parts of the Tethyan basins.

Reef and reef-like limestones (so-called Štramberk limestones) are known from the flysch sediments of the Outer Carpathians where they occur exclusively as olistoliths or exotic fragments. In the Štramberk limestone, the assemblage of brachiopods is characteristic for reefal and inter- and/or peri-reef environments, with the genera *Septaliphoria*, *Juralina*, *Weberithyris* and *Tropeothyris*, with small, epibiont brachiopods (craniids and thecideids), and with dominating rhynchonellid *Lacunosella hoheneggeri*, however pygopids are rare.

Considering the distribution of brachiopods during the Tithonian-Berriasian, the Carpathian sector appears to be a paleobiogeographically rather isolated part of the Tethys. Although the fauna shows typically Mediterranean features, the northwest European influences are locally evident, especially prior to the Tithonian. Mass occurrence of brachiopods over the intra-oceanic Czorsztyn pelagic swell, and on its southern slope was limited from the north and the south by deep-water troughs in which pelagic limestones of Maiolica facies formed. These troughs impeded the migration of brachiopods. The endemic character of some species as a result of their susceptibility to environmental stress (bathymetric, facial, deposition rate changes) was also controlled by migration at larval stage.

CRETACEOUS UPWELLING IN THE NORTHERN MARGIN OF WESTERN TETHYS

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Breakup of Pangea during Jurassic and Cretaceous times created a system of rifts along the northern Tethyan margin extending from France and Switzerland to Afghanistan. Some of these rifts developed into oceanic basins with underlying oceanic crust. Others developed on attenuated/transitional continental crust and turned into aulacogenes. The basins were separated from main Tethys ocean by several plates and ridges like Brianconnais, Czorsztyn, Moesian and Rhodope plates, Pontides, Armenian and Lut plates. Partial uplift of main European plate and late Kimmerian orogeny resulted in establishment of restricted conditions in the marginal Tethyan basins. The paleogeographic and paleoclimatic setting favoured upwelling along the ridges and continental margins. Firm evidence for upwelling was provided by detailed studies of Berriasian, Valanginian and Albian/Cenomanian? sediments of the Pieniny Klippen Belt (PKB) in Poland and Slovakia.

The PKB includes Mesozoic and Paleogene rocks strongly folded during Late Cretaceous and Tertiary orogeneses. The Mesozoic deposits are represented by various limestones (e.g. crinoidal, nodular - Ammonitico Rosso-type, ammonite-brachiopod coquina, calpionellid, crinoidal-brachiopod, and cherty-Maiolica-type), radiolarites, shales and siliciclastic turbidites formed in the basin which belonged to the Alpine-Carpathian part of the northern Tethys. The PKB Basin is characterized in the palinspastic reconstruction by latitudinal facial zones (Klippen successions), and those in turn correspond to ridges (pelagic swells) and troughs in the basin. The ridge was uplifted as the result of extension during Jurassic supercontinent breakup. The gradual tectonic uplifting of the Czorsztyn Ridge, particularly in the post-Tithonian time (Neo-Cimmerian movements), caused a significant shallowing over the vast territory where the Czorsztyn Succession was deposited. The resulting shallow submarine ridge separated various zones of oceanic currents what could lead to the formation of upwelling. The presence of phosphate-rich deposits (phosphorites and microbial phosphate structures macrooncoids) in the Berriasian of the Niedzica Succession (Jaworki village - Poland), localized in a palinspastic reconstruction near shelf-edge/slope boundary, supported this idea. On the other hand the condensed, lowermost Valanginian deposits of the Czorsztyn Succession contain ferruginous crusts, glauconite grains and concentrations of ammonite shells, and are rich in small ferruginous-phosphatic nodules, and also small limestone clasts coated by microbial phosphatic stromatolites. Additionaly, the oldest part of the Puchov marls (Albian/Cenomanian?) of the Czorsztyn Succession (Dursztyn-Poland, Vrsatec Castle-Slovakia) contain thick phosphatic stromatolites which occur on the unregular surface of the Neocomian limestones.

In the Pieniny Klippen Belt Basin this suggestion is additionally supported by the massive occurrence of the Tithonian-Berriasian brachiopods and crinoids in the Czorsztyn Succession. The distribution of these fauna was probably controlled by upwelling-induced trophic relationships which is resulted in the intense growth of invertebrates on the ridge, where nutrient-rich oceanic water formed such conditions which caused the proliferation of benthos. Probably similar type of circulation took place during Cretaceous and Paleogene in northernmost parts of the Outer Carpathians basins. It suggests occurrence of regional Cretaceous horizons of phosphorite concretions which originated on the submerged swell (Subsilesian Ridge). On the other hand, the mass occurence of radiolarian fauna within Paleogene variegated shales indicates high primary organic production. Most likely it was due to increased supplay of nutrients carried by cold currents from deeper parts of the basin. Changes of foraminifera/radiolarian ratio during Paleogene presumably reflect fluctuations of intensity of upwelling currents. Additionally, abundant glauconitic grains within siliciclastic turbidite deposits are the evidence for their mass occurence in source area (Marginal Northern Cordillera).

The authors used PALEOCLIMATE program to model global atmospheric pressure, derive paleo-wind directions and estimate the likelihood of upwelling. The program is based on the paleoclimatic methods first developed by Judith Parrish, adopted by C.R. Scotese and modified by M.I. Ross. The maps depict air pressure, wind directions, humid zones and areas favorable for upwelling conditions plotted on the paleogeographic background. The outline of paleogeography during Tithonian-Berriasian was used as input for paleoclimatic modeling. Paleoclimate modeling suggests that prevailing Jurassic/Cretaceous-Paleogene wind directions (from south-southwest) in the northern Tethys area were parallel both to the axis of Czorsztyn Ridge and Pieniny Klippen Belt Basin and also Outer Carpathians one.

TITHONIAN CRUSTACEANS (DECAPODA: BRACHYURA) FROM THE ŠTRAMBERK-TYPE LIMESTONES OF THE CARPATHIANS

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The Štramberk limestones are present as limited sized klippen-like occurrences in Moravia (Štramberk, Czech Republic), Austria, Romania or as olistholites and small exotic fragments in Slovakia and Poland. In Poland the Tithonian Štramberk-reef facies is known only from exotic material occurring within the Upper Cretaceous-Paleogene strata of the Outer Flysch Carpathians. The Štramberk-facies limestones represent the various lithofacial types of carbonate platforms, developed during Tithonian close to the northern shore of the Tethys and/or around intrageosynclinal cordilleras, present in the Jurassic/Cretaceous Outer-Carpathian basin of the Tethys. The assemblage of benthic organisms contains corals, thick-shelled bivalves, brachiopods and also numerous decapods (crabs (Brachyura): Prosopidae, Homolidae and also Galatheidae), among which prosopid crabs dominate (genus: *Pithonoton* (several species), *Longodromites*, *Nodoprosopon*, *Lecythocaris*).

Our knowledge on early, Mesozoic crabs is still rudimentary, based mainly on few findings. Despite the high number of modern crab species, about 4,500, we do not know much about their early progenitors. This is mainly due to their poor preservational potential of crustacean decapods. The Prosopidae is an extinct family, consisting mostly of Mesozoic species, almost exclusively known by carapace. Most probably it accommodates the ancestors of all brachyurans in the large sense. This family appeared in the late early Jurassic, one genus survived the Cretaceous/Tertiary boundary but disappeared at the end of the Danian.

The mode of life of prosopids, and therefore, brachyuran evolution started on moderately deep, soft bottom environment. The greatest expansion of prosopid fauna in carbonate environments took place during the late Jurassic, probably due to the vast expansion of sponge (Oxfordian), sponge-coral (Kimmeridgian) or coral (Tithonian) biohermal and reef structures in Europe. These crabs expanded rapidly all over Europe in the Oxfordian, corresponding to the distribution of sponge megafacies from Portugal, Spain, France, Germany, Poland to Romania. It was formed in the deep-neritic environment parallel to the northern margin of the Tethys. The Oxfordian prosopid crabs could live either probably within the rigid framework of sponge buildups or also in the inter- and/or peri-bioherm environments surrounding these structures. In turn, a regression in the peri-Tethyan area during the latest Jurassic resulted in changes of habitats and in colonisation of the Štramberk coral reefs developed during Tithonian close to the northern margin of the Tethys, where these crabs probably reached a climax. The deposition of the Štramberk limestones was probably in the littoral or sublittoral zone of a warm, rather quiet sea. Small prosopids might used the coral reefs as hiding places from potential predators, especially during a soft-shelled phase of moulting stages. The close relationship between crabs and massive, abundant corals was probably commensal in its character.

As long as the late Jurassic organic buildups were present with numerous cavities (rigid framework) within their structures, fine prosopid crabs could find a refuge from predators. On the other hand, the abundance of nutrients in such places facilitated food gathering and survival. The isolated occurrences of Upper Jurassic prosopids outside the centres of a „reef" sedimentation confirm additionally a low adaptability of this fauna to non-reefal palaeoecological conditions. When biohermal and reef facies retreated at the Jurassic-Cretaceous boundary, the favourable conditions for crab development also vanished, so the Cretaceous prosopids are rare and spatially dispersed. The Upper Cretaceous prosopids, in contrast to the Upper Jurassic species, seemed not to prefer any specific sedimentary environment, occurring both in siliciclastic and carbonate sediments. Therefore, they have not been concentrated in one palaeogeographical region with the domination of a specific megafacies, as it happened in the late Jurassic of Europe. So, prosopids had their climax during the late Jurassic time with a wide distribution in sponge and/or coral reef environments of Europe, probably developed under tropical and subtropical conditions in shallow, warm waters. The closely related descendants of them, homolodromiids, inhabited preferably soft muddy bottoms in deeper, colder waters. Some homolodromiids live actually deeper than 1000 meters.

FOUR TECTONIC STYLES IN THE NEOGENE OF YUGOSLAVIA
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FOUR TECTONIC STYLES IN THE NEOGENE OF YUGOSLAVIA

The territory of Yugoslavia was in the Neogene differentially involved in tectonic movements.

(1) The Dinarides, possibly with the Pannonian region, was cought in crust thinning before the wide rift event. Unlike the Pannonian region, where subsidence continued after the deposition of synrift products, the Dinarides were uplifted in the late Lower Miocene

(2) The region between the Dinarides and the Carpatho-Balkanides, including marginal belts of both mountain ranges, was dissected during the post-collision spreading into a broad rift. Tectonic style is proved by the type of volcanism. The spreading reached its maximum in the late Lower and early Middle Miocene, i.e. somewhat later than the movements in the Dinarides.

(3) The clockwise rotation of the Balkan peninsula southern half led in the Upper Miocene to dilatation over an extensive area from the Bulgarian midrange to the Vardar valley (and beneath the presentday Aegean Sea?) to Athens. These movements were of a smaller scale than the former two.

(4) Obduction of the Asia Minor over Balkan peninsula caused detachment of the thin crustal skin in the region roughly coincident with the one embraced by the third tectonic type. Prolonged pressure of Asia Minor caused insignificant folding even of Pliocene deposits. The very thin skin was partly eroded in the end of the Pliocene and in the Quaternary exposing "old" units of Dinaric trend which still moved slowly along the intermittent faults.

Nadežda KRSTIĆ

NEW PRINCIPLES OF CARTOGRAPHIC PRESENTATION OF GEODYNAMIC AND GEOTECTONIC PROCESSES OF THE EARTH CRUST DEVELOPMENT

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Principles, which are used nowadays for cartographic presentation of the processes changing structure and matter composition of the crust, were developed more than half-century ago. They were based on mapping of only upper (exposed) structural levels, because study of the deep-seated structure was still at its initial stages. Now there is a dense network of deep parametric bore-holes and a number of super-deep borings. A good foundation is formed for the forecast of the crustal structure and composition at a great depth. Rapid development of diverse geophysical techniques made it possible now to use data obtained through boring for production of 3D images of not only the sedimentary cover, but also of the ancient metamorphized basement within the continents and of the many-kilometer three-layered formations within the ocean basins.

Thus, the preconditions do exist for the small- and medium-scale geological mapping that would reflect the structure of not only the superficial crustal levels, but of the deep-seated ones, too. The maps would allow to trace dynamics of sedimentation, magmatism-metamorphism, fissure and fold dislocations for different geotectonic epochs available for the analysis. In other words, a possibility has occurred to make a kind of retrospection through the whole Phanerozoic (590-550 mil. years) and partially Riphean for a particular region.

The author, in cooperation with the staff of "Geoprohnoz", has developed a new legend for tectonic maps of small and medium scales. It enables to present actual structure, formational units, and paleogeodynamic environments of not only those structural levels that are exposed at the day surface, but also of the deep-seated ones. The legend allows to create a chronological series of maps and to demonstrate the latter in a desired combination. I.e., every single tectonic region can be autonomously characterized by the individual structural level, which is considered to be the most interesting from the point of view of geological history, or promising for mineral resources. These principles were used to compile the map of the main structural levels of the Carpathians, perspective for hydrocarbons. The map is in the scale 1:1500000 and acts as an example of the methodology application. In spite of a smaller scale, it is more informative than "The Geodynamic Map of Ukraine" published in 1993 in the scale 1:1000000.

The legend has a for of a matrix. The rows correspond to tectonic regions of platform and folded areas and embrace a significant number of elements (up to separate structural-formational zones, thrust sheets, depressions, etc.). The columns convey important geotectonic epochs and their temporal limits. The most important and original peculiarity of the legend is a chrono-stratigraphical correlation of structural-formational units of every tectonic element with the scale of the most important geotectonic epochs of the earth's crust development. This is achieved through the allocation of every structural-formational unit within the time span corresponding to the tectonogenesis epoch during which the former was formed (Baikalian, Caledonian, Hercynian, Cimmerian, Alpine).

Every tectonic element has its "visit card" in the matrix – a rectangular with a unique color fill corresponding to respective polygons of the graphic part of the map. The color is selected to indicate consolidation time of structural-formational units referring to the selected structural level. The shade of the color conveys structural autonomy of the tectonic region. Under such a "visit card" the whole formational column is located. The latter is controlled by temporal limits adopted for the respective event, and geodynamic environments of the formations' accumulation are shown. The header of the matrix contains names of every large tectonic element accompanied with a brief description of morphological peculiarities of its structure. For platform elements it is given separately for the basement and for the sedimentary cover. Conveyance symbols for the formational units are given separateiy.

The developed principles of mapping of geotectonic and geodynamic processes, which are embodied in the legend, are a vivid graphic material that conveys the most important information about tectonics of different regions. It also contains data about general structure, formations and geodynamic environments. The matrix allows to trace the development of every separate crustal element from the most ancient epochs to nowadays, and to compare it with the other tectonic regions – neighboring and remote. The legend could be viewed as a kind of an explanatory note to the map, which compactly reflects all the main features of structure and the geological history of development of prospective for hydrocarbon areas within Ukraine.

PALAEOGEODYNAMIC MAP OF UKRAINE AT THE SCALE 1:1 000 000

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A small-scale colorful geodynamic map of Ukraine in four tiles is compiled by a team of Ukrainian and Russian geologists (editors V. Pastukhov and L. Galetskiy). This is a first attempt of cartographic presentation of the structure and geodynamics at a national scale, made from the perspective of the lithospheric plates tectonics. It is a result of a long process of interpretation of a geological and geophysical material and compilation of an extensive series of structural, structural-formational, tectonic, palaeotectonic, palaeovulcanologic, mineralogical and some other maps and diagrams. Some of them have been created on a palinspastic geographic basis. Petrochemical and geochemical data, including distribution of rare lands as indicators of some geodynamic environments, were also widely used.

The area of Ukraine appears to be a unique geological test ground for diverse geodynamic studies. All the main structural elements of the earth crust are developed here: ancient and young platforms, aulacogenes and rifts, great depressions, ancient and young folded belts, pre-mountainous and intra-mountainous troughs, marginal seas regions. Within these geostructures there are elements that have been developed on different types of the earth crust - oceanic, transitory, and continental. Compilation of the geodynamic map was supported by a simultaneous creation and publication of two national-scope tectonic maps (with different legends) in the scale 1:500 000 consisting of 16 and 20 tiles. They were produced by almost the same team of authors.

The legend of the map is a matrix reflecting vertical and lateral correlations of complexes and formations developed at the Ukrainian territory from Early pre-Cambrian till Quaternary. Structural-substantial complexes are delimited on principles of the formational analysis. The complexes of Early pre-Cambrian are singled out through correlation of their rock associations with rock associations of indicating complexes for actual and Phanerozoic environments. Fractioning of small, rare, and rare land element has been considered. The map is classified as a palaeogeodynamic one according to the contents. Each main tectonic element within the Ukrainian territory is autonomously represented by the most important, from the point of view of geological history or perspectives for mineral resources, structural level-section. I.e., the fulfilled generalization appears to be a palaeogeodynamic map of the main structural levels of Ukraine. According to the criteria, geodynamics of the next sections is shown: pre-Upper Permian – the Dnipro-Donets Aulacogene, pre-Mesozoic – the Volyno-Podillya and the Ukrainian Shield, pre-Upper Cretaceous – the Northern Dobrogea and the Moldovian Depression, pre-Upper Neogene – the Crimea and the Black-Sea Region, pre-Quaternary – the Carpathians.

The delimited sections characterize Archaean complexes as well as formations of shelves, oceanic crusts, lateral rows of island arcs and of the LateArchaean-Early Proterozoic active continental margin of the Ukrainian Shield, of Proterozoic vertical and lateral rows of hot points, of continental plains, of the self and the slope of the Volyn-Podillya, of Paleozoic complexes of Dnipro-Donet Aulacogene. Within the zone of the Alpine folding the complexes and formations of the Moesian Microcontinent and of the Northern Dobrogea - the Steppe Crimea folded system of Early Cretaceous are marked out. The youngest Alpine lateral and vertical complex-and-formation rows are delimited within Jurassic-Neogene structures of the Carpathians and within the active continental margin of the Black Sea Region (the Mountainous and the Steppe Crimea, Pre-Black Sea depression).

The deep-seated structure of the lithosphere is presented on geodynamic profiles along geotraverses. Geodynamic models of the Ukrainian Shield and the Carpathians formation are shown additionally in a form of series of palinspastic sections.

The explanatory notes contain the methodology of the map's compilation, descriptions of lateral and vertical structural-substantial complexes and formations for every geostructural region, discussion on structural correlations and peculiarities of the latter. They also include the model of the Ukrainian lithosphere structure, developed on principles of the lithospheric plates tectonics. Distribution of some most important mineral resources is analyzed according to the delimited geodynamic environments and structural-formational palaeozones. Geodynamic environments and structures prospective for non-traditional types of mineral deposits are determined too.

MODERN GEODYNAMIC CONCEPT OF THE CARPATHIANS

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Performed in recent years, drilling and seismic work on the territory of the Carpathians, East- and West European Platforms, Transcarpathian region, as well as studies of the rock stresses in these areas allow to make several significant conclusions:

1. The whole complex of the Carpathian flysch is allochthonous. This is demonstrated in Eastern Carpathians by a regional seismic profile, which goes through the area of the Lopushna oilfield NE to the Marmarosh crystalline massif. The platform type Neogene to Jurassic deposits are identified on this profile at 6 to 7.5 km up to a distance of 190 km from the NE margin of Carpathians. In the territory of Poland in both E and W Carpathians, Neogene deposits are found under the flysch sequence by a number of wells in the Skole, Subsilesian, Silesian and Magura Units. At the southern slope of the Ukrainian Carpathians in the Pienniny Klippen Belt, overthrusts are identified in Svaliava. Southward, under the Vyhorlat-Hutynska volcanic belt, drilling and seismic data show the occurrence of Neogene deposits. Hence, the whole flysch complex of the Folded Carpathians from the Carpathian Foredeep to the Transcarpathian Deep is allochthonous.

2. In the Transcarpathian Deep the classic features of a collision zone are present. The main ones being: - fragments of ophiolites, which have been identified in the base of the Transcarpathian Deep and are known from surface in the Marmarosh Klippen Belt and elsewhere; - post-orogenic magmatism, which is clearly reflected by the Vyhorlat-Hutynska volcanic belt; - the intense increase in heat flow in the Transcarpathian Deep c.f. the heat flow of the Folded Carpathians; mixed fluids occurrences (oil, gas, mineral water); metallogenic mineralisation (barite, gold, mercury, polymetals); - large granitoids intrusions, identified recently in Badenian deposits; and - a significant elevation of the Moho from 55-65 km under the Folded Carpathians to 25-32 km under the Transcarpathians. Similar features from collision zones are known in E-Slovakian Depression, as well as in E and S parts of the Transylvanian Depression.

3. Rock stress vectors in the Eastern Carpathians have north-eastern direction; in West-European Platform - eastern and north-eastern directions and in the East-European Platform - northern and north-western directions.

These data, as well as data on geological structure of Alpidic Thrust belts in the region and their complex correlation show that formation of the Carpathian Arc is related to the movement of several plates and microplates. The movement of the African plate to the north-east through the Adriatic and Pannonian-Transylvanian microplates and oncoming movement of the Euroasian plate caused collision of Pannonian-Transylvanian and East-European microplates and formation of the East Carpathians, Carpathian Foredeep and Transcarpathian Deep. The movement of the Arabian plate through the intermediate Anatolian and West-Black Sea microplates caused the collision and formation of the Southern Carpathians. North-western directions of rock stress vectors in Volyno-Podillia, forming here the latitude direction highs of anticline structures and the present-day anomalies of the thermal field and small local earthquakes are evidently also related to this movement. The movement of the West-European microplate in eastern and north-eastern directions caused formation of the Western Carpathians, their foredeep and East-Slovakian Depression in their back part. Calculation of the weight of microplates at the convergent boundaries in collision zones shows small difference between them. Consequently, the detachment planes are subhorizontal and this causes the intense present-day heat flow in Pannonian and Transylvanian Depressions.

TRIASSIC CAI-DISTRIBUTION PATTERNS AND THEIR IMPLICATIONS FOR THE TECTONIC HISTORY OF NORTH SLOVENIA

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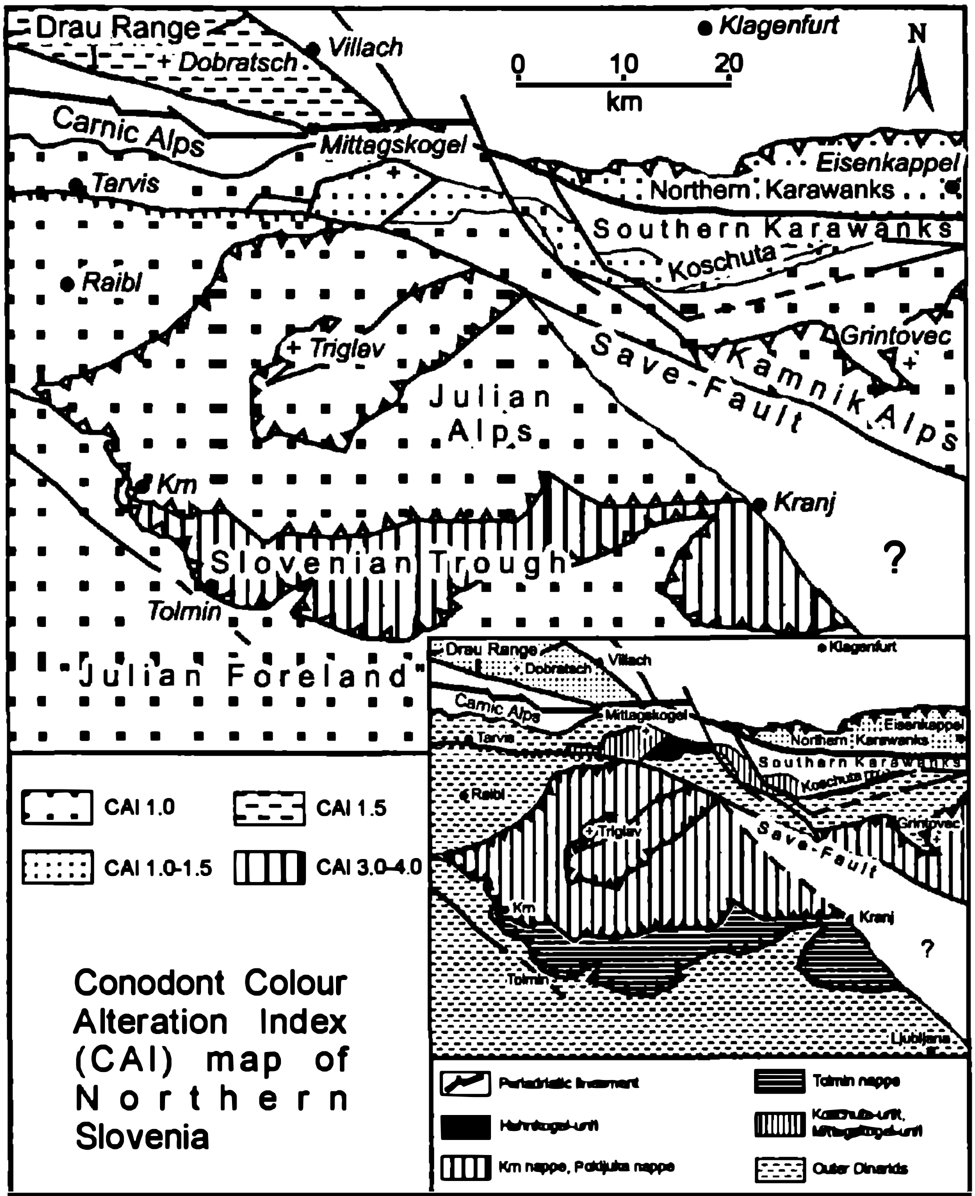
A CAI distribution map of Northern Slovenia shows predominantly low CAI-values (CAI 1.0-1.5) with the exception of a small, from Kranj to Tolmin E-Wtrending, tectonically isolated segment with much higher CAI-values (CAI 3.0-4.0). The latter corresponds to the Slovenian Trough which is tectonically sandwiched between the Outer Dinarids (= "Julian Foreland") and the Inner Dinarid equivalents (Julian and Kamnik Alps). Both Dinaric units show nearly the same thermic overprints as the units north of the Periadric Lineament (Drau-Range, Northern Karawanks - LEIN et al. 1997).
The contrasting high CAI-values of the Slovenian Trough are thus a proof of the allochthonous nature of this unit and confirm the tectonic nappe concept by KRYSTYN et al. (1994). Further studies have clear where and when the thermal overprint of the Slovenian Trough has happened and how it was transported onto the foreland from its original deposition area northwards of the Bosnian trough (KRYSTYN & LEIN in HAAS et al. 1995: Fig. 7)



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SUBSTANCE-GENETIC TYPES OF MANGANESE-BEARING ROCKS AND ORES OF THE UKRAINIAN CARPATHIANS

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Polygenic structure-formation complexes having the different ages (Pz -Q) containe numerous and genetically various manganese concentrations (minerals, rocks, ores, manifestations, deposits, having >1% MnO) which are various according to their age, geotectonical position, genesis, morphology, composition and other features, differentiated in time and space within the East Carpathians on the territory of Ukraine. The distribution of manganese concentrations within the territory of the Ukrainian Carpathians are very irregular and spotted.

The following manganese-bearing types of rocks and ores are noted. The ENDOGENIC types are: 1 metamorphosed, contact- and metasomatically changed; 2 - hydrothermal and hydrothermal - metasomatic. The EXOGENIC units are of some types. The marine and sedimentary-diagenetic type includs: 3 - isolated concretions and their accumulations, small lenses and interbeds, consisting of manganese carbonates; 4 - isolated concretions and their accumulations, small lenses, layers, accumulations, composed of manganous siderite; 5 - clayey, sand- and carbonate-clayey rocks (alevrolites, argillites, tuff-argillites, etc.); 6 - clayey sandstones, sandstones, silicified rocks and sandstones with carbonaceous cement; 7 -carbonaceous, clay- and sand-carbonaceous rocks, marls, limestones, dolomites. The continental sedimentary and volcanic-sedimentary type includes: 8 - limnetic-swamp iron (brown iron and siderite-bearing) ores; 9 - limnetic-swamp mineral paints; 10 - alluvial, alluvo-deluvial pebbles of manganese and manganese-iron carbonaceous ores; 11 - tuffes and tiffites. The hypergenic type (including crusts of weathering) has: 12 - mineral paints; 13 - ochreous, ferruginizated rocks; 14 - infiltration and infiltration-metasomatic hydroxided manganese and iron-manganese ores; 15 - infiltration-metasomatic and infiltration brown iron ores; 16 - infiltration-metasomatic and infiltration brown ores with siderite.

Every type from these groups have a different distribution in age, geotectonic and space aspects. They belong to Paleogene-Neogene (3, 5, 8, 10 types) age in the Near Carpathian depression; in the Flish Carpathians they are of Late Cretaceous - Eocene age and have Oligocene age in smaller degree, and in the Marmarosh massif they have Paleozoic (1-8, 10 types) age, in the Transcarpathians depression they are of Neogene age (2, 7, 9, 11 types). Crusts of weathering and other hypergenic formations (12-16 types) are being actively developed during Prequaternary and Quaternary times.

The following manganese minerals compose these types: 1 - hydroxides (psilomelane, barium psilomelane, manganite, vernadite, rancieite, etc.); 2 oxides (pyrolusite, rarely hollandite, etc.); 3 carbonates (rhodochrosite, manganocalcite, manganous ankerite, manganosiderite-oligonite, etc.); 4 - silicates and alumosilicates (rhodonite, pyroxmangite, manganous garnets spessartine and others, dannemorite, manganous pyroxenes of diopside-hedenbergite row, manganous ferrostilpnomelane, bementite, pyrosmalite, ilvaite, manganous chlorite, etc.) Silicates and alumosilicates are developed within metamorphic (including metasomatic) rocks, rarely in hydrothermal ones and they are in endogenic rocks as accessories or relics.

The three epoches of the most intensity manganese accumulation are fixed in the Ukrainian Carpathians: 1 - the Paleozoic (the Prealpian) one includs rhodonite-rhodochrozite primary-sedimentary metamorphic rocks and ores; 2 - the Cretaceous-Paleogene (the Middle Alpian) one includs manganese chemogeno-sedimentary rocks and ores; 3 - the Quaternary crusts of weathering and other hypergenic formations.

Manganese sources are multiformed on their nature and genesis. On their own base they are related to the following two types: 1 - crusts of weathering, developed in source areas including volcanogenic formations. This source prevail under the formation of the Mesozoic-Cenozoic strata; 2 volcanogenic and volcanogeno-sedimentary type, which is a base type under the creation of manganese concentrations in the Paleozoic strata and it is an auxiliary one in the Mesozoic-Cenozoic formations. Metamorphogenic (including metasomatic) and hypergenic (including infiltration-metasomatic) manganese concentrations are being created owing to transformations of early created manganese accumulations. This is manifested in the transformation of their mineral composition under limited (local) displacement of manganese as chemical component.

*Ramo Kurtanović

MORPHOGENETIC CHARACTERISTICS OF POLYMETALLIC MINERALIZATION IN THE BOROVICA-VAREŠ ORE ZONE (MIDDLE BOSNIA)

This ore zone, located in North Bosnia, stretches from the Gornja Borovica village in the Northwest to villages Pržići and Brgule Southeast of Vareš town.

Occurrences of various ore mineralizations within the zone was attractive for numerous investigators. However, the exploration interest was focused to iron deposits and polymetallic barite mineralization.

Long-lasting mining activity on the iron ores made possible a knowledge on controlling factors of their mode of occurrence, morphological and genetical characteristics. It was concluded that this is a syngenetic mineral deposit genetically related to the Triassic magmatism:

It is quite obvious that polymetallic barite deposits are not in a direct genetical connection with the iron mineralization. It could be concluded that the polymetallic - barite mineralization have predominantly epigenetic features of are bodies. Besides that, based on the composition of major and subordinate ore and gangue minerals, and accompanied elements participating in the compositica of ore mineralization, the iron mineralization is diametrically different thaw the polumetalic barite mineralization. It is without doubt that the original igneous complexes producing ore solutions have not been same for the iron mineralization and polymetallic barite mineralization.

The original Triassic magmatic complex that gawe ore selections the iron mineralization must have been of a basaltic composition.

Composition of the original magmatic complex which produced ore solutions for the polymetallie - barite mineralization must have been more acidic probably
composition andesitic than the original magmatic complex of the iron mineralization.

Age of the original basaltic complex which produced ore solutions for the polymetallic - barite mineralization, is obviously younger than the one producing the iron mineralization.

Morphological shapes of ore bodies area a consequence of mutual relations of lithological units and structural features of the geological space in which ore mineralizations originated. Basic spatial characteristics of deposits show that the polymetallic - barite mineralizations have basically epigenetic characteristics which indicate that the ore deposits originated after definitive consolidation of the adjacent country rocks.

The epigenetic characteristics of spatial occurrence of the polumetallic ore bodies represent additional evidence that they were spatially and temporally originated under different conditions when compared with Triassic iron mineralizations. The latter represent a younger post - Triassic mineralizations.

In polymetallic mineral paragenesis, barite, galena, sphalerite and pyrite predominate over antimonite, chalcophycite, cinnabarand some other minerals. The mineral paragenesis is defined by mineralogical, major - and trace - element and some other analyses.

Polymetallic barite mineralizations occur in different lithological units and they are particularly common in contact parts between underlying limestones and overlying siltstones. Such occurrences are characteristic for the Rupice and Beovača mineral deposits. The mineralization which occus in such contact areas represent comparatively large mineral deposits.

Key words: Vareš, polymetallic mineralization, iron mineralization, syngenetic and epigenetic ore bodies.

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STRUCTURAL EVOLUTION OF PENNINIC BASEMENT THRUST SHEETS IN THE TAUERN WINDOW: IMPLICATIONS FOR MESOZOIC PALEOGEOGRAPY OF THE EASTERN ALPS

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The Penninic oceanic sequence of the Glockner Nappe and the foot-wall Penninic thrust sheets of continental basement exposed within the Tauern Window (Eastern Alps) have been investigated in detail. The basement slices are covered by sedimentary sequences of different geodynamic settings. These units are incorporated into a nappe stack that was formed during the collision between a Penninic Zentralgneis block in the north and a southern Austroalpine block. In the foot-wall the Venediger Nappe and the Storz Nappe are characterized by metamorphic Jurassic shelf deposits (Hochstegen Group) and Cretaceous flysch sediments (Kaserer and Murtörl Groups). In the hanging-wall the Eclogite Zone and the Rote Wand - Modereck Nappe comprise Permian to Triassic clastic sequences (Wustkogel Quartzite) and remnants of platform carbonates (Seidlwinkl Group) as well as Jurassic volcanoclastic material and rift-sediments (Brennkogel Facies), covered by Cretaceous flyschoid sequences. The Permian to Jurassic evolution documents an extensional regime. Rifting within a simple shear regime resulted in the formation of an oceanic basin (South Penninic Glockner basin). The units that are incorporated within the Rote Wand - Modereck nappe probably formed an extensional allochthon within this basin. Nappe stacking was contemporaneous to and postdated subduction-related (high pressure) eclogite and blueschist facies metamorphism. Emplacement of the eclogite-bearing units of the Eclogite Zone and the Glockner Nappe onto Penninic continental units (Zentralgneis block) occurred subsequent to eclogite facies metamorphism. The Eclogite Zone, a former extended continental margin, was subsequently overridden by a pile of basement-cover nappes (Rote Wand - Modereck Nappe; former extensional allochthon). An alternative explanation for the emplacement of this unit is a ductile out-of-sequence thrust. Low-angle normal faults that have developed during the Jurassic extensional phase might have been inverted during nappe emplacement.

GEOLOGICAL AND GEOPHYSICAL INTERPRETATION OF GRAVITY AND MAGNETOTELLURIC DATA ALONG SUPKOV-JAROSLAW PROFILE, POLISH OUTER CARPATHIANS

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MESOCENOZOIC THERMAL EVOLUTION OF THE EAST CARPATHIANS

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The thermal field of the Carpathian region is featured by a high differentiation. The heat flow (HF) varies from 35 to 110 mW/m^2. It increases from the ancient East-European platform toward the (intracarpathian region. Maximal values are recorded in the Pannonian basin and the Transcarpathian trough. The HF level suggest separation of three geothermal zones corresponding with three main tectonic elements: Precarpathian trough Fold Carpathians and intracarpathian depressions formed at the alpine stage of the East-Carpathian region evolution. This law shows that it is mesocenozoic tectonic events which defined the present character of the thermal field.

Within some geothermal zones the thermal field is inhomogeneous. Several different — scale anomalies of different nature and intensity are distinguished. In particular, an anomaly of high values is distinguished against low HFs in the NW Precarpathian trough. Several anomalies are distinguished in the Transcarpathian trough and in Pannonia.

The HF distribution is influenced by the Earth's crust heat, HF from the mantle, thickness and structure of the sedimentary layer, large overthrusts, underground water dynamics, volcanism. The main regional rules are defined by the heat flow from the mantle which is 15-20 mW/m^2, 25-35 mW/m^2 and 60-70 mW/m^2 in the Precarpathian trough, Fold Carpathians and Transcarpathian trough, respectively. The radiogenic component of the Earth's crust slightly changes and does not cause notable HF variations

As part of the alpine belt, the whole Carpathian region is in its thermal field a vast anomaly of low intensity against which the intensive regional anomaly of the Pannonian basin and of the Transcarpathian trough and several smaller anomalies are distinguished. This HF distribution is caused several heat sources of different age. On the basis of the results of mathematical modelling three main mesocenozoic phases of the increase of thermal and tectonic activity may be concluded which are reflected in the present thermal field. Carpathian regional heat flow anomaly is associated with Jurassic opening of the Carpathian basin. The neat thermal activity is due to the Late Cretacous-Paleogene tectonic phase with shortening, thrusting and folding processes. Maximum manifested are the events of the last stage (Late Oligocene-Pliocene). associated with the asthenospheric protrusion formation in the intracarpathian region. The asthenosphere products as a diapir (or a series of diapirs) ascended too 45-50 km depth. At present the asthenosphere is at 60-65 km depth in Pannonia and Transcarpathian trough.

The anomalous-mantle elevation has notably transformed the Earth's crust, formed a series of rift-shaped troughs, increased the temperature in the lithosphere and originated many melting hearths. Particularly intensive were destructive processes and volcanic activity on the asthenospheric protrusion periphery. The ascending mantle substance spread about and was accompanied by uneven transfer of lithospheric plates and corresponding Earth's crust deformations. The asthenospheric protrusion formed against the background of regional compression within the alpine beet, which left its mark in the Carpathian region evolution.

NEW CORRELATION POSSIBILITIES BETWEEN THE TITHONIAN AND VOLGIAN SUBSTAGES: BIOGEOGRAPHIC AND TECTONIC IMPLICATIONS

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Lower and Middle Volgian sections, more continuous and expanded than in the classic areas of the Russian Platform, are provided by the Pałuki Formation of Central Poland, where the following biostratigraphic units can be distinguished: the Eudoxus Zone, and the Autissiodorensis Zone, with the Fallax Subzone at the top, in the highest Kimmeridgian; the Klimovi, Sokolovi and Pseudoscythica Zones, as well as the Tenuicostata Zone (not recognized in Russia), in the Lower Volgian; and the Scythicus Zone, with the Quenstedti, Scythicus, Regularis and Zarajskensis Horizons, in the lowest Middle Volgian. The latter horizon is followed by Purbeck-type sediments, which are overlain by marine sediments of Late Berriasian age. The Late Kimmeridgian to Middle Volgian ammonites of central Poland (monographed in papers by Kutek & Zeiss, 1974; Kutek, 1994; and Kutek & Zeiss, 1997) permit to reconstruct a phyletic lineage which, starting with the Submediterranean group of *Discosphinctoides stenocyclus-roubyanus* in the Eudoxus Zone, gave rise to the following Subboreal succession of ammonites in cratonic regions of Poland and the Russian Platform: *Discosphintoides subborealis* and *Sarmatisphinctes* in the Autissiodorensis Zone, *Ilowaiskya* and *Pseudovirgatites* in the Lower Volgian, and *Zaraiskites* in the Scythicus Zone.

Several scattered occurrences of Tethyan ammonites in cratonic Poland, and of Subboreal ones in Franconia and the Carpathian-Balkan area, permit to establish a new correlation of the Volgian with the Tithonian, according to which the top of the Sokolovi Zone corresponds to a level situated but slightly beneath the base of the Middle Tithonian, and the base of the Middle Volgian roughly corresponds to the base of the Upper Tithonian. The Regularis Horizon corresponds to an interval located fairly high in the Upper Tithonian, within the Calpionellid Zone A.

Subboreal ammonite faunas developed in central and northern Poland in the latest Kimmeridgian and in the Volgian, but intermittent occurrences of Tethyan ammonites (chiefly Haploceratacea) are recorded up to the Sokolovi Zone in the Lower Volgian. This can be explained evoking a filtering effect of a belt of shallow-water carbonates of the Stramberk type, developed along the Carpathian margin of the Tethys. Significantly, a southward spread of Subboreal ammonites in the latest Early and earliest Middle Volgian (latest Middle and early Late Tithonian) is testified by occurrences of *Ilowaiskya, Pseudovirgatites, Zaraiskites* and *Isterites*, associated with *Buchia* at some localities, in the Polish Carpathians, and in Slovakia, Bulgaria, Hungary, Moravia, Austria and Franconia.

In central Poland, a transgressive-regressive sequence ranging from the Upper Kimmeridgian (Eudoxus Zone) to the Middle Berriasian, is formed by marine sediments and the overlying Purbeck-type sediments. The base of the latter sediments is situated within the Zarajskensis Horizon, providing circumstantial evidence for a late Tithonian uplift of the Meta-Carpathian Arch (a zone of lesser subsidence and intermittent uplift, that separated the Central European Basin from the basins of the Carpathian domain in the Permian, Mesozoic and Cenozoic). A sequence boundary can be recognized within the Eudoxus Zone, and a higher-order sequence boundary at the base of the Middle Volgian. No sequence boundary corresponds to the Kimmeridgian/Volgian junction. A special problem is connected with the latest Kimmeridgian to Tithonian sediments developed in cratonic regions of south-eastern Poland and the western Ukraine, which provide evidence for a rifting phase, and are largely synchronous with the Stramberk shallow-water carbonates, and the carbonate flysch of the Cieszyn Beds, of the Northern Outer Carpathians.

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GEOPHYSICAL DATA COMPLEX AS THE BASE OF IMAGING OF THE MECHANICAL-GEOLOGICAL INTERNAL STRUCTURE OF THE UKRAINIAN CARPATHIANS

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In the proposed report we have matched the results of investigations of geophysics and mechanics, that usually are presented separately. The primary base of investigations is a network of transverse and longitudinal regional profiles. These profiles at first were organized as seismic ones. Nowadays it is understandable that only the complex of geophysical methods may give the reliable information about the geological and tectonic structure. As the base of the complex the seismic and gravitational methods, added by magnetic and electromagnetic sounding methods, are relied.

Geophysical materials are presented by arrival time and seismo-geological cross-sections (2D) and density distribution cuts (2D). Point geoelectric cuts and constructions utilizing magnetic field data are auxiliary.

We utilize finite element method for seismic wave fields modeling. The method of solving of the direct dynamic seismology problem for seismic prospecting gives the possibility to model seismic wave fields in the case of complex-structured seismic cross-sections. It allows the wave field analysis aiming the interactive interpretation of boundary slopes, faults, inhomogeneities, multiples and P- and S- reflections on seismograms.

Deepness of investigations on separate methods oscillates in the interval 12-24 km. Deep cuts along regional profiles coordinate in this case with the wave field, gravity field, magnetic and magneto-telluric field, drilling results and other geological information. Detailed lithological stratigraphical characteristics of the geological cross-section and new data concerning tectonic situation are obtained as the result. In the central Carpathian region the cut from mezzo-Paleozoic basement to allochtone is characterized. The drawn part of the Carpathian flush is mapped in the region of the Fore-Carpathian inclination. The cut is presented with periods from artherozoic to chalk on the platform. Tectonic contacts for all shown structure units are fixed unequivocally.

RESULTS OF TECTONOMAGNETIC INVESTIGATIONS IN THE CARPATHIANS

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The study of modern geodynamics and seismotectonic processes based on geomagnetic and other geophysical investigations hase been started in a seismoactive part of the Ukrainian Carpathians - Transcarpathian trough in early 70-s.

This territory is attached to regions with moderate seismicity. Every year 2-10 earthquakes occur here (with magnitude $M \leq 3$). But by historical data earthquakes with the intensity of 7°-8° according to MSK scale are registered in this region. Seismologists consider earthquakes of maximal power to be possible here once per 130-150 years. Such peculiarities allow to study each seismic event separately.

The area of investigations is about 4200 sq.km. The network of plane (about 100) and profile points for repeat geomagnetic observations as well as secular fundamental marks for gravitational measurements have been created. 8 seismic stations, 4 regime geomagnetic stations are operating, observations by extensometer are carried out in adits.

Modern protone magnetometers of sensitivity 0.1 nT are used for geomagnetic observations. 4-component magnetovariational stations (H,Z,D,F) with quartz magnetometers installed in a non-magnetic pavilion is in continuous regime operation at one of the regime stations.

Differential observation methods to avoid changes of an external origin field are used. The accuracy of repeat F-surveys is ±0.6-1.2 nT. The kinds of geomagnetic monitoring are as follows.

1. Plane and profile F-surveys. In terms of long repeat F-surveys anomalies of geomagnetic field temporal changes - tectonomagnetic anomalies - are singled out. As a rule, these anomalies map regions of modern geodynamic processes - deep faults, zones of active geological inhomogeneities (e.g. Volcanic ranges) etc.

According to the results of discrete observations (once or twice a year) of the territory under investigation, a series of maps of annual and seasonal field variations giving and idea of geomagnetic field temporal variations for various time has been made.

Anomalous zones separated are distinquished by morphology and intensity.

- ◊ Isometric anomalous zones are upto the first tens of kilometers and characterized by annual field changes upto 3-5 nT per year. These anomalies are applied to the regions where volcanogenic rocks of Vyhorlat-Hutynska Ridge occur, effusives of Beregove hills and horizons of Nankovski tuffs within Solotvynsk Trough. Here magnetic rocks being indicators of the medium stressed-strained state changes are widespread.
- ◊ Linear anomaly of Carpathian stretch is attributed to Pienine fault and Carpathian electroconductance anomaly zone. Annual changes in this zone reach 4-7 nT. Anomalous field changes are supposed to be due to electrokinetic phenomena in fractured sedimentary rocks of the fault zone.

Calculations to prove that anomalous variation source is within magnetic rocks have been carried out. As it is estimatied longwave field variations are regarded to be due to piesomagnetic effect but local variations are in zones of basement faults where electrokinetic events are the most probable.

2. Permanent regime observations for studying earthquake precursors. These investigations are based on continuous F-observations at the network of 4 regime stations in anomalous zones found according to spacial repeat F-surveys. The stations are in various geostructural zones with different peculiarities of a seismic regime.

Basic parameters obtained during regime observations are daily average values of difference field ΔF between stations, daily average of F at every station, variance (σ^2) of field ΔF and coefficient ρ between fields F at different stations. The further processing of data consists in finding daily average, ten daily average, monthly average and annual average values of F and ΔF, plotting time series curves of regime observations, their analysis to detect anomalous effects.

During 1982-1995 21 anomalous effects were determined; 15 of them (more 70%) were connected with local earthquakes with K=8-11. Anomalous effect peculiarities:

- ◊ baylike excitation with slower decrease of field at the initial stage followed by field stabilization, sign change of temporal variations and fast resuming the initial level;
- ◊ anomaly duration of 1.5-3 months;
- ◊ the earthquake moment coincides, as a rule, with the final stage when the field is resumed.

The results presented testify to efficiency of using geomagnetic monitoring for studying modern geodynamic and seismotectonic processes necessary for predicting disastrous phenomena of natural and technogenic origin.

UNUSUAL CRYSTALS OF GOLD FROM THE UKRAINIAN CARPATHIANS

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Gold is found in primary and placer occurrences of the Ukrainian Carpathians, in various structure-facies zones. The primary gold is associated with Proterozoic (?) metamorphic rocks of Marmarosh crystalline massif in the Rakhiv and Chyvchyny areas, and also with Neogene volcanic rocks of Beregove and Vyshkiv areas. The gold placers are known in Quaternary and other terrigenous formations (Cretaceous, Paleogene, Neogene) representing transitional collectors of this mineral. The principal regions of the occurrences of the gold placers are Chyvchyny, Rakhiv, Verkhovyna, Yabluniv, Perechyn and Nyzhni Vorota areas.

Morphology of visible gold from the Carpathian occurrences is very various. Among the grains there are well formed crystals as well as regular and occasional intergrowths, rounded forms and grains with indications of the skeletal growth, dendrites, dendritoides, plates, scales, lumps, drops, needles, wires and other irregular forms. This especially concerns to Trans-Carpathian's shallow buried gold (Muzhieve deposit, quatrz-barite veins). Most of gold grains from quartz-barite veins are well formed crystals. There are also many dendrites and less amount of irregularly shaped crystals. Almost all crystals are cube-octahedrons with variable habit of the both forms. The crystals are often distorted, being flattened along the triple axis, scaresly along other crystallographic directions. Tetragon-trioctahedron {311}, rhombic dodecahedron and tetrahexahedron {210} are rarely observed.

Quite often cube-octahedrons combine with two, three or more grains and simple or complex twins. Complex twins are unusual forms for they have an apparent five-fold symmetry. Goniometric and X-ray analysis have established that "pentagons" are cyclic twins without re-entrant angles of cube-octahedrons after spinel law. Twin forms of such the combinations are represented by joined pseudoforms of pentagonic prism and bipiramide, which in fact correspond to real faces of cube and octachedron of five combined polyhedra respectively. "Pentagons" external symmetry is close to $L_5 6P$. L_5 is pseudoaxis on complicated twins of gold. The dimension of "pentagons" reaches 0.5-0.8 mm along L_5. They have a zoned construction: internal parts are enriched by Ag and external parts are enriched by Au.

Also the original, but epitaxy intergrowths of gold were found in an alluvium of the Lyuchka River (Yabluniv area). They are the rounded gold's plates with very small epitaxically developed cube-octahedrons of gold. These plates occur here with size from 0.2 to 0.5 mm. The standard of this gold is very high (930-980).

Similar cyclic twins of gold crystals were observed in low depth deposits of Romania (Boitza deposit) and of Russia (the Lower Amur River). A lot of cubic minerals and their synthetic analogous (diamond, gold, silicon, carbide of silicon, spinel and others) form the similar twins. It is probable that over saturated solutions favour the growth of cyclic twins of these minerals and their analogous. Gold "pentagons" as well as dendrites of gold may be considered as an indicative feature of the ore deposition formed under surface conditions.

The above epitaxial growth of gold crystals could take place in transitional collectors (in older terrigenous sediments of the Miocene) or even in the Quaternary alluvium.

THE RHEOLOGY OF THE CARPARTHIAN – PANNONIAN AREA, IMPLICATIONS FOR TECTONIC MODELS OF BASIN FORMATION

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The strength of the lithosphere is controlled by a number of factors, the most import ones include the temperature, structural composition of the lithosphere and the strainrate.
Lithospheric rheology can be inferred from extrapolation of laboratory failure data to lithospheric scales, constrained by thermal and structural models of the lithosphere. Furthermore, forward modelling of the tectonic evolution of sedimentary basins in the study area provides insight in the strength of the lithosphere. Additionally, flexural calculations on the bending lithosphere underneath the foreland basins surrounding the Carpathians yield predictions of the lithospheric strength. These three methods are yield comparable results with respect to the magnitude of lithospheric strength and the distribution thereof. Independent validation of lithosphere rheology is derived from the depth distribution of earthquakes.
Predictions of the rheology of the lithosphere in the PANCARDI area indicate a large lateral variation in the present day strength distribution. The cratonic areas surrounding the Carpathiam arc are characterized by a very strong lithosphere, whereas the lithosphere underlying the Pannonian basin system is very weak. These strength contrasts played a key role in the tectonic evolution of the system, during assembly of the individual tectonic units and during the evolution of the sedimentary basins. Furthermore, the lithosphere rheology also appears to change in time. The example of the Styrian basin indicates a general strengthening of the lithosphere since Karpatian – Badenian times. This is reflected in the architecture of the sedimentary basin fill.
Analyses of the tectonic history of the Pannonian basin system indicates two major phases of extension (Karpatian and late Sarmatian – Earliest Pannonian) governing the subsidence of the basins. The different spatial distribution of these extension phases indicates a direct relation to lithosphere rheology. The peculiar rheologic situation in the central basins of the Pannonian Basin system is directly related to extreme lithospheric thinning and associated high lithospheric temperatures, and appears to be reflected in the extensional Pannonian to recent evolution of the central basins.
Therefore, a two-stage extensional evolution is proposed for the Pannonian basin system. Karpatian extension affected the whole system. Earliest Pannonian extension was limited to the central system, and causally related to the evolution of the asthenospheric dome underlying the system. However a chicken and the egg problem remains, whether the dome caused the second stage of extension or vice versa.

THERMAL REGIMES WITHIN KARKINIT DEPRESSION (THE NORTH-WESTERN BLACK SEA) THROUGHOUT THE LATE MESOZOIC AND THE CAINOZOIC

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Karkinit depression is the largest sedimentary basin on the north-western Black Sea shelf where thickness of the Mesozoic and Cainozoic sequences changes up 4-5 km to 7-9 km. Active subsidence with average rates of sedimentary units accumulation not less than 60-80 m/my were during the Late Cretaceous and Eocene, and the Late Oligocene and Miocene phases.

Thermal regime of a sedimentary basin is characterised by density of heat flow, distribution of temperature and geothermal gradient within layers. There are insufficient data concerning surface heat flow density and measurement of temperature in sedimentary layers, especially on marine part of Karkinit depression.

Thermal regime of the depression is characterised on the base of temperature evaluation used original approach considering alteration of heat flow and properties of sediments throughout time and by subsidence. Temperature evaluation has been done for areas of few local structures: Gamburtseva, Central, Desantnaya, and Odesskaya. Obtained results have been compared with temperature measurement in well Golitsina-3.

Distribution of temperature measured within Cretaceous and Cainozoic sequences in western part of Crimea are characterised by significant variation with depth and area (Novosiletsky at all, 1985). Also, there is a variation of current geothermal gradient within various sedimentary complexes. It is changes within Paleogene and Neogene layers from 55° C to 28 ° C. It is much less within Cretaceous sequences - about 28 -32° C, and the lowest one is within pre-cretaceous rocks - 18 -23° C.

Estimated temperature on the roof of Maykop Series are changed from 25°C to 35°C. Maximal temperature of 68° C is calculated in Desantnaya well, this depends on large thickness of Middle Miocene and Pliocene sediments. Temperature on the roof of Eocene is about 40° C on Gamburtseva and Odesskaya anticlines, and it is more than 70° C in other ones. Temperature within Upper Cretaceous layers is more than 100° C, in general, and should be until 200° C and more in deepest part of the depression.

According to obtained results it is possible to assume that average geothermal gradient within accumulated during the Cretaceous sediments was relatively high: about 38° - 40° C. Later in the Eocene it was decreased until 30° C. It needs to emphasise that average geothermal gradient does not correctly reflect temperature conditions within sedimentary layers because its changes are visible within sections lower than 2 km.

Taking into account well known effect of the temperature increasing in area of over anticlines it should expect that temperatures at surrounding depressed areas should be less, but the highest temperatures are there within Lower and Upper Cretaceous layers as well.

Mining Dumps - Hazardous Waste-Sites?

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The Pb-Zn deposits of the Graz Paleozoic are formed as stratiform to the Arzberg Formation (Schöckel Nappe) and as sedimentary exhalative deposits in the Lower Devonian. These deposits were exploited from the 16^{th} century to the beginning of the 20^{th} century.
Mining activities usually cause impacts on terrestrial and aquatic ecosystems. Investigating old mining areas, it is very important to understand mining induced long-term effects on soils, ground- and surfacewaters, and its consequences on surface morphology.

In this work two mining dumps of Pb-Zn deposits were chosen for the exploration of heavy metal contents in the soils and sediments of such dumps. One dump belongs to the mining area of Guggenbach, which was shut down in 1927. On this dump a thin soil layer has already developed. It is covered with deciduous trees and contrasts with the surrounding surface only by its typical morphology. The second dump originates from an exploration adit in the area of Großstübing in 1983. It differs markedly from the first dump. On this dump no soil has yet developed. These different stages of development are the starting point for checking the contents and changes of heavy metal distributions in the course of time.

The amounts of the elements Cd, Co, Cr, Cu, Fe, Ni, Mn, Pb, Zn were measured on samples < 40 µm with AAS. For estimating the bioavailability and the potential risk of heavy metals, other parameters like pH, C org., mineral components and the content of S of the soils were measured.
In the dump of Großstübing there are generally higher contents of Co, Cr, Cu, Fe, Ni and Mn. The contents of the heavy metals Cd, Pb and Zn are much higher in the dump of Guggenbach although the geochemical initial composition is the same. The data considerably exceed the limit value of the Sewage Sludge Regulation („Klärschlammverordnung") of Styria.

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CRYSTAL-CHEMISTRY OF Cr-SPINELS FROM FLYSCH DEPOSITS OF SE - ALPS.

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In Friuli and Trieste area (Italy), western Slovenia and Istria (Croatia) an extensive Flysch complex (mudstones-sandstones facies) is well exposed. The rock sequence belong to different depositional basins and have different ages. The age of rocks outcropping in the northern part of the Flysch complex (Slovenia and Friuli) spans from Maastrichtian to Middle Eocene (Tunis & Venturini, 1989; 1996) while in the southern part of the complex (Istria, south-western Slovenia and Trieste) the age spans between Middle and Late Eocene (Marincic et al., 1996). All the analysed samples are from Tertiary Flysch.

The crystal-chemistry of eight Cr-spinels in the investigated area show that all the analysed spinels fall in the range of Alpine-peridotites. Crystal-chemistry of some samples from the southern area (Trieste) were already studied by Lenaz & Princivalle (1996). The chemical compositions and the cell edges show that these Cr-spinels are similar to those of harzburgitic rocks of the Internal Dinarides.

No evident differences are recognised between the chemical and structural features of Cr-spinels in the northern area, both temporarily and areally. Differences are recognised between the northern and the southern area and the most important and discriminant features are evidenced by TiO_2 and Fe_2O_3 content (calculated from stoichiometry) and by silicate inclusions. In fact, all the analysed samples from the Friuli and Slovenia area are higher than 0.27 wt. % TiO_2 while in the Trieste area TiO_2 is lesser than 0.20 wt. % . Fe_2O_3 content in the northern area spinels is higher than in the other zone. Moreover, in the northern zone spinels silicate inclusions are present while they lack in spinels from the Trieste zone. Arai (1992) noticed that Ti content is related to the tectonic setting of the source area. Many Authors showed that silicate inclusions are trapped as silicate melt drops, enriched in Mg, alkalies and Ti. These drops successively crystallise as composite inclusions or euhedral crystals. The tectonic setting could be related to a tectonic convergence environment in which there is the interaction of fluid phases with a depleted mantle.

We conclude that in the northern part, the supplies of Cr-spinels may be related to a source rock located in a different tectonic environment with respect to the source area rocks of spinels from the southern one.

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SEISMICITY OF THE VIENNA BASIN

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The Vienna basin is regarded as one of the most prominent seismic active regions of Austria. Stronger earthquakes tend to occur along a major NE-SW striking fault structure, crossing Wiener Neustadt, Ebreichsdorf and Schwadorf (Fig.1), most probably at a depth of approximately 7 km. In all documented cases the prevailing mechanism could be interpreted as sinistral strike-slip faulting. Following Meissner & Strehlau (1982), we may conclude, that peaks of the focal depth-distribution (Fig.2) also coincide with the maximum of the prevailing shear stress. The more emphasised these peaks are, the more developed should a geological structure be in order to generate more often seismic events at similar depth. This fact could be observed on several occasions, when earthquakes of magnitude 5 and above originated below the Vienna basin. Earthquakes of this magnitude happen on average every 25 years in this seismic region.

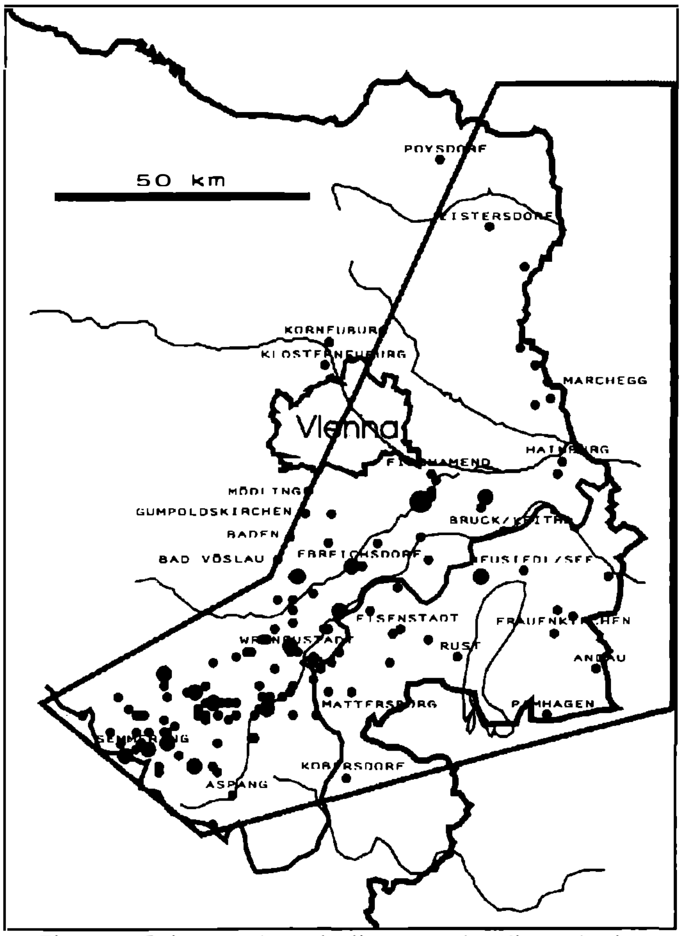

Figure 1. Epicentres in and adjacent to the Vienna basin.

At a depth of around 7 km most favourable conditions seem to exist, which enhance the occurrence of faulting processes due to high shear stresses at the bottom of the brittle crust. This observation applies not only to the Vienna basin but also to those regions in Austria, which experience similar seismic activity, such as the Inn-valley in Tyrol or the Mur-Mürz-valley in Styria.

Considering the spread of the focal depth distribution in the Vienna basin, and postulating a thickness of the seismogenic layer of 5 km - resulting from varying focal depths between 3 and 8 km -, we end up - according to Wells & Coppersmith (1994) - with a magnitude of M=5.6. Such an earthquake needs to be considered already as of extreme nature. Related recurrence intervals cannot be estimated with the accuracy which is needed for sound probabilistic hazard estimates. Therefore, geological investigations are deemed extremely useful in this regard.

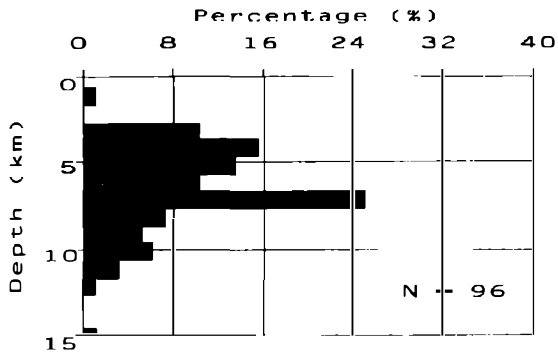

Figure 2. Focal depth distribution in the Vienna basin.

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POLLUTION OF HEAVY METALS IN PART OF THE TERRITORY OF THE REPUBLIC OF MACEDONIA *DATA ON POLLUTION OF WATERS, SOILS, FLORA AND FAUNA

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Examinations presented in this paper were carried out for the Kratovo-Zletovo volcanic area which is one of the largest Tertiary volcanic areas in the Balkan peninsula. The area is situated in the south-eastern part of the Republic of Macedonia. It is characterized by the presence of significant Pb-Zn occurrences as well as occurrences of other mineralization styles. Examinations were carried out in order to determine the amount of presence of heavy metals in water, soil, flora and fauna.

Another reason for these examinations is that the Dobrevo mine which is in operation and plants for mineral processing are situated in the vicinity of the town of Probistip. The waste waters from the mine and mineral processing plant pollute the water and the soil. These secondary geochemical environments pollute other environments in biosphere or flora and fauna. In this regard preliminary examinations were conducted on samples taken from larger river flows (the Rivers Bregalnica and Zletovska (as well as on samples from soil and plant and animal organs.

The contents of Ca, Mg, Na and K as major, and Fe, Al, Mn as secondary and As, Ag, Ni, Cr, Co, Cu, Pb, Zn and Id as microelements were determined by AEC-ICP method.

Table 1 Distribution of elements in the soil samples in the locality Globica

	Pb	Zn	Cu	Cd	As	Na	K	Fe	Al	Mn	S
1	322	269	25	5	21	0.08	0.28	3.47	2.16	0.19	0.08
2	174	245	61	8	<1	0.06	0.43	5.13	3.01	0.20	0.21
3	529	693	44	9	18	0.08	0.21	3.53	1.11	0.61	0.11
4	193	347	72	9	9	0.06	0.37	5.18	2.84	0.21	0.22
5	944	706	55	9	18	0.06	0.34	3.58	1.70	0.28	0.11
6	177	532	31	4	9	0.06	0.21	2.74	1.10	0.13	0.13
7	429	306	38	5	6	0.09	0.41	3.44	2.19	0.19	0.07
8	502	402	34	7	5	0.07	0.40	3.61	1.79	0.21	0.11
9	164	201	24	4	16	0.1	0.34	2.90	2.05	0.12	0.08
10	244	353	44	6	10	0.08	0.29	3.43	1.41	0.17	0.09
11	445	398	34	7	11	0.07	0.35	3.78	1.31	0.22	0.16
12	1007	770	90	9	4	0.08	0.47	3.62	2.49	0.17	0.26

The AEC-ICP method was chosen because it performs routine simultaneous, multielement determination of both major and trace elements disolved in surface water, drinking water, soil as well as some animal organs and plants. The examinations were focused on determination of the degree of Pb, Zn, fe, Mn, As, Cd, and Cu presence as the most toxic heavy metals.

THE GEOLOGICAL UNITS AND STRUCTURAL EVOLUTION OF THE AGGTELEK-RUDABÁNYA MTS. (NE HUNGARY)

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The Aggtelek-Rudabánza Mts., located in the NE part of the Pelsonia Composite Terrane, is one of the the most complex regions of Hungary by both its geological build-up and structural evolution. Its basement is formed mostly by Triassic rocks, ranged into three major groups. The second and third groups roughly correspond to the **Meliata series** of the Slovakian geologists. However, in order to avoid the enormous confusions accumulated into this name, we prefer not to use it further on.

1. The non-metamorphic **Aggtelek-Bódva series-group** was deposited on continental crust. Its sequences start uniformly with Permo-Triassic evaporitic to sandstone beds, followed by shallow marine, terrigeneous but ever more limy Lower Triassic (Werfen beds), then by shallow marine, platform carbonatic Anisian (Gutenstein and Steinalm beds). In the **Aggtelek series** (in the Aggtelek Mts., its definition see later) this carbonate platform survived up to the Carnian (Wetterstein beds) with an intraplatform basin (the **Derenk facies**). Meanwhile in the **Bódva series** (in the Rudabánya Mts.) pelagic limestones (laterally interfingering with the slope development of the **Szőlősardó facies**) can be found starting from the Middle Anisian. In both series the Upper Carnian and Norian are represented by the same pelagic Hallstatt and/or Pötschen Limestones. The Jurassic in Hungary is known only in the Bódva series: It is built up by rhyolitic olistostrome. Primarily this series-group can be found in the **Silicic nappe system** (s.s.), the upper tectonic unit of the Aggtelek-Rudabánya Mts., that is supposed to be detached from its Paleozoic basement along the Upper Permian evaporites.

2. The deep diagenetic to anchimetamorphic **Bódva Valley series-group** was deposited on intermediate and oceanic crust, having opened in the Middle Triassic, origininally to the S from the Aggtelek-Bódva depositional environment. In the true oceanic **Tornakápolna series** (Aggtelek Mts.) Middle-Upper Triassic ophiolites and radiolarites can be found. The intermediate crust is represented in the **Bódvarákó series** (Rudabánya Mts.) built up by Gutenstein beds, Middle Triassic dark radiolarites and Jurassic olistostrome. Primarily this series-group formed the middle tectonic unit of the basement (the **Bódva Valley nappe**), however, several tectonic slices of the ophiolites have been replaced into the basal layers of the Silicic nappe system in the course of its overthrusting.

3. The anchi- to epimetamorphic **Torna series** (in both mountains) represents probably the original Mesozoic cover of an unknown Paleozoic continental crust. The Triassic seqnence is similar to that of the Aggtelek-Bódva series-group up to the Steinalm beds. The major part of the Middle Triassic and the entire Upper Triassic are built up mainly by grey pelagic limestones. Primarily this series represent the deepest tectonic unit of the mountains. the **"allochton"**

Starting from the Late Jurassic, one part of the Tornakápolna oceanic crust subducted northward below the Aggtelek-Bódva crust, simultaneously its other part obducted southward onto the Torna crust. After the collision of these two continental crusts, the primary nappe structure of the mountains took shape at the middle of the Cretaceous. Later, probably in the Late Cretaceous the area was folded, thrusts of southern vergency, and also smaller retrocharriages (the **Alsó-hegy** and **Derenk "klipps"**) were developed.

Until the Earliest Miocene when the next transgression came, the whole area was a dry-land. Simultaneously, the active **Rudabánya Mts.**, having situated until that time to the S from the rest of the Gemerides, were removed in three segments by the sinistral lateral movements of the Darnó zone with a few 10 kilometres to the NE, and arrived at its recent place, to the Eastern neighbourhood of the passive **Aggtelek Mts.**, by the middle of the Miocene. These movements have generated complementary strike-slips, as well as thrusts of northern vergency in both mountains, moreover, masses that were squeezed out from the active segments have been overthrusted onto the neighbonring passive segment (the **Species-forrás klipp** composed by the Bódva series lies upon the Aggtelek Mts; the **Martonyi klipp** built up by rocks from the Torna series lies upon the central segment of the Rudabánya mountains). The Upper Miocene Pannonian lake flooded the marginal and inner basins. Only brittle-tectonic movements can be shown in this time and after.

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GEOLOGICAL CROSS SECTIONS THROUGH THE AGGTELEK–RUDABÁNYA MTS., NE HUNGARY

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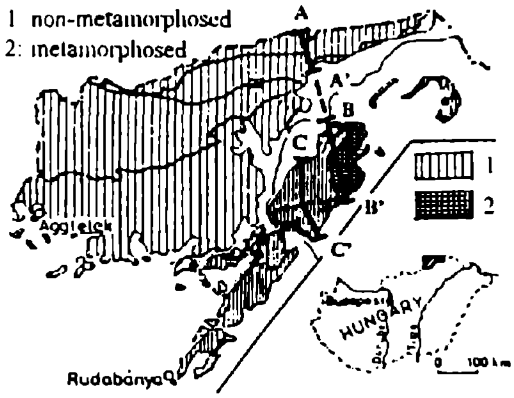
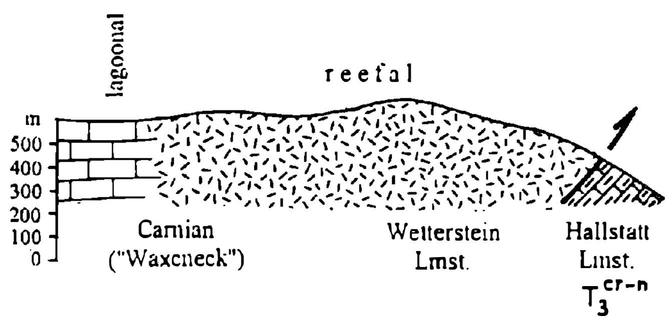
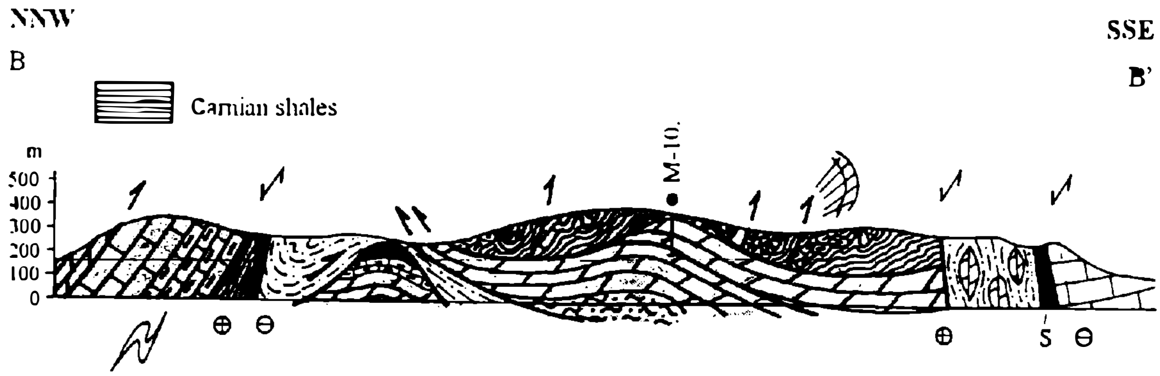
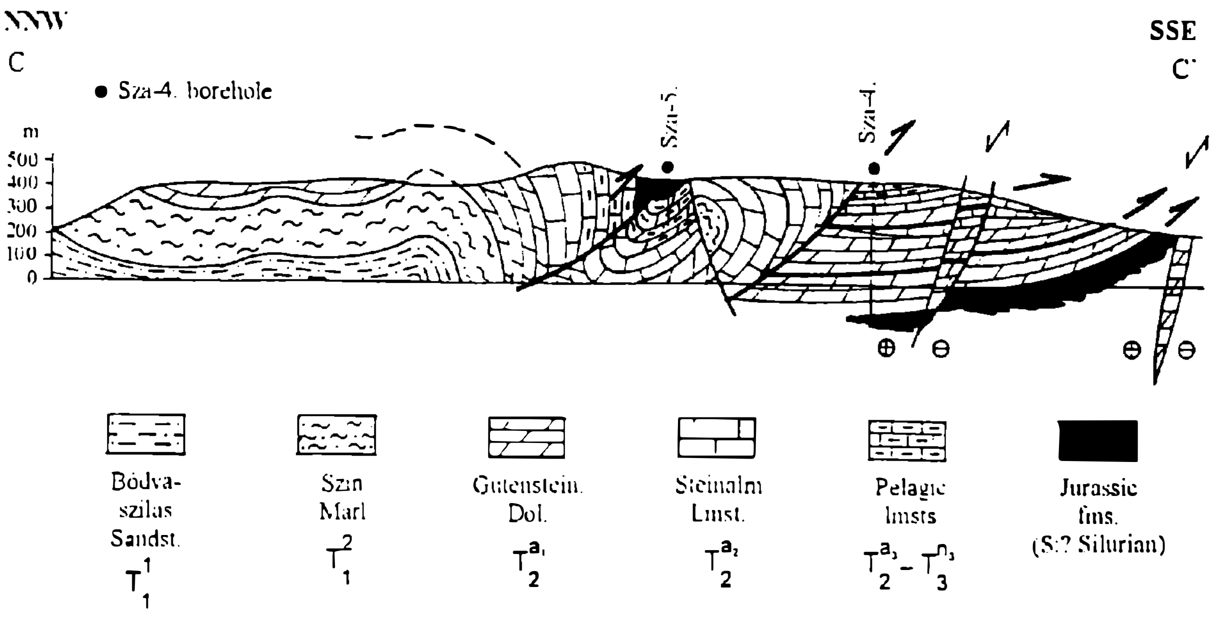
Preliminary results of the structural geological reambulation of the Aggtelek–Rudabánya Mts., located in the NE part of the Pelsonia Composite Terrane, are presented. The sections bear evidence of older, south-vergent (Dinaridic-type) movements (folding, thrusting) and superimposed younger north-vergent (Carpathian-type) ones (backthrusting, formation of neoallochthons), both in the metamorphosed and non-metamorphosed units.









DISTINGUISHING BETWEEN TECTONIC AND EUSTATIC SEDIMENTATION CONTROLS IN SUCCESSIONS ORIGINATED IN COLLISION-RELATED BASINS: EXAMPLES FROM THE POLISH OUTER CARPATHIANS

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The facies of the Upper Cretaceous – Paleogene part of the flysch succession of the Polish Outer Carpathians (POC) indicate sedimentation in several deep-sea basins separated by subaqueous to subaerial ridges. The setting developed under northerly compression that resulted from convergent motion of the Apulia continental fragments with respect to the European Platform. Such compression is evidenced by the supply of clastics predominantly from sources located along the southern margins of the flysch basins. The supply together with the flysch facies itself indicate supremacy of tectonics over other factors in sedimentation control and a passive character of the northern margins of the flysch basins. The latter feature is also suggested by enrichment in synsedimentary shallow-marine biota, glauconite and calcareous matrix, and generally finer and more mature siliciclastic components of the material supplied from the northern margins when compared to that supplied from the southern sources. The difference in composition also suggests that the southern margins were bordered with a narrower shelf when compared to the northern ones. All the named features are best expressed in the Upper Cretaceous Paleogene successions of the northern zone of the Magura nappe and the Silesian nappe. These successions were alimented principally from the Silesian ridge (cordillera) located between the Magura and the Silesian basin.

Vertical facies distribution in the Upper Cretaceous – Paleogene successions of the POC suggests some irregularity particularly when distribution of the deposits supplied from the southern and northern sources is compared. In some periods, e.g. in the Senonian – Paleocene, intense supply occured both from the north and south (Inoceramus Beds of the Magura nappe and the Istebna Beds of the Silesian nappe). Some other time, e.g. in the Middle Eocene, intense supply from the north was not compensated by alimentation from southern sources (the Pasierbiec Sandstone of the Magura nappe). A particularly intense sediment supply from sources located along the northern margins that was not compensated by the supply from the southern sources occured at the beginning of the Oligocene (the Magura Glauconitic Sandstone and different coarse clastic units of the Sub-Chert Beds of the Dukla, Silesian and Skole nappes). The irregularity in the supply of the clastic material from the southern sources relative to that from the northern ones is here considered as reflecting difference in the recurrence time of the eustatically controlled sea-level fluctuations and tectonic activity. Intensified supply from the northern sources resulted from distinctive sea-level changes along the basin margins. A precise correlation with the global eustatic curve is necessary to unequivocally recognize whether such supply resulted from eustasy or a local tectonics. Eustasy appears to have played dominant control over sedimentation of the units alimented from opposite basin margins. The southern sources appear to have responded weaker to the eustasy than their northern counterparts. The difference resulted from a higher steepness of the southern basin margins. The eustatic sea-level changes were there restricted to exclusively vertical migration of the sea margin and therefore were insignificant in controlling sediment supply.

THE GEOLOGICAL MAPS OF THE WESTERN CARPATHIANS AND ADJACENT AREAS

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PETROLOGIC MODEL OF THE ŠTIAVNICA STRATOVOLCANO, CENTRAL SLOVAKIA NEOGENE VOLCANIC FIELD

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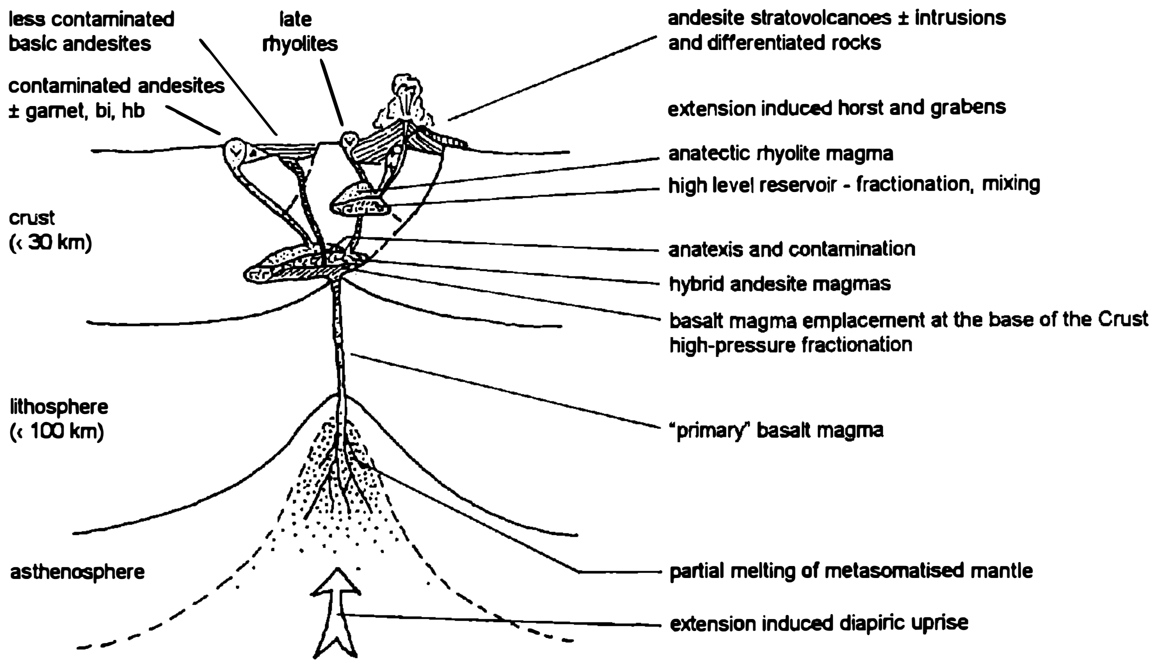
Evolution of the Štiavnica stratovolcano took place in several stages: (1) Early to Middle Badenian: build up of a large stratovolcano of px and hb-px andesites, including rare garnet-bearing and bi-hb-px andesites, (2) early Late Badenian: erosion of the volcano and multiple phase emplacement of subvolcanic intrusive complex involving a large granodiorite/diorite bell jar pluton, granodiorite porphyry stocks and dyke clusters, and quartz-diorite to diorite porphyry sills and dykes, (3) late Late Badenian: a large caldera subsidence accompanied first by lateral outpouring of hb-px and bi-hb-px andesites, later filled by dome/flow complex of bi-hb andesites to dacites, (4) Early to Middle Sarmatian: alternating explosive and effusive activity of px, hb-px, and bi-hb-px andesites in several pulses, mostly on slopes of the stratovolcano, (5) Middle to Late Sarmatian: resurgent horst uplift in center of the caldera accompanied by rhyolite volcanics, (6) Pannonian: dispersed dykes, necks and lava flows of high alumina basalts and basaltic andesites.

Petrologic interpretation of available data indicates a complex evolution of magmas, governed by density relationship between the crust and magmas in which crust represents a "density filter" The model starts with a "primary" basalt magma emplacement at the base of continental crust and its high pressure fractionation towards andesite composition, accompanied by crustal contamination. Andesites of lesser density reached the surface and in multiple pulses built up the stratovolcano, individual batches of magma being influenced to a various degree also by high level crystallization (and limited fractionation ?). Due to growth of the volcano pressure in the lava column finally exceeded lithostatic pressure at the base of the upper crust and consequently a formation of a high level magma chamber took place. Evolution of magmas in this magma chamber took place by fractionation, crustal contamination and mixing with anatectic magma as well as new portions of less differentiated magma from the deep source. The first round of magma evolution finished with emplacement of granodiorite bell jar pluton. Following replenishment by undifferentiated magma, the second round of magma evolution finished with emplacement of stocks, sills and dykes of granodiorite and quartz-diorite porphyry. The third round of magma evolution in the high level magma chamber finished with the caldera colaps and surficial outpouring of differentiated magmas. Postcaldera andesites represent new portions of magma from the deep source variably unaffected (px andesites) and/or affected (hb-px and bi-hb-px andesites) by evolution in small and temporary high level magma chambers. Subsequent uplift of the resurgent horst accompanied by extensive rhyolite volcanics reflects a large scale evolution of anatectic magma, most probably at the expense of the crustal block subsided previously into the magma chamber. The youngest basalts and basaltic andesites represent apparently a new portions of the deep source magmas, least affected by fractionation and crustal contamination.



BALANCING LATERAL OROGENIC FLOAT OF THE EASTERN ALPS

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ANTIGORITE FROM ALDINA REKA (EAST SERBIA, YUGOSLAVIA)

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Very complex area of metamorphic rocks occur between gabbros of Gabrovnica and granitoides of Ravno Bučje and Janja on Stara Planina. Minor serpentine masses are associated with foliated amphibolites, often on the contact with granites and gneisses. Bulky antigorite was found in fissures of tectonized serpentine between Aldina reka and Vraža planina. Mineral occur in platy, lath - like aggregates, with easy recognizable direction of parting. Laths with uniform orientation are easily separable, and can be long up to the 5 cm. Color is green with silky luster. On the surface of the mineral and in some fissures, there is a white crust of aragonite. X-ray diffraction pattern (Philips PW1710, CuKα) proved the antigorite with the following lattice parameters (Å):

$$a_o = 43.49(2),\ b_o = 9.247(5),\ c_o = 7.202(9),\ \beta = 91.3(1) \text{ and } V = 2895(4)\ \text{Å}^3.$$

Characteristic band in the IR spectra occurs in (OH) stretching region, which easily differentiate antigorite from other serpentine minerals. Chemical composition, determined by wet method is expressed by the formula:

$$(Mg_{5.26}\ Fe^{3+}_{0.35}\ Al_{0.06}\ Ca_{0.09})_{5.76}\ Si_4\ O_{10}\ (OH)_{8.0}$$

Calculated density, 2.58 g/cm^3 is in accordance with measured one 2.59 g/cm^3.

It is well known that modulated structure of antigorite (Kunze, 1961) is polysomatic (Mellini et all, 1987). In the half-wave reversion zones, Mg ions are consistently omitted resulting in small but noticeable deficit of Mg comparing with Si. The length of half-wave can vary. Thermodynamic calculations indicate that antigorites with a long wavelength are more stable at low temperatures while those with short wavelength would be more stable at high temperatures (Tromsdorff, 1983).

It obvious that the parent material for antigorite formation in prograde metamorphic conditions must be lizardite or chrysotile. In the circumstances when both minerals can be found side by side it seems necessary to define conditions which are operative locally, on small area.

This is a second occurrence of antigorite in Yugoslavia (Logar, 1995) from the highly tectonized area. In locality Aldina reka, according to textures of the rocks, action of shearing stress is recognizable, but the question of its contribution to the antigorite origin, remains open.

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THE FINAL EVOLUTION AND EXTINCTION OF TETHYAN ACTIVE MARGIN (FROM THE SREDNOGORIE TO THE MINOR CAUCASUS)

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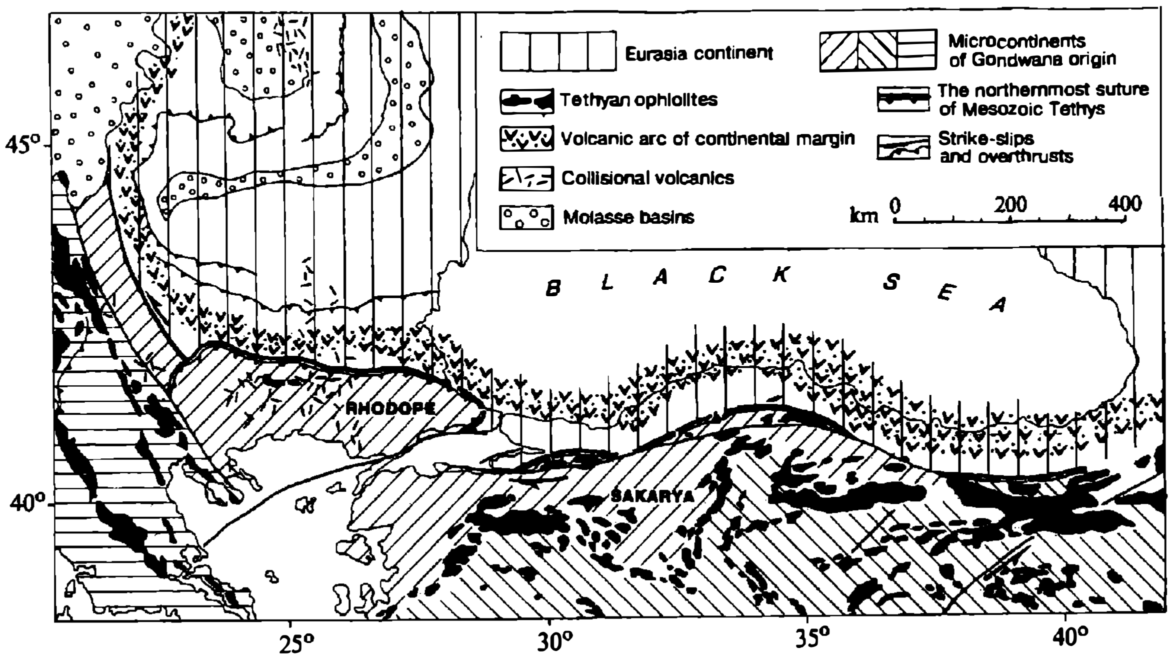
The reinterpretation of the final evolution of Tethyan active margin brings together some important new geological data of the last decade. The following main structural elements of this extinct continental margin are the most informative: 1. **Continental-margin volcanic belt.** This above-subduction volcanic arc stretches for 2,5 ths km from the Apuseni and Banat to the Srednogorie, to the Pontides and to the Minor Caucasus. The central segment of the belt was detached from continent by opening of Black Sea backarc basin, and it developed as ensialic island arc. According to the age of volcanics, the conclusive phase of subduction started at the Middle Cretaceous; the subduction ceased first in the Pontides (by the Early Senonian), then eastward (at the Middle Santonian) and westward - at the close of Senonian in Srednogorie and up to the Early Eocene farther to NW. **2. The northernmost Tethyan suture** coupled with this volcanic arc. Traditionally it was traced along the Erzincan-Ankara-Izmir-Vardar ophiolite belt at surprisingly far distance (up to 350-400 km) from the volcanic front. It became more advisable now to trace it along the Intra-Pontide zone to Armutlu peninsula, and then to the frontal thrust zone of the Rhodope. This suture originated of the north-dipping subduction zone at the Eurasia/Tethys boundary, and it is marked by exhumated high-pressure metamorphites (Geyve metaophiolite; eclogites and peridotites of Lower Arda-2 unit) and by the structures of synmetamorphic underthrusting. Rhodope (Drama), Sakarya and other continental blocks south of the suture can be regarded as Gondwana fragments. Prior to the Late Cretaceous phase of subduction these microcontinents were separated from Eurasia by oceanic branch of the Tethys. It was sufficiently narrow to be entirely sutured after 15-25 Ma of subduction. **3. Arc-trench gap** between the suture and the volcanic front. Well preserved in the Western Pontides, it was overlapped by Early-Middle Eocene brittle thrusting in the Rhodope, and it was partially cut off by tectonic erosion in the Minor Caucasus.



FAULT PLANE SOLUTIONS FOR EARTHQUAKES IN ALBANIA-WESTERN GREECE FROM BODY-WAVEFORM INVERSION

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The south-eastern Adriatic region, from the Dalmatian coast through Albania up to the Cephalonia island in NW Greece, forms an area of intense seismicity. Along this zone continental collision is believed to take place between the Adriatic microplate and the Eurasian lithospheric plate. This collision terminates at the western part of the Ionian islands against two active dextral stike-slip faults, the Lefkada fault and the Cephalonia fault.

In order to investigate in more detail the active tectonics of the area we used body-wave modeling to compute the fault plane solutions of all the events with M>5.0, which occurred along the Dalmatian coast - Albania - NW Greece up to the Cephallonia island, during the period 1979-1997. Thus, we computed the focal mechanisms of 13 events that had good digital records for waveform modeling. The data consist of P and SH long period waveforms from the IRIS Global Digital Seismographic Network (GDSN), with epicentral distances ranging from 30° to 90°. In all cases, short period records were used to accurately read the arrival times of the direct phases (P or S) and to better constrain the focal mechanisms using the first onsets at smaller epicentral distances. In this way, together with focal mechanisms previously determined, we compiled a database consisting of 23 focal mechanisms, determined by waveform modeling, that are presently available for the area of study.

The data show that low angle thrust faults, striking in a NW direction, dominate along the coast of southern Dalmatia, western Albania and NW Greece. The activation of these faults is attributed to the continental collision between the Adria and Eurasian plates. The fault plane solutions of two earthquakes, modelled in this study, together with fault plane solutions from previous studies, show that eastern Albania as well as NW Greece are characterized by horizontal extension. The T-axes are trending mainly in the E-W direction but N-S extension is also active. The E-W trending extension along the orogen may be due to the response of the lithosphere to the adjacent compressive tectonic stresses.

MINERALOGICAL AND GEOCHEMICAL DIVERSITY OF TESCHENITES (SILESIAN UNIT, POLISH WESTERN CARPATHIANS)

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The most western part of the Polish Flysch Carpathians is characterised by many small outcrops of eruptive igneous rocks. They are distributed in the Cretaceous sediments of Silesian unit where they form a complex of hypabyssal bedded veins (carrying subordinate felsic rocks as veins). The igneous rocks belong to basic, even ultrabasic rocks of alkaline series, and are divided into three groups namely melanocratic (lamprophyres), mesocratic (teschenites, diabases) and leucocratic (syenites).

The pyroxenes apper to be the most considerable group of mafic minerals in teschenite associaton rocks. They are under-saturated in SiO_2 and mainly represented by salite and titan-augite .They occur in melanocratic and mesocratic types of rocks in varying amount, the most (up to 60 vol.%) in teschenite clinopyroxenite. On the basis of the current research two generations of the pyroxenes were established. The first, older generation is represented by Ti-augites. The results of spot analyses revealed that Ti-augites are characterised by high Ti content (up to 6 wt %), high Al content (10-15 wt %), and high Na content (1 wt %) replacing Ca. Such a high Na content is supposed to be responsible for high content of Ti and Al. The second generation of pyroxenes-salites are characterised by an extremely high content of Ca (up to 62 wt %). In comparison to the previous group these pyroxenes have lower Ti content (up to 4 wt %) and lower Al content (3-8 wt %). The amount of Na is negligible. The leucocratic rocks formed from squeezed out, late stage, liquids crystallizing at lower temperature under hydrous conditions, contains ferri-ferrous augites. In all pyroxenes the deficiencies in Si have been made up by adding the requisite amount of Al and Ti and in small number of cases also Fe^{3+}, to Si to complete the ideal 2 tetrahedral ions formula unit. Pyroxenes zoning varies from slight to major, and may be very complex. The most dominant type of zoning is: Mg↓, Fe↑, Ca↑, Ti↑ (from core to rim), the less dominant types are Mg↓, Fe↑, Ca↓, Ti ↑, and Mg↑, Fe↓,Ca↓, Ti ↑ In addition there was found Ti-augite surrounded by salite, which indicate that Ti-augites crystallised earlier than salites.

Petrogenesis of teschenite association rocks is still not clear. Part of them are alkaline lamprophyres (AL). They represent mainly: camptonite and monchiquite. The mafic-felsic association where the pluton contains a wide compositional range (alkali gabbros, monzonites, syenites, teschenites, theralites) are the most characteristic for AL (Rock 1991). Alkaline lamprophyres are the most typical of divergent or passive margins (Rock 1991). The interpretations of gechemical data suggest the early rift character of teschenite association rocks (Narebski 1990). The comparison of mineralogy, geochemistry of different rock types and the plate tectonic interpretation seems to be essential in undestanding the petrogenesis of these rocks series.

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P -T PATH RECONSTRUCTION OF THE HIGH-GRADE METAPELITES, THE TATRA MTS., WESTERN CARPATHIANS

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The Tatra Mts. represent typical core mountins within the Tatric unit of the Western Carpathians, only weakly affected by Alpine metamorphism. In the Tatra Mts.. high-grade metapelites are in allochthonous position. i.e. they have been tectonically emplaced over a lower-grade micaschists along the major Variscan thrust fault. The pre-Mesozoic basement of the Tatra Mts. thus exhibits an inverted metamorphic zonation, where the staurolite-kyanite and kyanite-fibrolite zones of the lower tectonic unit are overlain by the kyanite and sillimanite zone of the upper unit. The higher levels of the upper unit are occupied by granitoids, forming a sheet-like pluton.

The most common assemblages of the metapelites from the upper tectonic unit are: I) garnet + sillimanite + biotite + quartz + plagioclase ± K-feldspar ± muscovite II) garnet + kyanite + biotite + quartz + plagioclase ± K-feldspar ± muscovite ± staurolite; III) cordierite + biotite + sillimanite ± garnet + quartz + plagioclase ± K-feldspar ± muscovite with ilmenite and minor amount of rutile and magnetite as Fe-Ti oxides.

During the initial part of the prograde metamorphism. the garnet was produced by reaction staurolite + quartz = garnet + kyanite + H2O. Based on the garnet-plagioclase (GASP) barometer and reaction garnet + rutile + kyanite = plagioclase + ilmenite. the P-T conditions of around 600°C and 9-10kbar were reached. Further progress of metamorphism yielded rising of temperature and pressure to more than 700°C and 11-12 kbar, calculated with GASP barometer and garnet-biotite thermometer. Muscovite dehydratation melting reaction muscovite + quartz ± plagioclase = K-feldspar + kyanite + melt was crossed in the stability field of kyanite. Further heating was accompanied by the dropping of pressure. the metamorphic peak conditions of 746 ± 46°C and 6.24 ± 0.76 kbar were reached in the stability field of sillimanite. The major melt and garnet producing reaction was the dehydratation melting of biotite. i.e. biotite + sillimanite ± plagioclase + quartz = garnet + K-feldspar + melt. The absence of orthopyroxene suggests that the higher-temperature dehydration melting reaction of biotite producing orthopyroxene was not crossed. Further decompression yielded cordierite crystallization, but only in most magnesian bulk compositions (assemblages III). by reactions garnet + sillimanite + quartz + fluid = cordierite and biotite + sillimanite + quatrtz ± plagioclase = cordierite + K-feldspar + melt. In addition, large poikilitic cordierites most probably grew during crystallization at solidus. Subsequent near-isobaric cooling led to solidification and sub-solidus retrogression (pinitization) and replacement of cordierite by white mica, pale-green biotite and quartz by reactions cordierite + K-feldspar + fluid = biotite + sillimanite + quartz and cordierite + sillimanite + K-feldspar + fluid = phengite + quartz.

The above results suggest that the Tatra Mts. high-grade metapelites followed a clockwise P-T path. The upper tectonic unit represents a deeply burried portion of the continental crust which was melted and exhumed during Variscan orogeny.

COMPARATIVE ISOTOPE-GEOCHEMICAL MODELING OF HYDROCARBON FIELDS ACCUMULATION IN CARPATHIAN PETROLIFEROUS BASIN

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CHLORITOID-KYANITE SCHISTS FROM THE VEPORICUM : REACTION TEXTURES, PHASE EQUILIBRIA AND IMPLICATIONS FOR THE ALPINE (CRETACEOUS) METAMORPHISM OF THE WESTERN CARPATHIANS

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Alpine tectonometamorphic processes in the Western Carpathians are best recorded in the Veporic unit. Here, Late Paleozoic chloritoid and kyanite-bearing schists occur in the south-eastern part, belonging to the Permian cover (Rimava formation).

Diagnostic mineral assemblage in pelitic schists is: chloritoid + kyanite + chlorite + quartz + white mica (muscovite-phengite-paragonite) ± ilmenite ± rutile. Based on microstructures, chloritoid is growing parallel to the foliation planes. In later stage of deformation, it was reoriented and rotated into the shear planes, which are related to penetrative Alpine extension (top-to-the E) due to unroofing of the Veporic core complex.

Metamorphic P-T conditions were calculated by means of geothermobarometry, using activity-composition relationships of mineral end-members based on microprobe analyses and internally-consistent thermodynamic data. For mineral assemblage chloritoid-chlorite-kyanite-quartz-water, in the FMASH system, estimated temperature and pressure range 456 - 459°C and 8.2 - 9.3 kbar (PTAX - Berman, 1988); 471 - 477°C and 5.6 - 7.2 kbar (THERMOCALC - Holland and Powell, 1990), respectively. In these rocks, the Si p.f.u. of around 6.55 in phengite is characteristic. The presence of kyanite and the absence of pyrophyllite indicates the overstep of the pyrophyllite stability curve. On the other hand, the absence of staurolite and garnet indicates that the upper boundary of chloritoid stability, i.e. the breakdown of chloritoid to garnet and/or staurolite was not reached, in accordance with calculated P-T conditions.

Based on field observations, microtextural relationships and calculated phase equilibria, it is concluded that chloritoid-kyanite schists from the Late Paleozoic (Permian) cover of the Veporic unit were metamorphosed during Alpine – Cretaceous tectonometamorphic events, as a consequence of collision-related crustal thickening.

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GEODYNAMICS OF THE EARLY ALPINE STAGE OF DEVELOPMENT OF UKRAINIAN SEGMENT OF THE CARPATHIAN REGION (TECTONO-MAGMATIC ASPECT)

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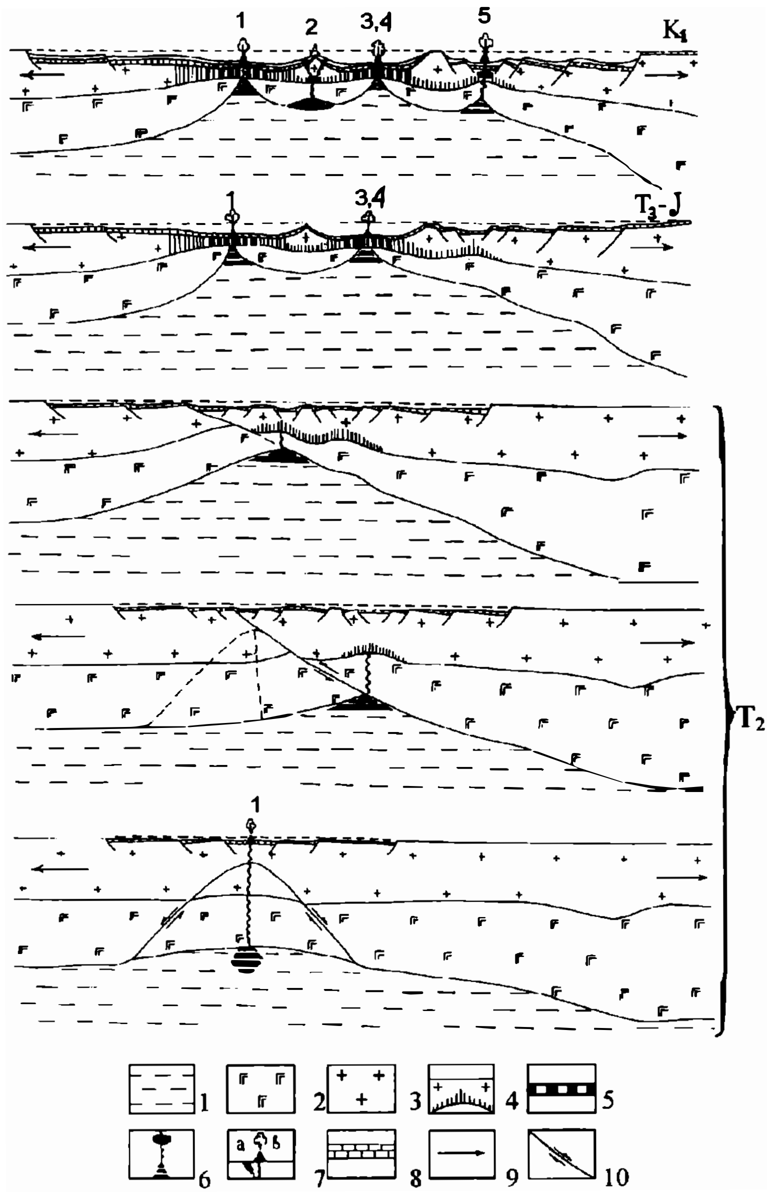
Study of Mesozoic magmatic formations of the Ukrainian Carpathians and Transcarpathian depression (results were presented on the CBGA XV Congress (Athens, 1995) and Pancardi Workshop (Stara Lesna, 1995)) allowed, on the basis on petrochemical, geochemical and mineralogical features, to divide them into several complexes: Transcarpathian (1 - on the figure), Vulhovchik (2), Ugolka (3), Rahiv-Chivchin (4) and Trostyanets (5). Each complex formed in specific tectonic setting and on the crust of different type: continental (high-K trachydolerites of the Vulhovchik complex (K_1)), oceanic (Na-tholeiitic basalts, diabases and associated lherzolites of the Ugolka and Rahiv-Chivchin complexes (T_3-K_1) which are interpreted as a fragments of dismembered ophiolitic sequences) and transitional (K-Na basalts, basaltic andesites and trachytes of the Trostyanets complex (K_1)). Rocks, which were formed in different tectonic setting,, are combined in the Transcarpathian complex: picritic tuffs and lavas (T_2?) - in the conditions of thick continental lithosphere at the beginning of extension and Na-tholeiitic basalts and diabases (T_3-K_1) - on the new formed oceanic crust.

Employment of these results for geodynamic reconstructions pennit to choose the model of breaking the previously formed Variscian continental crust (passive rifting) and to established succession of paleotectonic setting changes at the Early Alpine stage of development of the territory of the Ukrainian Carpathians (Fig.).



Legend: 1 astenosphere, 2 peridosphere, 3 - continental crust, 4 - continental crust enriched in mafic material, 5 - oceanic crust, 6 - magmatic sources, channels and cameras, 7 manifistations of magmatism: a hypabyssal, b effusive, 8 - sedimentary rocks, 9 - direction of plate movement, 10 - faults.

Geomathematical study on intermediate volcanic rocks of the Tokaj Mountains

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Evolution and classification of volcanic rocks of the Tokaj Mountains (NE Hungary) has not been clarified yet. In this study 500 major element analyses of the intermediate volcanic rocks of the Tokaj Mountains are mathematically evaluated. Multivariate geomathematical (factor, cluster and discriminant analysis) and mapping methods were used.

On the basis of the major element compositions 5 factor groups can be distinguished which represent the following geological processes: (1) igneous differentiation, (2) K-metasomatism, (3) enrichment of Fe-Ti minerals, (4) oxidation, (5) kaolinization. Factors represent 82 % of the total variance. The samples were classified by a hierarchical cluster analysis method in the 5 dimensions factor space. Stepwise discriminant analysis was performed for each pair of the 9 sample groups defined. The results of this analysis suggest that the differences among sample groups are principally due to the different scale of alteration. Therefore, by their major element composition, most samples are only partly suitable for coming to a magmagenetic conclusion.

Mapping the single factors in the real space, centres and range of the above mentioned geological processes could be represented. Based on these maps it can be stated that both secondary alteration processes belong to the hydrothermal stage of a young dacitic volcanism. The original geochemical character of the volcanic rocks has highly been converted by the secondary processes (weathering, potassium metasomatism). This influence, however, can be neutralized by a new and proper mathematical method (by using the inverse of the factor matrix), and, in a statistical sense, composition of the original volcanic rocks can be reconstructed.

Our study is the first one in which, instead of the classic discrimination diagrams, modern geomathematical, geostatistical methods are used for evaluating the major element composition of the intermediate rocks of the Tokaj Mountains.

HP relics in Variscan amphibolites of the Tisia Block, East Hungary

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Crystalline basement of the Pannonian basement in the East Hungary consists mainly of MT-MP rocks, gneiss, mica schist and amphibolite of the Variscan age. The chemical composition of the amphibolite samples is close to T-MORB tholeiites. They are common amphibolites with hornblende, plagioclase, sphene (ilmenite), quartz and at places with biotite and/or garnet. Although, the samples usually have equilibrium texture, they may be relict in part, and contain eclogite facies minerals.

Three main types of retrograded eclogite samples exist. 1) The kyanite-eclogite consists of garnet, clinopyroxene, kyanite, phengite, zoizite and rutile. As secondary phases amphibole, plagioclase, quartz and margarite occur. Thermobarometric calculations yielded 12 kbar as minimum pressure at 550-600 °C. Eclogite facies conditions were followed by decreasing both P and T down to the greenschist facies. The next progressive event reached its peak in the amphibolite facies. Amphibole and plagioclase grains with conspicuous chemical zoning grew

2) Another type of retrograded eclogite exhibits symplectitic texture with relict garnet, rutile, phengite and alkali amphibole. Its formation temperature is in the range of 500-550 °C. This rock type shows evidence of a similar two step evolution (eclogite-greenschist-amphibolite facies) as the type was given above.

3) Several amphibolite samples contain relict garnet grains with rutile and ilmenite inclusions Thermobarometric calculations in this GRISP paragenesis yield equilibrium conditions at about 500 °C and 10 kbar.

By combination of all textural investigations as well as results of the PT calculations, the scheme of the metamorphic evolution prior to the main Variscan event can be set together. The MT eclogite samples broke down under the greenschist facies condition and recrystallized in the amphibolite facies at about 600 °C, 6 kbar afterwards. This evolution is foreign to that of the other HP rocks of the Tisia Block. The samples examined seem to be similar to those described from parts of the Bohemian Massif, like the Saxothuringicum and the Lugicum.

DIGITAL GEOLOGIC MAP OF THE VELENCE MOUNTAINS, HUNGARY

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PLEISTOCENE GLACIATIONS OF THE EASTERN EDGE OF THE ALPS

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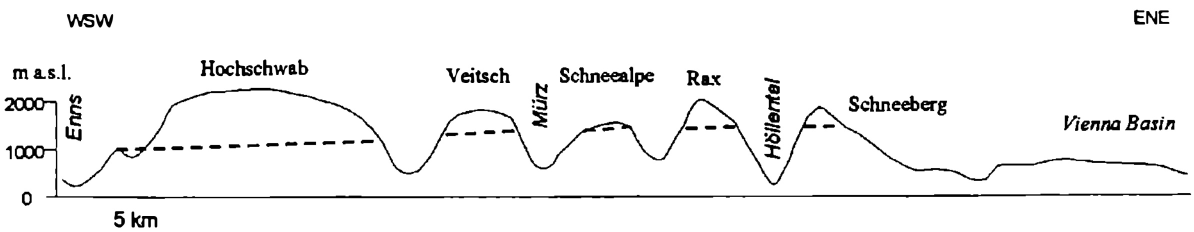
The investigations aimed at the reconstruction of the extent of the Pleistocene glaciers in the isolated montane massifs of the Rax (2007 m asl.), Schneealpe (1903 m), Schneeberg (2076 m) and Stuhleck (1782 m), located in the easternmost part of the Alps. The remnants of the last (Würm) glaciation are preserved relatively well, while those of the Riß and older are scarse and doubtful.

The massifs, lying relatively close each to other (ca 30 km), reveal considerable differences in sizes of the glaciers. This is due to the differences in geomorphology, heights and slope aspect. Rax, Schneealpe and Schneeberg represent a plateau-type of morphology, controlled by the bedrock (carbonates). Vast accumulation areas reflected in relatively intesive glacierization. Some glaciers were supplied by the plateau ice caps and were the longest in the area (4 - 5.5 km). Much shorter (ca 1.5 km) were valley glaciers supplied only by the firn fields. Stuhleck is built mostly of metamorphic rocks and reveals a ridge-type morphology. It is lower at ca 120 - 250 m, moreover. Poorly supplied glaciers were short (ca. 1.2 - 2 km) and filled upper parts of the NW side vellys. Glaciation of the SE side was limited to three small cirque glaciers.

Würm, Riß and older (Mindel ?) fluvioglacial terraces and fans occur at the mouths of the NW Stuhleck valleys. Relatively easily erodible bedrock contributed to intensive fluvioglacial accumulation. More resistant carbonate rocks of other massifs produced aparently smaller amount of debris.

The altitude of the equilibrium/firn line (ELA) was estimated by calculating the AAR (accumulation area ratio) for well reconstructed walley glaciers. Subsequently, the calculation was carried out for adjacent glaciers supplied by the plateau ice caps. It lowers from ca. 1380 - 1430 m asl. in the Stuhleck to ca. 1330-1400 in the Schneealpe and even less further westward (Hochschwab 1050-1100 m; *Cornelius* 1934 & 1939, *Fritsch* 1993, *Kolmar*1993).



Analysis of the ELA and distribution of the moraines reveals that only a portion of the plateau ice caps supplied the valley glaciers while large parts of them remained inactive or contributed very little to the feeding of the active glaciers.

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UPPER PLENIGLACIAL TO HOLOCENE PALAEOENVIRONMENTAL CHANGES IN THE FOREGROUND OF THE SOUTHEAST CARPATHIANS (KARDOSKÚT, HUNGARY)

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Sedimentological, geochemical, pollen, charcoal and molluscan analyses of radicarbon dated sediment cores from lake Fehér-tó, SE-Hungary provide a 23,000-yr palaeoenvironmental history of the area. A *Pinus silvestris-P.cembra-Picea abies* boreal forest association grew near the site between 23,300-21,800 yr. BP. The malacofauna was characterized by the appearance of species that presently have a ponto-mediterranean distribution, indicating milder climate conditions. As a result of the increased precipitation rate intense weathering proceeded in the area, and podzol or podzol-like soils evolved, mainly on floodplains being rich in silica.

Increased percentages of grassland pollens, and higher charcoal frequencies suggest that the climate became drier and cooler by about 21800-yr. BP. The structure of the surrounding woodland altered, dense forests opened up and were replaced by *Pinus silvestris-Larix decidua-Betula pubescens* parkland between 21.800-20,250 yr BP. At the same time, a slow minerogenic sediment accumulation started and the water level showed periodical fluctuations. Within the lake a similair malacofana developed than that is characteristic of the recent lakes of the German-Polish Lowland and is defined as the water equivalent of the continental loess fauna.

Between 20,250-18,600 yr. BP boreal woodland interspersed with tree genera of mesic forest (Quercus, Tilia, Ulmus) expanded again. At the LGM, about 18,600-yr BP, high charcoal frequencies indicate enhanced fire activities around the lake. A major decline in boreal trees with accompanying return of steppe genera identifies it.

From 16,550-yr. BP faunal and floral changes suggest gradual warming and a tarnsition from oligotrophic to mesotrphic water conditions.The appearance of mollusc genera that have a present middle- and southeast-european distribution started around 12,000-yr BP. The first detectable anthropogennic activity occured at 7500 BP Following this, the accretion process sped up and the lake reached its recent state through marsh - eutrophic lake - marsh stages, when it dried out and a strong alkalization process has started.

DYNAMICS OF ANOMALOUS GEOMAGNETIC FIELD FOR IT TO BE USED IN DEEP AND APPLIED GEOPHYSICS

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By dynamics of the Earth's anomalous magnetic field we mean its temporal changes caused by modern physical-chemical processes in the Earth's crust and the upper mantle (seismotectonic, geothermic, geochemical etc). To detect dynamics of anomalous magnetic field data from the network of european magnetic observatories have been treated analytically and experimental investigations in the seismoactive part of the Ukrainian Carpathians have been held.

Based on mean yearly data of magnetic observatories secular variation structure has been studied in the european territory in the second part of the 20^{th} century. Difficulties of studying such SV anomalies are connected with the necessity to detect small field changes (1.5-2.5 nT/year) against the background of secular variation global focuses with the intensity of several tens of nT/year. The main peculiarity of secular variation in Europe for the considered time interval (1950-1990) is a presence of two SV focuses: European with the epicenter in the Southern Europe and Arctic with the epicenter in the North of Europe; their dynamics and kinematics caused by processes in the Earth's core and greatly influences the field structure.

Permanent regional SV anomaly of lithospheric origin exists in Europe against the background of mobile global SV focuses. This anomaly of secular variation in the vertical component δZ_a (2.0-2.5 nT/year) covers the Central and Western Europe, stretches from North-West to South-East from Great Britan to the Black Sea.

Despite the schematic character of δZ_a distribution, correlation of its structure with the most general elements of tectonics and geophysical fields is observed. Thus the positive δZ_a region in Europe doesn't practically come out the limits of Alpian and Hercynic folded structures; the most intensive values δZ_a are characteristic of the Alpian region. On the East-European platform negative values δZ_a are dominated. Similar zonality is also observed in the gravitation and heat fields. Comparison of δZ_a with electroconductance distribution is of special interest. The sign change zone of δZ_a coincides with a central part of asthenospheric geoelectric inhomogeneity at the depth of 100-150 km and stretches from North-West to South-East in parallel to the boundary of the East-European platform. Oder-Caucasus linearment is characterized by similar stretch. Alike zonality is observed in the structure of geomagnetic field D_{st}-variations.

Analysis of geophysical fields testifies to a big lateral inhomogeneity in the upper mantle and the Earth's crust of the region. This inhomogeneity is characterized by high electric conductance, low seismic wave velocities, high heat flow and which regional anomaly δZ_a is attributed to. According to calculations, the depth of source δZ_a center is about 150 km, what corresponds to the depth of the inhomogeneity mentioned.

Local dynamics of anomalous magnetic field is investigated on the Carpathian geodynamic polygon. Temporal changes of anomalous magnetic field with an intensity of 2-7 nT/year have been found on the base of surface and profile repeat magnetic observations. The most intensive dynamics of field F is typical of Vygorlat-Gutynsk volcanic range, Transcarpathian and Prepannonian deep faults. On the base of regime observations on the Carpathian polygon temporal changes of magnetic field characterized by duration of 1.5-3 months and amplitude of 2.5-4 nT and their connection with local earthquakes have been found.

Investigations of anomalous magnetic field dynamics in sedimentary basins showed the scope of magnetometry for detecting active geological inhomogeneities and prediction of promising oil- and gas-bearing zones.

The experimental researches in Carpathians, Nothern Caucasus and Dniprovsko-Donetsk Trough have shown, that in zones of deposits of petroleum and gas the temporary changes of magnetic field F reach 2-10 nT/years. These temporary changes of magnetic field are caused by fluid-dynamic processes in fault zones and within the limits of deposits and have an electrokinetic nature.

GRAVITATIONAL SLOPE DEFORMATIONS IN THE GEOLOGICAL STRUCTURES OF SLOVAK CARPATHIANS

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The gravitational slope deformations represent the most dangerous geodynamics phenomenon in Slovakia. The present regional investigations have documented about 13.000 old landslides, which cover an area of about 1619 km2. These investigations found out that the landslide extent depends on the geological structure and on the geomorphological and climatic conditions.

The most affected region by sliding is built up by flysch complex, many landslides occure in the intramountainous basins and in the young volcanics mountain ranges. Particular types of gravitational slope deformations were originated in the core mountains of Slovakia in crystalline rocks of paleozoic age, or in the sedimentary rocks of mesozoic age.

Core mountains are built up by Variscan crystalline rocks, sedimentary mantle and by tectonic nappes. The most often detected gravitational deformations types are types, which are described as loosening, respectively disruption of mountains crests and shifts of massive blocks on the slopes. In more plastic metamorphic rocks the gravitational foldings occured. Block type failures generate in mesozoic age formated mountains and on slopes, where rigid linestones and dolomites lie on more plastic clayei shales. Up today was mapped around 700 failures of presented character.

Flysch belt (Paleogene, Upper Cretaceous). It is characteristic by largest number of landslides. They occupy total area up to 818 km2 (50% of total landslides area in Slovakia). Substantial part of these landslides, which have mostly areal, or stream-like form, is formed in regions with clayei type of flysch. In these areas relative slope deformation is up to 25 %.
The average landslide dips are 9°-13° Their maximum depth ranges 15 m.

In addition to sliding also earth flows are very often in flysch zone. They form due to extreme rainfall, which locally ranges amount up to 1100 mm/yr.

For the neovolcanic mountains in many areas is characteristic structure where rigid volcanic rocks (andesites, basalts, ryolites and agglomeratic tuffs) lie on tertiary claystones, respectively tuffitic clays. Owing to this geological structure the block type failures (block rifts, block fields) form on the slopes. Their depth ranges more than 100 m.

On the periphery of block type failures is situated large rim of areal, stream-like and frontal landslides. The prevailing types are potencial and active types. The average dips of the failured slopes are oddly mild. Their dips are 6-8° Landslides depth is up to 30-40 m. A share planes form is usually rotational in top parts of slopes, planar in middle and bottom parts.

The most extensive slide region in Slovakia is situated on the periphery of volcanic mountains Vtačnik and Kremnické hory Mts., where landslides occupy above 200 km^2 and on periphery of Slanske vrchy Mts. (120 km^2).

Intramountain basins. The landslides occurrence is conditional by geological construction of slopes, where in top parts lie lacustral, or terrace gravels, which are bedded on tertiary claystones. According to incomplete study were have registered 1570 landslides (130 km^2) in Slovak basins until 1985. We estimate that their actual number is up to about 30 % higher.

The landslides in basins are less dimensions. Prevailing landslides are frontal and stream-like slides. Their dips are 8-10°, share planes depth is 5-7 m.

Gravitational slope deformations in Slovakia damage the forests, arable soils, meadows and pastures. They endangered railways and motorways in 1300 sectors. About 90 % of new landslides take place by reactivization of old potential landslides due to men negative intervention. Substantial part of landslides in Slovakia is already registered in Geofond state archives. At the present time is started revision of these files.

THE ENGINEERING-GEOLOGICAL PROBLEMS IN NEW MOTORWAYS CONSTRUCTION IN THE EAST SLOVAKIA

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A motorway development in Slovakia will require building up communications, which will create in East Slovakia linkage between Poland and Hungary and at the same time its attachment on Ukraine frontier. Therefore we were required to execute engineering-geological appreciation of suggested communications influence on rocks enwironment according to technically-forecast study of road moves on tract "Poland frontier - Prešov - Hungary frontier" and on tract "Prešov - Ukraine frontier" (Figure 1.).

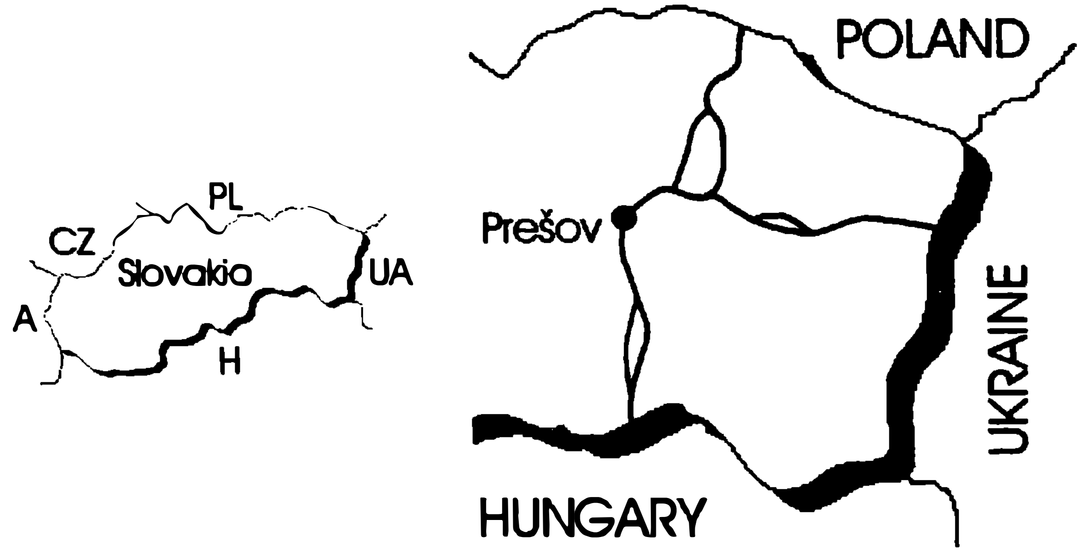

Figure 1. - The location of projected motorways in East Slovakia

The tracts of appreciated communications pass the region with complicated geological-tectonic structure. In the north part there is morphologicly dissected region, which is prevailingly formed by Paleogene rocks of exteriory flysch zone. Generally prevail claystones, or claystones-sandstones. Prequarternary substratum of Prešov-Hungary frontier tract is built by neogene sediments of molas type (clays, claystones, gravels and sands) which testify also smooth modeled relief of region. The region surface is covered by quarternary sediments.

The most important factor affected engineering-geological appreciation presented variant solutions of the tracts was slope stability and concretely the landslides occurence (of different activity degree) on presented tracts. The most often the landslides affect slopes built by Paleogene rocks. Ourselves observed data document it. Total appreciated distance of all variants on "Poland-Prešov" tract is 115 km. 25% of this distance pass slide regions. In section "Prešov-Ukraine" (145 km) slide areas represent 14 % (20 km) of total track distance. In section "Prešov-Hungary", formed by neogene layers, the landslides are less often (8 % of tract) and they are first of all bounded on structure, where less indurated saturated gravels lie on claystone-siltstone substratum.

Tracts leading in slide slopes is a most important geotechnical problem. The motorway building in landslides body require considerable costs in coherence with underground slope dewatering, building of anchored pilet walls, respectively with of bridging landslides.

In regions where tracts are leaded by fills through alluvial flats, with regards to impact on geological environment the places with unconsolidated sediments are dangerous.

Based on appreciation of all knowledge and ground mapping we recommended most optimal tracts of suggested variant solutions, which will invoke least negative impacts to rocks enwironment and which are most advantageous from economic point of view.

SUSPECTED LOWER PRECAMBRIAN COMPLEXES UNDERNEATH THE EASTERN MARGIN OF THE CARPATHIAN FOLDBELT

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In the Ukrainian Carpathians the only known Precambrian records are presented by Proterozoic units outcropped in Marmarosh complex. However, much more Precambrian suites could be expected eastward from the Carpathians, especially underneath the Fore-Carpathian folded system. Despite of these complexes are of lesser importance in whole understanding of the Carpathian tectonics om the meso- and micro-scales, their bearing could be suspected on macro-scale from the view of gross block-layered structure of the continental crust built up with Precambrian complexes not only eastward, in the Ukrainian Shield, but also in its close neighbour. Preliminary set of the Precambrian complexes underneath the Fore-Carpathians can be designed using general patterns of the Ukrainian Shield which structures are mainly propagate southwestward.

At least six Precambrian litho-tectonic complexes (LTC) could be expected in the vertical cross-section of the continental crust (from the base):

- *charnockite-granulite LTC* characterized by supercrustal, plutono-metamorphic and plutonic rock associations metamorphosed under monofacial granulite conditions and in places diaphthored by retrograde amphibolite metamorphism during the next litho-tectonic complex development;
- *granitoid-amphibolite LTC* composed of supercrustal, plutono-metamorphic and plutonic rock associations metamorphosed under monofacial amphibolite conditions;
- *tonalite-greenstone LTC* characterized by volcano-sedimentary and volcanic rock associations gradually metamorphosed under conditions from amphibolite and epidote-amphibolite to greenschist facies;
- *granitoid-metaterrigenous LTC* comprised by essentially metasedimentary rock associations and is presented by two distinct varieties. The first is developed as greenstone belts spatially-inherited units and is metamorphosed under greenschist facies (in the Ukrainian Shield, the areas of central parts of Krivoy Rog, Verkhovtsevo, Belozyorka and Konka structures, Middle-Dnieprean geoblock). And the second one has a zoned metamorphic patterns from amphibolite to granulite facies accompanied by strong granitization (Ingulo-Ingulets geoblock in the Ukrainian Shield);
- *plutonic LTC* presented by rapakivi-granite, gabbro-anorthosite, alkali-syenite-granosyenite and diorite-granodiorite associations. Stratified portions are virtually absent (North-Western, Ingulo-Ingulets and Priazovian geoblocks in the Ukrainian Shield);
- *volcano-sedimentary LTC* includes slightly metamorphosed units of Belokorovichi, Vilchany and Ovruch depressions in North-Western geoblock in the Ukrainian Shield.

Since the boundaries between different geoblocks comprise ancient and renewed mobile zones, some of these tectonic lines could influenced specific tectonic units in the Carpathians. Recently consideration of the strike-slip fault systems in this respect is of particular interest being propagate southward from the Ukrainian Shield (for instance, Odessa-Sinop fault zone).

Another value of the Precambrian complexes might be considered in term of their gold mineralization which is rather widely distributed according to modern data. Such the mineralization could have some importance for the Carpathian folded system gold deposits formation because of possibility of gold remobilization from buried crustal Precambrian mineralized units.

IMPORTANT MESOZOIC PALAEONTOLOGICAL SITES IN EASTERN SERBIA

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Geological treasure of Serbia is far too vast for us to assess collectively all the sites representing its immovable cultural property. A classifying system was therefore devised with different categories-levels for assessing geosites according to their significance and content. The geological column was divided into time-stratigraphic sections characterized by recognizable events and phases (epirogenic and orogenic). The same principle was applied to stratigraphic and sedimentological material as well as to the sites demonstrating the evolution of exceptionally important animal or plant groups. It was established that the most significant features of palaeontological sites coincide with chronostratigraphic division.

Discordantly overlying Proterozoic and Paleozoic rocks, Mesozoic formations on the territory of eastern Serbia have a wide geographic distribution. With respect to petrology, there occur sedimentary, igneous, and volcanogenic-sedimentary rocks. As regards their source environments, they encompass marine (shallow-water, chiefly reef and pelagic) and continental formations. The Jurassic and Cretaceous sediments have the widest distribution. The fossils from the Jurassic and the Cretaceous illustrate the dynamics of the evolution of organic world during these time sections. They provide a basis for a reconstruction of palaeoecosystems, distribution of terrestrial and marine areas, and for understanding climatic changes. Palaeontological material, together with the sites where it was discovered, offers invaluable data for interpreting events and processes in time and space.

URGONIAN SHALLOW-WATER FAUNA FROM THE CENTRAL PART OF YUGOSLAV CARPATHO-BALKANIDES

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Regional distribution of Urgonian formation in the central part of eastern Serbia (mountain systems of Kučaj, Tupižnica, Ozren, Devica, Svrljiške Planine) is presented. Sedimentological and biological elements related to the time interval Barremian - Lower Aptian have been studied in detail. Chiefly present were biomicrites and biosparites, bioclastic W, W/P, P and G. The remarkably varied macrofauna was dominated by shallow-water representatives, corals, gastropods, pachyodont and other shells, echinoids, and bryozoans. Micro-association comprised representatives of microflora - mostly green, blue-green and red algae, and microfauna, almost exclusively benthon foraminifers.

UPPER MANTLE BENEATH THE EASTERN RHODOPES, BULGARIA: EVIDENCE FROM OLIGOCENE ALKALINE BASALTS AND LAMPROPHYRES

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Eocene-Oligocene magmatism in the Rhodope Massif is mainly characterised by the occurrence of widespread calc-alkaline and shoshonitic volcanic products and minor intrusive bodies. However, more or less contemporaneous (28-26 Ma; Marchev et al., 1997) alkaline basalts and alkaline hornblende lamprophyres (camptonites) occur as dykes and diatremes. They are situated south of Krumovgrad (central-southern Bulgaria) close to the villages of Egrek, Gorni Jurutsi, Purjenaka and Strajets and are characterised by almost vertical emplacement (85-90^0) along NW-SE, N-S to NE-SW striking faults. The Krumovgrad alkaline rocks are the most primitive Paleogene rocks found in the Rhodope Massif as indicated by their high Mg#, and high Ni and Cr contents, and by the relatively common occurrences of olivine and clinopyroxene xenocrysts and upper-mantle xenoliths. Amphibole megacrysts have been found in the alkaline lamprophyres. Contents of highly incompatible element are significantly elevated compared to oceanic island basalts (OIB). $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ isotopic ratios variations of the Krumovgrad basalts (0.70323-0.70338 and 0.512893-0.512904, respectively) fall in the range of so-called Low-Velocity Component (LVC; Hoernle et al., 1995) or European Asthenospheric Reservoir (EAR; Cebria & Wilson, 1995). However, Krumovgrad basalts have lower $^{206}Pb/^{204}Pb$ (18.91-19.02) and $^{208}Pb/^{204}Pb$ (38.59-38.87) ratios than the LVC or EAR, which could reflect involvement of a component from the lithosphere or shallowest asthenosphere. Alternatively, it is possible that spatial variations may also exist between western, central and eastern European LVC.

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KARST PROCESSES IN THE WIDER AREA OF BOKOKOTORSKA BAY (MONTENEGRO, YUGOSLAVIA)

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Specifity of karst development in the wider area of Boka Kotorska bay is conditioned by geological structure, polyphase tectonic structure, coastal and continental position of the analysed terrain as well as by changing of different processes of morfologic formation (fluvio-calcarious, glacial and calcarious processes) within relatively short period of time.

The area analysed consists of Adriatic-Ionic zone, as the lowest tectonic floor, of carbonate composition of the upper chalk age, zone of Budva, constructed of mesosoic carbonate sediments with important participation of marl and silcium component including also paleogenic flish sediments, and zone of High Karst, represented by mesosoic sediment of carbonate composition. These units are in inverse position and in th SW direction.

Dislocations separating the units stated, have regional dimensions spreading in the NW-SE directions. Hower, the most important morphologic formation occured in the time of neotectonic activity and it reflects in activating intermittent ruptures formed in oligocene and formation of younger ruptures in pliocene-pleistocene. Within so reconstructed tectonic events, genesis of karst processes being also connected with hydrogeologic occurrences and phenomena has been considered.

Carbonate sediments of High rocks zone represent favourable environment for development of fluvio-karst and karst processes. Tese sediments represent very impermeable environment of broken cavernous and fissure porosity with plenty of underground waters. In the area of concentrated porosity amplitude of watertable fluctuation as well as velocity of running of underground water is great. Atmospheric water sink guickly and it mainly flows out at the contact with neotectonically plunged block of Bokakotorska bay and sediments of Budva zone. Thus the occurences of numerous springs below sea surface are explained, whose connection with groups of pits, caves and abysses from the hinterland have been recorded.

The conclusion has baen made that fluvio-karst reljef is the oldest within the analused area, which is represented by remains of valleylike depressions, spreading in NE-SW direction, tending toward Adrijatic sea. They are vartical comparing to contemporary dry valleys, formed by neotectonic movements indicating the existence of peneplena of premiocene age. The processes of karstification, erosion and denudation have lasted till the beginning of pleistocene when this region has been subjected to glacial processes. The remains of premiocene reljef, in postglacial period, now importantly neotectonically disturbed, are stricken by more and more intensive karstification resulting in reshaping of the products formed in previous processes as well as development of various types of karst reljef and accompaning shapes, with tendency of lowering into deeper parts of the terrain, according to velocity of sinking of tectonic block of the bay of Boka Kotorska.

THE STRUCTURE AND OCCURRENCE OF ROMANIAN RESERVES OF EXPLOITED COMPLEX ORES

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The complex ores contain zinc, lead and copper as major metals and always secondary gold and silver which can be extracted in some proportion. In addition, trace elements as: Mo, Sb, Bi, As, Se, Ge, In, Ga, Ta, Cd, Te, W, can be locally defined, sometimes of economic importance.

The Romanian complex ore deposits are ranking on the second place as importance, from the total reserves of common non-ferrous ores, after the copper and before gold-silver and bauxite ore deposits. Arround 52% common non-ferrous ore deposits contain complex ores.

The industrial exploitation of the complex ores started in the XVII-th century, as well as the gold and silver ores. For the second half of the XX-th century, estimative data of the exploited quantity show arround 100 millions tones, but actually could be more. For this time period, the mean content values were: 1.55% Pb, 2.49% Zn, 0.35% Cu, 0.93 g/t Au, 41.17 g/t Ag and 11.84% S.

In between these exploited complex ores, 57% represent common and 43% the gold-complex ones.

Generally, the common type of complex ores appear in the metamorphosed volcanic-sedimentary deposits, formed in the pre-Alpine cycles. The gold-polymetallic type is usually metalogenetic-related to the Alpine subduction processes, mainly of Neogene age.

Concerning the formation of the exploited complex ores, their genesis is related 67% to the hydrothermal and about 19% to the methamorfosed volcanic-sedimentary deposits.

The andesitic magmatic phase of Mio-Pliocene age generated the main part of the actual exploited reserves (roughly 66%). Together with the Cambrian rhyolitic volcanism, this genetic process contributed to the formation of arround 80% of the exploited complex ores reserves.

Around 76% of these reserves were formed during the Alpine cycle, while 16% of these reserves are related to the Early Caledonian cycle. The other reserves were formed during the Hercinic, Upper and Middle Proterozoic cycles.

About 64% of the Romanian complex ores reserves were exploited in 3 metallogenetic districts: Dealul Crucii - Băiut, Baia Borsa and Ilba - Nistru. Together with other five districts (Muncel - Rapolt, Brad - Săcărâmb, Fundu Moldovei - Lesu Ursului, Ruschita and Rodna), where they supply 84% of exploited quantity.

Also, complex ore deposits were exploited in the following districts: Moldova Nouă - Sasca, Ocna de Fier - Dognecea, Băisoara, Băita - Hălmagiu, Baia de Aries, Nimaia - V Lupului, Somova - Marca, Eastern Carpathians, Vorta - Dealu Mare, V. Blaznei - Guset, Silvas - Boita - Lingina, Cârlibaba - Dorna - Arini, Oravita, Tarna Mare, Săsar - V. Rosie, Toroiaga, Zlatna - Stăruja.

In conclusion, the main part of the exploited complex ores have a hydrothermal genesis, being formed by the andesitic magmatism related to the Mio-Pliocene subduction, and the Cambrian rhyolitic volcanism. From tectonic point of view, these ores belong to the Alpine and the Early Caledonian orogenic cycles. Their distribution is mainly related to the 8 of those 25 previous described exploited metallogenetic districts.

THE CONTRIBUTION OF GEOSCIENCES IN THE STRATEGIC PLANNING TOWARDS SUSTAINABLE DEVELOPMENT

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Despite the fact that, concepts such as environment, environmental protection, environmental awareness, environmental education and sustainable development, became popular only a few decades ago, Environmental Sciences invade our lives, creating an additional new philosophy in the planning of Man's activities, with the result that today the environmental factor plays a decisive role in programming and executing of projects.

Environmental respect has become for some people a way of life. People all over the world however, have started to become aware of environmental matters and rightly so, as environmental damage is not the concern of a group of people, nor of a nation, since environmental pollution is not confined within a country's borders.

Environmental problems feature a multi – dimensional character, since the environment is a multi – dimensional complex system, made up by the Atmosphere, the Pedosphere, the Hydrosphere, the Biosphere, the Geosphere and the Hydrogeosphere.

Man's awareness has been focused however mainly on the Atmosphere and the Hydrosphere and recently also on the Pedosphere, while little is known about the Geosphere and the Hydrogeosphere resulting at total lack of basic studies on the infrastructure of the geological situation in urban-planning complexes.

In order to fill this gap, people should be made aware that the environment does not stop at the Earth's surface.

The concept of Geo- environment is a new essential concept of fundamental importance. Its systematic study may protect human society from the effects of natural phenomena, which either are abrupt and occur rapidly such as earthquakes, or occur very slowly, as the sinking of coastal regions connected with the tectonic regime or with human interventions.

All this at the Strategic Planning Level should be put on maps of a suitable scale, that correspond to the planning scale, namely the familiar Urban-Geological Maps supplemented with geo-ecological data, that is the Urban-Geo-Ecological Maps. These maps differ from the simple urban-geological ones in that they give sufficient quantitative data on the boundaries within which the evaluation of the physio-geological potential can be made.

The Urban – Geo – Ecological Maps allow urban societies to specify the boundaries of their financial and social development. They meet the needs of the development, "without destroying the environment, without exhausting natural resources on which human activity relies and without putting at risk the ability of future generations to meet their own needs", as provided for in the Program of the European Commission (EEC, 1992) which refers to policy and action concerning the environment and sustainable development.

GEOSCIENCES AND SUSTAINABLE DEVELOPMENT

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The major Earth Summit achievements of the UN Conference on Environment and Development held in Rio de Janeiro on 1992 were:

- The Rio Declaration on Environment and Development.
- Agenda 21
- A set of principles in order to support the sustainable management of forests worldwide.
- Two legally binding conventions aiming at prevention of global climatic changes and the eradication of biologically diverse species.

Worth to note that it is actually the first time in international policies we have consensus that the future of planet Earth is at stake if we do not reverse the process of abusing it.

The Rio Declaration on Environment and Development is a series of 27 principles defining the rights and responsibilities of States in this area whereas Agenda 21 is a comprehensive blueprint for the global actions to affect the transition to sustainable development.

For any geologist aware of Agenda 21, it has become obvious that "Geo-environment" has been heretofore a more or less underrated concept.

The concept of "Environment", according to the contemporary aspect, is constrained within the Pedosphere, the Atmosphere, the Hydrosphere and the Quality of Surfacial Waters, without paying the adequate attention to the Lithosphere and the Quality of the Underground Aquifers as Environment Does Not Stop on the Earth's Surface.

In this paper, emphasis is given to the four-dimensional character of the Geo-environmental problems, i.e. the three-dimensional Lithosphere plus Time.

Special attention should also be given to the apparent interconnection between Sustainable Development and Geological Processes, e.g. the man-induced subsidence of the land-surface due to compaction caused by water or oil pumping, the man-induced seismicity caused by mining, reservoir water filling, etc.

The following issues are discussed in brief:

- Geo-environmental Sustainability

    in Town Planning
    in Hydrogeology and
    in Engineering Geology

- Geological Education and Sustainable Development

It should also be discussed the way in which geologists, and more generally geoscientists, could interfere in the Sustainable Development as well as the way in which geologists could take the initiative to bring to notice and then to promote the role of Geo-sciences in the scope of Sustainable Development.

QUATERNARY REPEATED ACTIVITY OF THE PSATHA FAULT (GULF OF CORINTH, GREECE)

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The preliminary results of the study of the Psatha fault are presented. Psatha fault is located between the easternmost margin of the Gulf of Corinth (Greece) and the westernmost margin of Pateras Mt., consisting the southern boundary of the Psatha bay, which is a lower order neotectonic structure (graben). It trends NE-SW and cuts the southern marginal fault zone of the Pateras Mt. horst which strikes NW-SE, and forms the boundary between the Pateras Mt. Horst and Megara half graben. From the neotectonic point of view the study area is located in the transition zone between a horst (Pateras Mt.) that is constituted with neritic limestones of the Sub-Pelagonian alpine geotectonic unit and a graben (Gulf of Corinth) that has been filled with Plio-Quaternary deposits.

Psatha fault constitutes a very interesting case study, as many reactivation have been expressed upon it during Quaternary. It constitutes the tectonic boundary between the Pleistocene deposits and the neritic limestone. In the area of Psatha Bay, mainly debris cones and alluvial fans represent the Quaternary deposits. They consist of calcareous gravels arranged in layers, slightly consolidated in the upper part, whereas in the lower parts are more cohesive. Very often limestone blocks occur within these deposits. The thickness of the deposits is estimated to be more than 60 meters, while the age - after some authors - is most probably Wurmian. A recent removal of the Quaternary deposits (scree) at a part of the fault that hasn't been eroded yet gave us the opportunity to observe and to study successive reactivations of the fault.

More specifically, the **shape** of the fault surface is not planar but curved, i.e. convex and concave. The **tectonic breccias** observed on the fault could be distinguished at least in two different categories taking into account the lithology of the fragments they consist, the matrix and their relative age. The oldest tectonic breccia is compact and oligomictic and consists exclusively of very small angular particles of the neritic limestones. The thickness of this brecciated sheet of the fault surface exceeds some centimeters. This breccia can be observed all over the fault surface, either it is eroded or not. A thin calcitic film the thickness of which in some places is about 5mm but usually is thinner covers this tectonic breccia. The relative younger tectonic breccia is polymictic and consists of fragments of post alpine deposits of Plio- Quaternary age (sands, silts, etc.) as well as of neritic limestones, whereas in some places of the fault surface, fragments from the older tectonic breccias are present as well. The size of the angular coarse material varies from 1 to 5 cm, the origin of the cement is from the Plio- Quaternary deposits. The thickness of this breccia is more than 2 meters.

The structure indicating successive reactivation of the fault is the presence of plunging **slickensides**. They are distributed all over the non-eroded fault surface independently if the fault cuts limestones, older tectonic breccias, or the younger tectonic breccias. The older slickensides set seems to be that of first (I) set, plunging $62^0/294^0$ It occurs always on the older oligomictic breccias surface dipping $68^0/332^0$ with very high frequency. A second (II) set occurs on the same surface plunging $55^0/278^0$. The next slickenside generation – whose frequency is relative low – is that of the third (III) set, plunging $34^0/260^0$ They occur not only on the surface of the oligomictic breccias, but also on the surface of the polymictic breccias and especially on pebbles that come from the limestones. This surface dips $70^0/336^0$. The fourth (IV) generation of slickensides occurs on fault surfaces cutting the polymictic tectonic breccias, plunging $62^0/282^0$. The slickensides have been printed especially on pebbles and gravels of the polymictic breccias coming from the neritic limestones. This surface dips $78^0/346^0$. Taking all the above mentioned into account that is;

(i) The curved fault surface
(ii) The successive breccias
(iii) The oblique slickensides
(iv) The oblique-slip character of the reactivated faults during the seismic activity of 1981 (MARIOLAKOS et al., 1981)
(v) As well as studies on Morphotectonics that have been done after the earthquake activity of 1981

We believe that the deformation of both the narrow and the major area is **not** that of **pure extension** but it is more complicated namely of a **rotational couple** stress field.

LITHO- AND BIOSTRATIGRAPHY: A KEY TO INTERPRET THE PALEOENVIRONMENT. THE CASE OF MESSINIA BASIN (GREECE)

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The post-alpine sediments at the eastern margin of the Southern Messinia basin overlie unconformably the alpine ones. Their deposition took place over an already wellformed erosional paleorelief.

Based on sedimentological and stratigraphic criteria, the above mentioned post-alpine sediments may be distinguished into:

a. Marine Pliocene - Pleistocene sediments, which include:
   i. The Thouria Asprochoma formation, that is attributed to a shallow-water depositional paleoenvironment, distal to the coast.
   ii. The Aghios Georgios formation, that is attributed to a shallow-water depositional paleoenvironment, proximal to the coast.
   iii. The Skopeftirion and Velanidia formations, that are attributed to an alluvial fan depositional paleoenvironment.

b. Continental Pleistocene deposits, which include:
   i. The Red-Siliceous Detrital formation, which is attributed to the *in situ*, or not, weathering of the oligomictic or polymictic marine conglomerates.
   ii. Monomictic scree and fans, whose deposition is mostly controlled by tectonism.

c. Continental Holocene deposits, which include fluviatile, swamp and coastal deposits.

The Pleistocene age assignment on some of the above-mentioned sediments is based on the presence of *Hyalinea balthica* (SCHROETER) and *Globorotalia truncatulinoides* (D'ORBIGNY).

Based on the litho- and biostratigraphy of the sediments, it is evident that the eastern part of the Southern Messinia area had been submerged until the end of the Middle Pleistocene.

Since then the area is under uplifting regime. Climate and tectonism, however, have now become the main morphogenetic factors. Nevertheless, tectonism is the main factor of morphogenesis in the area after the Middle Pleistocene.

THE ROLE OF FAULTS DURING THE TERTIARY EVOLUTION OF THE WESTERN CARPATHIANS

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By means of paleostress analysis, accepting paleomagnetic data, several successive Tretiary paleostress events were distiguished in the Western Carpathians. Within described microfault related paleostress fields was deduced with support of sedimentological and starigraphic data kinematics of regionaly important faults in single periods. This approach was used as background for geodynamic reconstruction of the Tertiary evolution in several focussed areas of central Western Carpathians. Strikes of structuraly important map-scale faults and their names were compiled from published papers and manuscripts.

During the Tertiary development of the Western Carpathians loop crucial role played regionaly important faults. Two distinct megablocks, outer and central Western Carpathians one suffered different tectonic evolution. Structure of the central Western Carpathians block consolidated (thrusted and folded) by mesoalpine orogenic processes during the Middle/Upper Cretaceous was later on divided by brittle faults to several parts. These faults accomodated mainly as strike-slips northward and later northeastward indentation of central Western Carpathians units by differentially moving subblocks, opened intramountain basins and controlled its sedimentation. Meanwhile outer Western Carpathians area was continuously shortened producing thin-skinned structure thanks to its lithology and geotectonic position. Contrary to the transpressional and transtensional strike-slip tectonics and normal faulting dominating in the realm of internides, the thrust and fold tectonics formed within externides structure of the orogenic accretionary wedge. Outer and central Western Carpathians blocks are juxtaposed by Pieniny Klippen Belt - extremely shortened and sheared suture zone. This zone accomodated mutual strike-slip and rotational displacement of two megablocks, what is recorded in tectonic structures as well as in amputation of formerly single paleogene basins occuring in between megablocks.

In the wetern part of central Western Carpathians area evolving Tertiary stress field induced the Paleogene-Lower Miocene transpression, Middle Miocene transtension and Middle-Upper Miocene extension with distinctive event of postpannonian compression. Reconstructed rotating directions of principal paleostress axes reflected progradation of orogenic front, shifting to the east and caused kinematic fluctuation of faults. Faults controling depocentres of sedimentation in transpressional regime formed Eggenburgian wrench furrows, which were later destroyed and replaced by Badenian pull-apart and finally overprinted by Middle-Upper Miocene extensional basins. Several field evidences confirms also Postpannonian stress field inversion, when had repeated compressive event with roughly N-S trending compression.

TECTOGENESIS OF LATE PALEOGENE / NEOGENE AND NEOGENE BASINS OF THE EAST SERBIAN CARPATHO-BALKANIDES

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Late Paleogene and Neogene deposits of the Carpatho-Balkanides in eastern Serbia were laid predominantly in freshwater lake basins and far less in the marine aquatorium. The depositional basins form two groups, clearly distinguished on stratigraphic-tectonic criteria. One group includes Oligocene and Oligocene / Lower Miocene basins whose sedimentary rocks form at the present narrow zones squeezed between reverse faults and thrust slices of NNW-SSE (NNE-SSW) trend, locally covered by imbricate systems of preexisting rocks. Formation of these basinal features is associated with the dextral transtensile shears in the domain of NNW-SSE faults, which were manifested during the Oligocene and the earliest Lower Miocene between the Mesian plate and the Vardar suture as a result of the Dinaride-Kraishte orogenic collapse. It was a broad belt of basinal structures and magmatic activities in NW-SE direction, extending from southern Slovenia south-eastward across the axial parts of the Dinarides, diagonally through parts of the Vardar zone, Serbian-Macedonian massif, Carpatho-Balkanides, to the Rhodope mass. The Oligocene and Oligo-Miocene extension within the belt was balanced by SW-vergent overthrust in the convergence (collision) area of the Dinarides-Hellenides and the Adriatic plate, and partly by similar movements, only NE-vergent, on the convergence margin of the Tisza-Dacia continental entity and the European plate. The definite inversion of the basinal structures was completed before the Karpathian, probably in the Ottnangian, and was particularly dramatic in the Carpatho-Balkanides of eastern Serbia, where dextral transpressive movements along longitudinal dislocations in NNW-SSE direction were complicated by clockwise rotation (southern Carpathian arc).

The other group of Neogene basins in the east Serbian Carpatho-Balkanides was formed by block downthrow along transverse and diagonal, or longitudinal, faults. Genetically, these basins can be associated with extensions in the Pannonian realm which began in Karpathian and was synchronous with overthrusts in the outer Carpathes. Extensional processes operated in Serbia south of the Sava and Danube rivers, where the Neogene Velika Morava trough is at present and the adjacent areas including the Carpatho-Balkanides of eastern Serbia. The extensional processes and thermal sublithospheric activity were less intensive in this region than in the Pannonian basin, so that the inversion of most of intracarpathian basins of eastern Serbia occurred as early as in the Lower Badenian. From that time on, especially after the Sarmatian and Pannonian, the basins were incorporated with the uplifted Carpatho-Balkan morphostructural sequence.

INNER WEST CARPATHIAN FLYSCH: RELATION BETWEEN PALEOMAGNETIC DIRECTIONS, PRINCIPAL SUSCEPTIBILITY AXES AND SEDIMENTARY TRANSPORT DIRECTION

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The Podhale Flysch of Poland and the flysch of the Levoča basin, Slovakia, both Paleogene in age, were sampled for paleomagnetic investigation at 18 localities.

The following measurements were carried out: anisotropy of the low-field magnetic susceptibility, susceptibility and NRM measurements in the natural state, stepwise AF or combined AF and thermal demagnetization of the NRM, identification of the magnetic minerals using IRM characteristics and by stepwise thermal demagnetization of the three-component IRM.

As a result, statistically well-defined paleomagnetic directions (carried by magnetite) were obtained for 6 localities in the Podhale, for 4 localities in the Levoča basin. All of them, except one, are characterized by foliated sedimentary fabric with weakly developed lineation, with the maxima scattered, or tending to cluster. On the contrary, the localities which failed to yield paleomagnetic directions, though the dominant magnetic mineral is also magnetite, exhibit well-clustered lineations.

The direction of the lineation is aligned with the direction of the sedimentary transport indicated by solemarks.

Thus we conclude that the lineation of the magnetic fabric must have been controlled by sedimentary transport, and the paleomagnetic directions, which are similar for the two basins, reflect the direction of the ancient magnetic field.

MIDDLE MARINE MIOCENE CALCAREOUS NANNOPLANKTON: A COMPARATIVE STUDY OF THE SUBCARPATHIANS AND TRANSYLVANIAN BASIN (ROMANIA)

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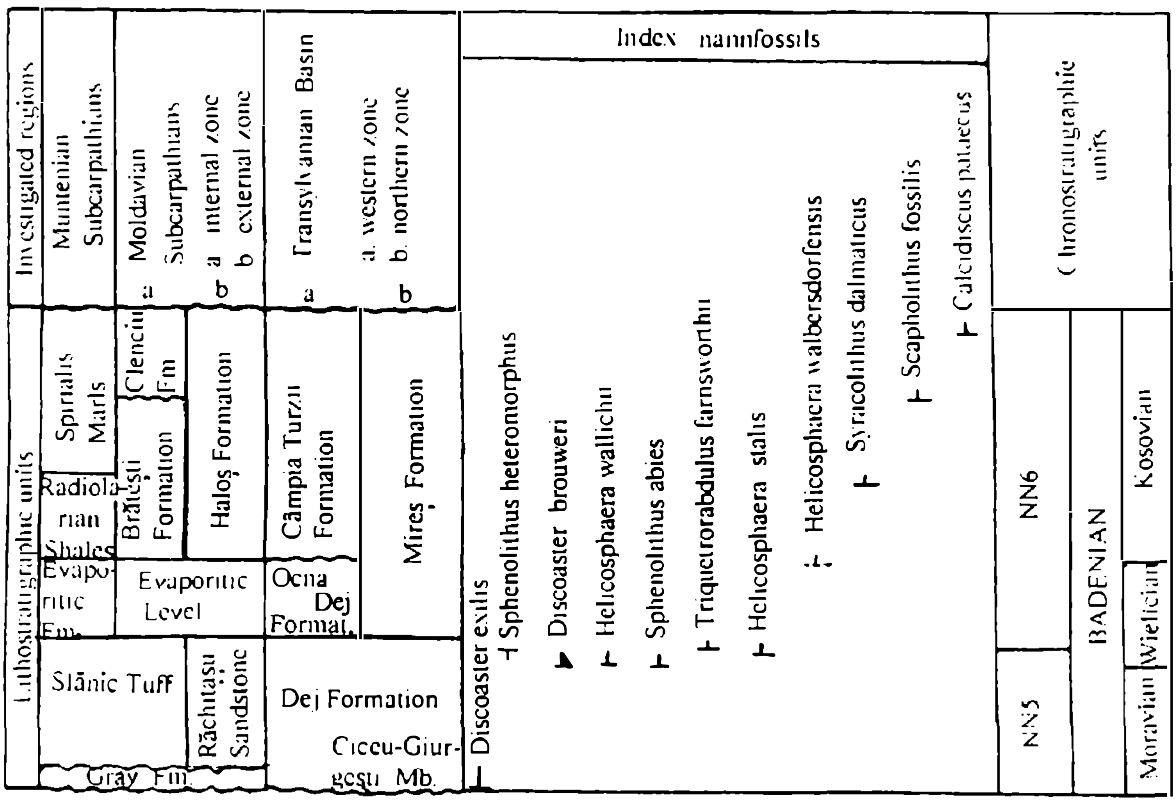
The Badenian abundant and various calcareous nannofossil assemblages of the Subcarpathians and Transylvanian areas, belong to NN5 and NN6 zones. The following succesion of bioevents was observed (Tab 1): the synchronous first occurences of Discoaster brouweri, Helicosphaera wallichii and Sphenolithus abies at the top of NN5 Zone, before the extinction of Sphenolithus heteromorphus; the last appearances of Sphenolithus heteromorphus and the first occurences of Triquetrorhabdulus rugosus / T farnsworthi, accompanied by the explosive development of Discoaster brouweri, that point out the boundary between NN5 and NN6 zones; first occurence of Helicosphaera walbersdorfensis in the lower part of NN6 Zone, only in Moldavian Subcarpathians; the succesive occurences of Syracolithus dalmaticus, Scapholithus fossilis and Calcidiscus pataecus in the upper part of the NN6 Zone.

According to the stratigraphic distribution of these nannofossils, the regional Badenian substage can be well defined. Thus, the Moravian is characterized by NN5 Zone, ist lower boundary being marked at the first occurence of Discoaster exilis. The Wielician can be correlated with the top of the NN5 Zone and the lowermost part of NN6 Zone, containing the time interval between the first appearance of Discoaster brouweri and, probably, the first occurence of Helicosphaera walbersdorfensis. The Kossovian corresponds to the most part of NN6 Zone, ist upper boundary being marked by the extinction of Cyclicargolithus floridanus.

Tab. 1 BADENIAN NANNOPLANKTON BIOEVENTS (ROMANIA)



ISOLITHIC AND HETEROLITHIC XENOLITHS IN THE LARAMIAN INTRUSIONS FROM BUDUREASA AND PIETROASA, APUSENI MTS., ROMANIA

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The mainly granodioritic banatitic massifs, from Pietroasa (in the South) and Budureasa (in the North) contain numerous xenoliths, of different types: *isolithic* = *autolithic xenoliths* (granodioritic rocks) and *heterolithic xenoliths* (fragments of diorites and also crystalline and sedimentary rocks). The xenoliths occur on significant surfaces and have various sizes, ranging from 1 - 2 cm to tens of meters. The xenoliths have their maximum development in the Pietroasa zone, along the Crisul Pietros Valley. In Budureasa zone, the xenoliths are less frequent and smaller.

Fragments of coarse granodiorite, microgranodiorite, porphyric granodiorite represent the autoxenoliths (isoliths) originating from the earlier consolidated borders of the intrusions.

The xenoliths of older (Istrate & Udubasa, 1980; Stefan et al., 1988) diorite rocks have hypidiomorph, microcrystalline (microdiorites) or porphyry structures.

The xenoliths of metamorphic rocks represent fragments of quartzites, chlorite schists, quartz+feldspar schists, amphibolite rocks and gneisses. The crystalline rocks ocasionally changed into amphibolite+biotite hornfelses. Metasomatosis (feldspatization) was also observed and is microscopically and megascopically emphasized by the occurence of well-developed pinky crystals of albite (up to 1-1.4 cm).

Sandstones, graywackes, carbonaceous rocks and seldom clays represent the sedimentary rocks xenoliths. The thermal and thermic-metasomatical processes transformed these xenoliths into quartz+biotite and cordierite - biotite hornfelses and pyroxene microskarns, respectively.

The borders between host rock (granodiorite) and xenoliths are, in general, well defined and sharp, especially in the cases of the autoliths. In some cases of metamorphic xenoliths, white - pinkish reaction rims of quartz + feldspars were observed.

The petrographic nature of the included rocks offer important information on composition, structure and depth of the geological assemblages at depth and are indicators of the thermic - barric constraints of the magmatic metamorphism.

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MAIN MINERALOGICAL REGIONS OF THE UKRAINIAN CARPATHIANS

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The main mineralogical objects of the Ukrainian Carpathians are situated in the following ore regions:

Trans-Carpathian Internal Trough

1. The Beregove region. It associates with the horsts of the Beregove and the Began' volcanic structural zones. Two structural stages could be marked in the geological structure - the Triassic-Cretaceous basement and the upper stage, consisted of three horizons of Miocene rhyolite tuff interbedded with two sedimentary beds. The magmatic rocks belong to the rhyolite and andesite formations. The magmatic process was followed by an extremely intensive hydrothermal activity, which has formed two ore fields - the Beregove ore fields with gold, polymetallic, alunite and kaolinite deposits, and the Began' ore field with alunite-barite-polymetallic ores. 2. The Vyshkiv region. It belongs to the Vyshkiv tectonic-magmatic structure, where the hypabyssal facies of the Miocene andesite volcanic belt was developed first of all. The principal mineralization of this region is the mercury ore formation: Grendesh, Borkut, Shayan, etc. Three mineral types appear here, as cinnabar, metacinnabar-cinnabar and sphalerite-galena-cinnabar ores. Organic minerals: idrialite, karpatite and various organic compounds occur nearly every where in the mercury ore deposits. 3. The Solotvyna region. It is situated in the Solotvyna depression and it is associated with the Miocene tuffaceous-evaporite formations. The main mineralogical objects are the Solotvyna and Tereblya rock salt deposits. 4. The Vyhorlat-Gutyn volcanic chain. The 20 km wide and more than 100 km long Vyhorlat-Gutyn volcanic chain extends across the whole Trans-Carpathians. It is consisted of Pliocene andesite formations. The main mineralogical objects are connected to the extremely active post-magmatic processes. The following metasomatic rocks and the accompanied ore mineralizations appear here: quartz-tourmaline type, quartz-topaz type with kaolinite, "hydromica" occurrences and with pilsenite, tsuomite, bismuth, galena, sphalerite ore occurrences; "ungvarite" and others.

The folded zones of the Carpathians

5. The Rakhiv region. It is situated in the north-western border of the Marmarosh crystalline massif, where Pre-Upper-Paleozoic metamorphic rocks outcrop in several places. The main mineralogical objects of this region are the gold (stratiform) and polymetallic (vein) ore formations. 6. The Chyvchyny region. It includes the Chyvchyny part of the Marmarosh crystalline massiff where the ancient metamorphic rocks outcrop on the surface. The principal mineralogical objects of this region are "graphite", manganese ores and also pyrite-polymetallic stratiform ore occurrences. 7. The Cretaceous-Paleogene flysh belt of the North-Eastern Carpathians. It takes up the main area of the Ukrainian Carpathians, they form thick layers in different structure-facies zones of the Carpathian foldbelt. The principal mineralogical objects are connected with the diagenetic processes and with the slightly developed low temperature hydrothermal activity. The first type is represented by copper-bearing mineralization and carbonate concretions, and the second one is with mercury, antimony-mercury-arsenical ore formations and with the "marmarosh diamonds".

Pre-Carpathian Foredeep

8. The Stebnyk-Truskavets'' region. It is situated in the north-western part of the Carpathian Foredeep. The principal mineralogical objects are K-Mg-bearing salts deposits (Stebnyk, Boryslav, etc.) and the Truskavets' lead-zinc ore deposit, which are connected with Miocene halide sediments. 9. The Kalush region. It contains the salt-bearing beds of the central part of the Carpathian Foredeep. The main mineralogical objects are the K-Mg-bearing deposits of the Kalush-Golyn' group, with halide formations and with copper-bearing mineralization. 10. The Nadvirna-Yabluniv region. The most part of this region is situated in the central part of the Carpathian Foredeep, in the junction zone of the Sambir and Boryslav-Pokuttya nappes. The main mineralogical objects here are copper - and gold-bearing ore occurrences.

RECENT ACTIVITY OF THE LITORAL ZONE TO THE N OF THE CITY OF VARNA

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The Black Sea littoral is placed in the Balkan fragment of the Southern margin of the Euro-Asian plate. The N Bulgarian sector of the above mentioned littoral is situated to the N of the city of Varna. This sector includes the E margin of the Moesian microplate and partiality W margin of the Black sea microplate. The most representative recent structures present the blocks without intensive vertical displacement and the faults, distributed mainly on the block peripheries. The principal fault directions varied between N-S, E-W and NNE-SSW, WNW-ESE.

The littoral characteristics pre a summary result of the preceding and recent stages of evolution. The recent one is realized in the conditions of relatively intensive tectonic processes of destruction and construction in the blocks mainly of the Moesian microplate. The both contrast tendencies are alternated: the block formation is followed by the block modification and separation.

Some of the most considerable deformations of the recent block relief, including significant flood manifestations in the continent, could be related to the paleo, historic and contemporary seismicity. The documented historic earthquakes of the Ic B.C. and XVc. provoked some important corrections in the type of the relief in the town of Kavarna and the city of Varna, considerable destructions in the highway netin the littoral zone between the city of Varna and cap of Kaliakra , also human caswalties. The effects had a faults and landslide predistination. Later, the Shabla 1901 earthquake with M=7.2, I=IX-X mobilized faults, landslides and rockfalls in the region. An agricultural territory of 200000m^2 was destroyed in the surrounding of the town of Balchik. The destructions were abserved between the town of Balchik and the village of Durankolak. The strong and relatively deep earthquakes of the Vrancea, Black Sea, Crimea, Caucasus, Asia Minor and Mediterranean cause ceratin local and regional activity of the investigated area. According the seismic zoning of Bulgaria the region is of seismic danger with a magnitude M up to 7.6-8 and an intensity to up to IX-X or X.

The recent epirogeny provokes specific movements which vertical components have the following values more + 2mm/a - in the surrounding of the city of Varna, about +2mm/a in the strip between the town of Balchik and the cap Kaliakra, 0+1mm - in the Dobrudga plateau, placed to the N of the above mentioned strip small blocks the indicated values could reach more impressive positive or negative characteristics.

The local and regional development of the abrasion, limans, marshes, landslides, rockfalls and suffusion effects produces an important influence to the relief evolution of the littoral. Here on the basis of the block divided region, the erosion, abrasion, denudation, also the eustatic changes, from one side, and sometimes the anthropogenic influence, from other side, cause the reactivation and new formation of the fractures and faults. The open up to 1.5m dislocations and a lot of landslides are observed in the city of Varna, the towns of Balchik and Kavarna, the villages of Kranevo, Batovo, Momchil, Shabla, Nanevo, Durankulak, the cap Kaliakra, the Taukliman. In the last 40 years the the abrasion, added by the tectonics, provoced the destruction of a 20-50 m wide littoral zone of the continent.

In some cases the combination of the geological instability and some unreasonable engineering activities with some climatic anomalies create exclusive conditions for local or regional expressive deformations. After the spring and antumn rains of 1997 the littoral between the city of Varna and the town of Balchik was very impressively deformated.

So the region has certain very sessions geoenvironmental problems. The situation in 1997 had influenced badly to the tourism, transport and whole economic evolution.

FIRST ACTIVITIES OF UNESCO-BAS PROJECT ABOUT LAND SUBSIDENCE IN THE REGIONS OF THE CITIES OF SOFIA, SKOPJE AND TIRANA

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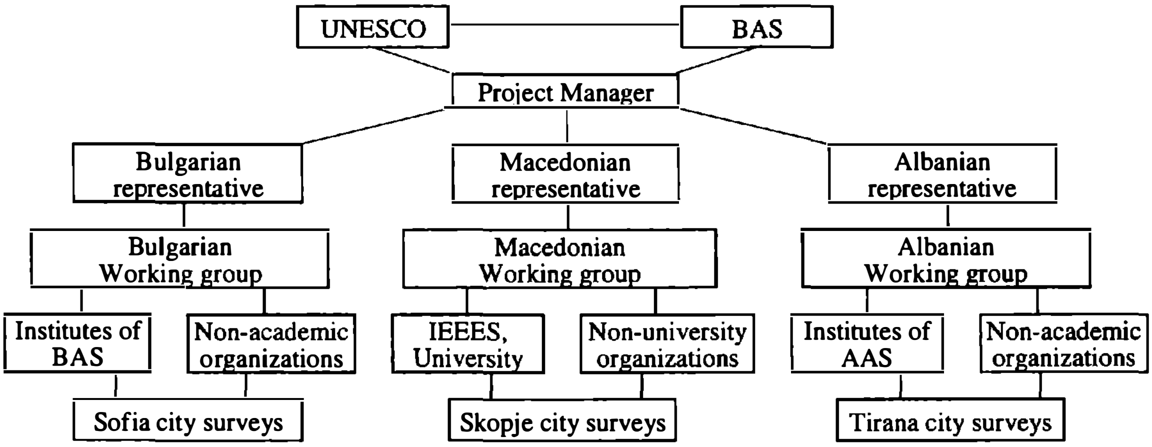
The International Project "Expert Assessment of Land Subsidence Related to Hydrogeological and Engineering geological Conditions in the Region of Sofia, Skopje and Tirana" (1996-2000) is a Project of UNESCO and Bulgarian Academy of Sciences (BAS). The recent activities are related to two UNESCO Programs: International Hydrogeological (responsible Dr. Szollosi-Nagy, Paris) and Land Subsidence (responsible Dr. Ivan Johnson).

The subject of Project is the research of the real and possible land subsidence in the three Balkan capitals Sofia, Skopje and Tirana. This subsidence is caused by the changes of the ground water levels, realized in very complicated geological conditions of relatively high seismic activity in active grabens which sediments have local variable hydrogeological, engineering geological and structural characteristics. The basis of the Project is presented by the preceding Balkan Seismic Project and its activities (1961-1965) and the national geological, hydrogeological, engineering geological and geodetical investigations up to 1995.

The main aims of the Project: use of the preceding research and realization of new one for data collection; application of common methodology of investigations and interpretation; comparison of the obtained results and the expert assessment of the land subsidence; periodical publications about the Project activities.

The two year results are the following: close personal scientific contacts among the Project participants of Bulgaria, Macedonia and Albania realized by a correspondence and meetings; similar contacts between the Project Manager and the responsible people of UNESCO and BAS; regional and local observation, measurements and investigations in each country during a period of relatively low seismicity with M<5; occurrence of two very successful Meetings (Sofia 1996, Skopje 1997); publication of two Meeting Proceedings; annual report for the scientific, administrative and financial activities, sent to UNESCO and BAS.

Scientific organization includes one Project Manager, three National representatives and three National Working groups (see the scheme). The national experts in the Working groups are not fixed and their participation depend on the different stages of Project activity. The Manager is responsible for the good coordination with the National representatives, also with UNESCO and BAS. The best manifestations of the Project studies present the annual Meetings and their publications.



Preliminary conclusions:
The ground water level changes in the complicated geological conditions, influenced also by the human activities, has provoked some local land subsidence manifestations. Our observations of the land subsidence is occurred in a relatively quiet seismic period. The first two Project publications permit the use of preliminary results. The Project activities are important for Balkan scientific collaboration for the national geological, hydrogeological, engineering geological, seismological, geodetical and geoenvironmental informations.

FLUID REGIME OF THE FORMING (CREATION) OF GOLD SAULIAK DEPOSIT (MARMAROSH MASSIF)

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Gold Sauliak deposit is composed by quartz and carbonate-quartz vein ore bodies. These bodies are localized among chlorite-serizite slate of Dilovetsk formation (Upper Proterozoic). The strike of these bodies are NW with rather slope dip (up to 35°) to the SW. The morphology of ore bodies is rather complicated, their thickness rarely exeeds 1,5m. Ore bodies are discovered by trenches, wells and adits.

We carried out asometric and ionmetric investigations of fluid composite of different generations of inclusions within Sauliak minerals by using methods of mass spectrometry (analysts J.Svoren';A.Kostenko), gas chromatography (analist P.Nikolenko) and gross water extraction (analist Zh.Simkiv).

Within fluid inclusions there were distinguished CO_2 (3-82%),CH_4(4-96%), N_2 (1-22%),H_2 (up to 3%), CO,ethan and propane (up to 1%). Certain components prevailed within different-age portions of mineral forming fluids among volatile components. For pre productive portions nitrogen (sometimes methan) was typical, for productive - CO_2 and for post productive - methan and its homologes. According to isotopic investigations of the CO_2 inclusions and separate vein calcite generations the fluides of juvenile and metamorphic origins took part in forming of the deposit.

On the base of water extracts from the inclusions within Sauliak ore there were distinquished Na^+ (1,56-16,4%-ekq),K^+ (0,6-33,9%-ekq),Li^+ (up to 0,05%-ekq), Sr^{2+} (up to 0,64%-ekq), Ca^{2+} (up to 4,12%-ekq), Mg^{2+} (up to 4,8%-ekq) Ba^{2+} (up to 1,43%-ekq) Fe^{total} (up to 0,56%- ekq), HCO_3^- (0,6-82,7%-ekq),Cl^-(1,9-12,0%-ekq), SO^{2-}_4 (up to 1,76%- ekq), $HSiO_3^-$ (7,6-81,9%-ekq).

The evolution of mineralforming fluids that took part in forming of the gold Sauliak deposit was discrete and it passed from nitrogen-silicate to vitalcarbonate composition. The gold was deposited from silicate-carbonate fluids. Post ore hydrothermal fluids were enriched by hydrocarbons.

INNER WESTERN CARPATHIANS - AN ALPINE ELEMENT WITH VARISCAN AND (?) KIMMERIAN PREHISTORY

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The Inner Western Carpathians (IWC) are the innermost part of the Western Carpathians. Situated mostly south of the Margecany-Lubeník line (Fig.1), they differ from the zones situated more to the north, because the Alpine subduction-collisional events took place here much earlier than in the northerly situated zones. The Meliata branch of the Tethys was closed as early as during the Upper Jurassic epoch.

The structure of the IWC is composed (from its base upwards) of four main tectonic units, the **Gemericum, Meliaticum, Turnaicum and Silicicum Units**. Speaking in terms of their Alpine structure, the IWC are simply a segment in which all the remnants of the oceanic zone (Meliaticum Unit), of the adjacent slopes (Gemericum and Turnaicum Units) and of the "southern" schelf (Silicicum Unit) are preserved.

Most of the **Gemericum Unit** is composed of Paleozoic assemblages that have a Variscan structure, although, strongly influenced, or deformed during the Alpine orogeny. The Mesozoic sequences are preserved in the Gemericum Unit only in fragments. Relatively widespread is metamorphosed Permian-Jurassic assemblage with a Gemeric affinity, which rests on top of the Gemericum Unit in a form of several tectonic slices, most of which are metamorphosed under the HP/LT conditions (occurrence of glaukophanites). It is a typical subductional-accretional suite of the Upper Jurassic age, assigned to the **Bôrka nappe**.

The **Meliaticum Unit** represents a remnant of a Middle Triassic - Jurassic oceanic realm. It has a chaotic, melange-like and olistostromatic structure. The Triassic rocks crop out amidst the Jurassic shale-sandstone matrix, in a form of blocks (cm to km across), most of which are incorporated in the evaporitic melanges at the base of the Turnaicum and Silicicum Units. It remains a matter of dispute if the Triassic blocks are the product of a continuous development (? Kimmerian), as suggested by Kozur (e.g. 1991 and his later works) or, if the Meliatic trough opened later, during the Jurassic period, and the Triassic blocks come from an "exotic" Kimmerian ridge. The first model is favoured because of the complicated, but not chaotic structure of the Bôrka nappe. The segments of Triassic sequences are preserved in individual slices.

The **Turnaicum and Silicicum Units** are rootless, nappe-like units thrusted not only over the Meliaticum Unit, but also over the Bôrka nappe and over the Gemericum Unit. On the basis of structural measurements their thrusting from "south" presumably occurred during the Upper Jurassic period, after the closure of the Meliata ocean. From the facies point of view, the Triassic sediments represent a carbonate platform and a slope toward the Meliatic trough, while the Jurassic sediments are predominantly pelagic and flysch-like and contain olistostromes. The concept of a "southern" origin of this group of nappes was not yet generally accepted, because some authors still use the facies as an argument to maintain concept of a Silicic nappe that originated in the area next to the Margecany-Lubeník line (Kovács, 1984, Kozur-Mock 1997)

Although, the view that the IWC were, or are part of the Kimmerian orogeny could not be fully substantiated, a conclusion can still be drawn that the Triassic and Jurassic were the most important periods for their development, as is the case for the Kimmerian orogeny. However, during the subsequent stages, the IWC became an integral part of the Alpine structural pattern.

SI/AL-RATION IN THE HEULANDITE-CLINOPTILOLITE SERIES AND GENESIS OF TRANSCARPATION ZEOLITE DEPOSITES.

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Heulandite and clinoptilolite are characterized by a similar crystal structure but the number of AlO_4 tetrahedrons in the silicate framework is different. The Si/Al ratio is varied from 2.8-4.0 (heulandite) to 4-5.5 (clinoptilolite). These ratio influences on the charge of the framework and thus on conten of exchanged cations. Thermal stability of the structure is also dependens on Si/Al ratio: decrease of content aluminium is accompanied by growth of thermal stability of the zeolites. Although the change of chemical properties in the heulandite-clinoptilolate series are continuous the difference in thermal behavior of the samples with intermediate Si/Al ratio is essential.

The X-ray and heating studies were performed for the samples of heulandites and clinoptilolites with nearest Si/Al ratio. The crystals of hydrothermali heulandites are characterized by high Si/Al ratio: 4.0-4.2 (Thaiharhorn, Iceland), 3.9-4.0 (Nizhniya Tunguska, Russian) and 4.3-4.6 (Tyrol, Germany). The Si/Al ratio in the clinoptilolites from Socimitsa deposite (Transcarpation) is varied from 3.8 to 4.7. Furthermore, the clinoptilolites have been divided in to alkali-clinoptilolites (Na + Ka > 65%) and Ca-clinoptilolites (Ca>50%) on the basis dominant exchange cations.

These results can be summarized as follows:

1. The heulandites and the clinoptilolites, having similar Si/Al ratio shows different thermal stability. The heulandites with Si/Al > 4 are stable at heating up to 450-500°C. The minimal temperature of stability of clinoptilolites (Si/Al = 3.8-4.4) is ranged from 750-800°C to 680-750°C for (Na, K) and A Ca-clinoptilolites.
2. At highsilica heulandites heating to 500°C two dehydration phases are formed. These phases are well identifed by the means of b parameter of unit cell: 17.15-17.35Å (I-phase) and 16.2-16.6Å (B-phase). Thermal stability of dehydrated phases is mainly depends on Si/Al ratio. The alkali-clinoptilolites do not formed the dehydrated phases, which may be registrated by X-ray methods. However, the Ca-clinoptilolites heating at 720-750°C shows phase formation with b=17.2-17.3Å.
3. The originals phase and dehydrated phases can be coexist in some thermal interval. The slight decrease of b parameter of the clinoptilolites (at on average 0.07Å) at heating from 500° to 700°C may be caused by the Al-rich layers.

One can suppose that zeolites of heulandite-clinoptilolite series with intermediate Si/Al ratio have heterogeneous structure. Such a peculiarity may be as is the result of the crystallization at low temperature and fluctuation of cation concentration in solution. Although the metastable crystallization of clinoptilolite resulted from supersaturated SiO_2 solution the Si/Al ratio in the structure depends on the (Na+K)/(Ca+Mg) ratio in solution. The clinoptilolites from Sokirnitsa deposite shows a good correlation between Si/Al ratio and alkali content. Wide regional and depth variations of Si/Al ratio within deposite are result of changed conditions of zeolititation of the tuffs.

TETHYAN / BOREAL CRETACEOUS CORRELATION: RESULTS OF THE IGCP UNESCO PROJECT NO 362

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Tethyan and Boreal Cretaceous palaeogeographic data from several countries of the northern hemisphaere were compiled and palaeobiogeographical ties between these realms including seaways and oceanic current system were interpreted.

Both abiotic and biotic developments along major Tethyan and Boreal seaways were evaluated from the point of view of the palaeogeography and global ecosystem development. Eight of these connections of the Mediterranean Tethys with Boreal basins (Portuguese-, Pyrenean-, Anglo-Paris-, Brabant-, Bohemian-, Danian-Polish-, South Russian-, Turgay ones) have been discussed more precisely and their paleogeographical and paleotectonic framework has been explained. The results from the Polish- and south Russian seaways deserves a special attention as they seem to be the main controllers of the major Tethyan / Boreal exchange in the Mediterranean area.

The periods of intensification of faunal exchange between both realms have been correlable with the times of the maximum sea level rise. Great attention has been paid to the definition of both facies- and biotic realms and to the diferentiation of major faunistic provinces, as their limits defined on the base of individual faunal and floral indexes distribution differ each of other. Moreover, they are changeable in time (with changing coast lines) and sometimes blurry.

The importance of quantitative changes in distribution of calpionellids, radiolarians, globochaetes, calcareous dinoflagellates, planktonic foraminiferids, nannoconids, coccolithophorids and other planktonic elements in the Mediterranean Tethys (but also in individual marginal seas and in Boreal basins, as well) for indication of palaeocurrents and seayways pattern has been stressed. Moreover, this method seems to be highly effective also in estimation of migration routes of nektonic and benthic animals, or in palaeoceanographic and palaeoclimatic reconstructions of the Tethys as an equatorial oceanic belt. Local differences in paleoclimatic regime could be detected on the basis of important changes in lithology (clastic admixture, evaporites, or carbonates), sedimentation rates, or percentage content of rock forming fossils.

The role of global factors responsible for major environmental changes has been discussed. Cretaceous global systems were extraordinary sensitive from this point of view giving an unique opportunity to study the reasons of global warming, cooling and other distortions of palaeoclimatic and palaeoceanographic regimes. Computer simulation models of these global systems and of their changes have been elaborated and presented. Sequence stratigraphic concepts have been applied in interpretations of anoxic events, evolution of organisms and paleobiogeographical evolution of individual basins along the Tethyan / Boreal junction.

High resolution events have been recognized on the basis of distribution of important biological markers correlated with magnetostratigraphic data. New detailed magnetostratigraphic scale of the Jurassic / Cretaceous boundary has been presented. Several well exposed Lower Cretaceous sections (Rio Argos, Carcabuey, Val Bosso, Brodno, Polomec) have been studied in detail. The necessity to create a net of regional and national stratotype sections seems to be inevitable.

The major attention has been concentrated on integrated stratigraphical methods as the main tool of interregional (intercontinental) correlation. Cretaceous biostratigraphical charts have been precised and the stage (or substage) boundaries defined by multicomponent associations of micro- and macrofossils (ammonites, belemnites, forams, radiolarians, calpionellids, dinoflagellates, nannoplankton, palynomorphs, etc.) have been correlated in mutually distant areas. Such an approach clearly contributes to solving of the long-termed problem of application of Tethyan standard zonation to the Boreal Cretaceous sequences which contain quite different spectrum of fossil organisms.

SEQUENCE STRATIGRAPHY OF THE LOWER CRETACEOUS PELAGIC CARBONATE SEQUENCES IN WESTERN CARPATHIANS, SLOVAKIA

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Centralides of the Western Carpathians were (together with East Alpine units) rifted from the Paleoeuropean Shelf and pushed to ESE during Jurassic / Early Cretaceous by Penninic spreading. Complicated evolution of tensional basins inside this large sialic block as recorded in their basinal infillings was analysed with the use of quantitative analysis of rock microcomponents. Dark argillites of the Kimmeridgian and Tithonian Jasenina Fm filled central part of the Fatric Basin. Lowstand terrigenous material was supported by river deltas on the S. This pattern was changed by Lower Berriasian extensive biogenic growths which covered neritic flats rimming uplifted areas. Consequently, benthics debris forms principal component of the Berriasian lowstand sediments. Late Berriasian (Be 7) carbonate breccia accumulation originated by substrate erosion in transporting channels, and Mid Valanginian (Va-4) renewal of clastic input of siliciturbidites containing chromian spinels deposited in submarine fans disturbed this regime. These phenomena cannot be explained by sole lowstand conditions, but by pull-apart tension of basinal bottom and by accelerated tectonic uplift of its southern coast. Hauterivian Strážovce Turbidite Fm or Hauterivian-Barremian Muráň Formation consist of material from eroded Urgonian carbonate platform rim of the basin. Carbonate sedimentation ceased in Late Albian being substituted by eupelagic shales.

North European shelf margin was the site of Lower Cretaceous pelagic carbonate sedimentation with local reefs. biodetrital and condensed facies. From the sequence stratigraphic point of view, the start of sequences is obviously indicated by influx of neritic biodetritus reaching deep into basin and by quartzose silt of probably eolian origin. Lowstand recorded maxima of calpionellids and globochaetes, sometimes with diverse associations of radiolarians. Dinocysts became more abundant during transgressive system tract with occasional fluxoturbidite beds. Maximum flooding surface coincides with the maximum abundance of radiolarians. Higstand deposits usually represented by thin bedded siliceous limestones with cherts and with thick marly intercalations generally contain lesser share of microplankton but abundance of nannoplankton. Berriasian to Barremian pelagic limestone sedimentation of the "majolica type" were influenced by climate fluctuations (marly interbeds. contourites, fluxoturbidite beds). Upper Valanginian strata and, predominantly, the Aptian black shales (Koňhora. Párnica Fms) recorded the most important climatic events leading to „mid-Cretaceous greenhouse" They are well evidenced by change in lithology, by C_{org} deposition and by $\delta^{18}O$ and $\delta^{13}C$ isotope excursions. During Albian, limestone sedimentation was substituted by deposition of pelagic marls reflecting rather deep - marine conditions.

POSTMAGMATIC ALTERATIONS OF THE HIGH TATRA GRANITOIDS (TATRA MTS., POLAND)

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Granodiorites and tonalites dominate among granitoids in the northern part of the High Tatra Mts. The occurrence of granites is restricted to the so-called pegmatitic and aplitic marginal zone. All these rocks exhibit intensive postmagmatic alterations - albitization, sericitization, chloritization, formation of epidote, carbonatization.

Albitization. Albite forms irregular rims in marginal parts of plagioclases or veins crosscutting plagioclases. Some albite veins contain epidote crystals. Albitization is more intensive in samples which exhibit other alterations also. Preliminary results of chemical composition analyses of albite indicate high chemical purity (An < 1 mol%).

Sericitization. Feldspars (mainly plagioclases) in all samples studied have been affected by sericitization. Sericitization is more intesive and sericite flakes are bigger in zones where granitoids are strongly deformed. The chemical composition of sericite has not been studied systematically. Besides Si, Al, and K, it contains Mg, and variable amounts of Fe and Na.

Chloritization. Two types of chlorite occurrences can be distinguished. The first type originates in the chloritization of biotite, which is wide-spread. This process is accompanied by the formation of Ti- and Fe-Ti-oxides, epidote, quartz lamellae, and some minute sphene crystals. Secondary muscovite is present, sometimes together with chloritized biotite. Chlorites of the second type crystallized in voids in the form of spherulitic aggregates or in small veins. The second type of chlorite occurs rarely. Microscopic study suggests that this type of chlorite exhibits variable chemical composition.

Formation of epidote. Epidote is commonly associated with chloritized biotite. It occurs also as discrete crystals in or around feldspars (mainly albitized ones) or in small veins. A greater amount of epidote is present in zones of intensive deformation. Beside typical epidote, also REE-rich epidote is present (allanite). Relations between epidote and allanite suggest that allanite formed later.

Carbonatization. Carbonate minerals (pure calcite) are present as small veins or aggregates. Calcite aggregates are associated with highly sericitized feldspars. It is probable that calcite post-dates the formation of sericite.

The distribution of intensity of secondary processes on the map of the study area gives a highly irregular pattern. It is possible to conclude that the whole volume of granitoids is strongly altered; the most intensive alterations occur in zones of tectonic deformations. Chemical composition of secondary minerals is studied only preliminarily. Because of this reason, the determination of conditions of alterations and of origin of fluids active in these processes is not possible at the present stage of investigations.

OPHIOLITE COMPLEXES (OR: OCEANIC ASSEMBLAGES) IN NORTHERN GREECE (OTHRYS, NORTH PINDOS, ...) AND NE HUNGARY: REMNANTS OF THE (NEO)TETHYS OCEANIC SYSTEM – GEOLOGICAL SETTING, GEOCHEMISTRY, RADIOLARIAN BIOSTRATIGRAPHY AND GEOTECTONIC COMPARISON)

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Neotethyan ophiolite complexes of Northern Greece and of NE Hungary, the latter ones displaced from the NW end of the Dinaridic Ophiolite Belt right-laterally about 500 km due to Tertiary strike-slip dispersion, are compared.

Ophiolite Complexes of NE Hungary occur in the NE part of the major Pelsonia Composite Terrane, within the smaller-rank Bükkia and Aggtelekia composite terranes. The *Szarvaskő Ophiolite Complex* is thrust from NW (according to present-day coordinates) onto the Bükk Parautochthon and is formed by the lower, olistostromal Mónosbél Unit and the upper, magmatic (intrusives: gabbros, dolerites, subordinate pyroxenite, hornblendite and ore-peridotite extrusives: massive basalt and pillow lava) – sedimentary (shales-sandstones, some black radiolarite intercalations and thin olistostromes) Szarvaskő Unit. Intercalated radiolarites are of Bajociau to Oxfordian age, whereas in related olistostromes blistoliths of Ladinian – Carnian red radiolarites also occur. In this complex, two distinct metamorphic events were detected. The earlier ocean floor hydrothermal (from zeolite to amphibolite facies) and the younger Middle Cretaceous regional (prehnite – pumpellyite facies) event. Geochemical character indicates back-arc, marginal sea-type, opened in Mid-Jurassic, closed in Late Jurassic. The closely related *Darnó Ophiolite Complex* consists of a lower, toe-of-slope type sedimentary complex containing slide blocks of Ladinian – Carnian reddish cherty limestones with associated basalts and an upper, magmatic unit with subordinate abyssal sediments. Magmatic rocks are represented by MOR-type pillow and massive basalts, gabbros and microgabbros and minor wehrlite, the intercalated/intersliced sediments by red radiolarites and mudstones, as well as bluish grey siliceous shales, yielding alternatively Ladinian – Carnian and Bajocian – Callovian radiolarians. The igneous complex shows only prehnite – pumpellyite facies ocean floor hydrothermal metamorphism, while the related sedimentary rocks suffered only diagenetic alterations. This setting in the upper unit suggests an accretionary prism and probably a Triassic oceanic basement which underwent new extension behind an intraoceanic subduction zone. The *Bódva Valley Ophiolite Complex* in the Aggtelekia composite terrane represents a disrupted oceanic terrane, occurring as slices of serpentinites, MOR-type basalts and gabbros in Upper Permian evaporites at the sole thrust of the Aggtelek Unit. The gabbroic layer suffered Alpine polyphase (blueschist and later greenschist facies) metamorphism. Sediments are represented by a single intercalated Ladinian red mudstone – radiolarite and a probably Jurassic dark grey siliceous shale – sandstone slice. The complex represents remnants of an oceanic basin opened in Middle Triassic and closed in Middle – Late Jurassic.

To the conclusions:

– The Northern Greek segment of this Neotethyan ophiolite zone represented a more advanced stage of rifting, where basalt volcanism began already in the late Scythian, whereas in the NE Hungarian one only in the early Ladinian.

– Two radiolarite depositional events can be recognized in both segments, an earlier one in the Ladinian – Carnian and a later one in the Bajocian – Oxfordian.

MIOCENE MICROFOSSILS OF NE BOSNIA AND SERBIA: BIOSTRATIGRAPHICAL CHARACTERISTICS AND PALAEOENVIRONMENTAL INDICATORS

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The investigation results are presented for Miocene microfossils of northeastern Bosnia (Tuzla, Ugljevik) and Serbia (Vojvodina, Posavina – Kolubara region, Belgrade environments, Negotinska Krajina). Microfossil assemblages (calcareous nannofossils, foraminifers, ostracodes and palynomorphs) were used in time-stratigraphic division of Miocene deposits.

The general trend, through the analyzed range of the geologic time, clearly indicates a progressive change (at variable intensity and in places unsynchronized) in the environmental conditions toward the salinity reduction. This trend significantly affected calcareous nannofossils and foraminifers, which are taken for typical marine organisms, and led to a reduction in taxon diversity and quantitative proportions of communities. A similar phenomenon is observed with dinoflagellates. The representatives of peneropleides (*Spirolina, Dendritina*) and *Sinzowella* in carbonates of Middle Sarmatian indicates the similarity of associations with those in the Besarabian of the Eastern Paratethys. The presence of typical endemites among nannofossils (*Praenoelaerhabdus, Noelaerhabdus*) during the Pannonian is noteworthy. Ostracodes are present through the Miocene, but only brackish and caspibrackish assemblages from the uppermost divisions have been well studied. For that purpose, the genus *Hemicytheria* is studied in particular. Their importance is particularly great for deposits bearing very scarce fossils of other faunas (freshwater equivalents of Lower-Middle Miocene – genus *Dinarocythere, Bosnacypris* etc.) but they have local stratigraphic significance. The extended number of the known spore, pollen, dinoflagellates and freshwater phytoplanctons (specifically freshwater *Zygnemataceae*) taxa from deposits of different origins, allowed more detailed palaeoecological considerations and correlation's with other regions. The increasing frequencies of moderate/warm and the scarcity of tropical and subtropical forms, and the impoverishment in dinoflagellates taxa in deposits of brackish origin, have been noted in microfloral associations.

Quantitative and qualitative analyses of microfossils and sedimentological characters of Miocene deposits are used in an attempt to explain better the nature of modifications and the character of the biotope in some of Paratethyan domains.

COMPUTER-BASED PROCEDURE FOR THE TREATMENT OF PUMPING TEST DATA IN ISOLATED WELLS

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The gap between the burgeoning developments in water resource systems engineering and their actual application in the diverse aspects and various levels of water resources planning and management appears to be significant.At the field level, for example, many engineers continue to use graphical and subjective methods for dealing with the various curve-fitting and calibration problems they often face. Use of techniques make available to the engineer additional time that can be spent in more important and creative endeavours.

The specific objective here is to present a simple computer algorithm of Bipartition for analyzing step-drawdown test data for a well. Some geohydrologists feel that the step drawdown test is not a useful tool. The intention of this paper is not to become involved in this debate but addressing those geohydrologists who have hesitated using the step-drawdown test because of its involved graphical solution. If the unwieldiness of current curve-fitting procedures has hindered use of this valuable test, it is hoped that this algorithm will encourage its greater application.

In comparing results of the algorithm in QBASIC with published results based on graphical techniques, the former were consistently more accurate. In which case primary advantage of the computer method is its speed and convenience, as well as consistency of results.

For the hydrodynamic substantiation of the water collection (for water supply) or draining drilling, an important role is played by the hydrodynamic tests through pumping, which must provide the necessary designing parameters. These experimental pumping are usually achieved by drilling groups which,beside the experimental drilling(out of which the pumping is performed), also comprises at least two piezometric drilling, settled on the same radius. Through these piezometers one measures the "response" of the aquifer (respectively, the level reductions) to the impulse that was created by pumping.

One must bear in mind the fact that the hydrodynamic performance test of an aquifer can only be achieved under the conditions of an experimental group and of many pumping (three at least) within a stationary regime.

From a hydrogeological point of view, the novelty of this work consist of the fact that one retakes the problem of processing and interpreting the performance hydrodynamic test , a test being achieved without piezometers and having a rigours mathematical methodology, in which errors have insignificant values. This can be achieved through graphic methods and also, approximately,through computer based techniques, which solve these problems in a short time, with a minimum effort, but with a great accuracy.

ROCKS CORRELATION OF MARMAROSH MASSIF WITH UKRAINIAN SHIELD TROUGH STRUCTURES FORMATION ACCORRDING TO PALEONTOLOGICAL DATA

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Crystalline basement of southwest part of East European platform including Ukrainian Shield was spreading far to the west within the territory of Carpathian-Balcan region in Late Proterozoic. It is practically impossible to reproduce nowadays the size, development character of Riphean-Paleozoic structures of this basement part as well as terrigenous material accumulation conditions and magmatism processes due to repeated structure reconstruction of the folded area in more late epochs.

Ukrainian Shield structures of this time were forming under conditions of the stable platform regime. They were "stunted" but are well remained and can be studied nowadays. Sections correlation of low-metamorphosed Riphean and Paleozoic formations, which are forming series and suites of riftogenes, graben-synclines and synclines imposed on ancient faults with coeval rocks of Carpathians massifs let one reconstruct structural plan of basement of the young geosyncline region as well as many processes which were taking place in those long-ago geological epochs. This is corroborated by the results of comparison of Gdantsevskaya suite above fault syncline with the rocks of Delovetskaya suite of Marmarosh massif.

Sections of these suites are similar which may be concluded from the rocks composition, layer thickness, conditions of their occurrence, intertransitions metamorphism degree and live matter remnants. Gdantsevskaya and Gleevatskaya suites sediments occur with discontinuity on the Low Proterozoic formations. The suites constitute the rhythmical carbonate-coal-schist and sand-schist thicknesses which contain carboniferous sporophytes complexes and higher plant tissues fragments. The most numerous occurrence findings in these rocks are the Denzosporites, Euryzonotriletes, Trilobozonotriletes, Zycospora, Zeiotriletes and Dictyotriletes subgroups spores. Analogous compositions of phytoremains are known to take place in carboniferous formations of Visean stage of Pripyat, Dnieper-Donetsk depressions, Moscow, Lviv-Volynian basins and Ural folded region.

According to paleontological investigations data the conditions of existence and burial of organic world in Riphean-Paleozoic sedimentation basins of European platform and its western folded environment are similar.

SEDIMENTOLOGY OF THE EPICLASTIC ROCKS IN THE PALEOGENE POST COLLISIONAL EAST RHODOPE DEPRESSION

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During the Paleogene the East Rhodope Depression was formed as a result of the block disintegration of the metamorphic basement. Some blocks subsided and were covered by sediments during the Paleocene and Late Eocene while others subsided at the beginning of the Oligocene. The new created basins were filled with molasse sediments and products of the collisional volcanism. According to the tectonic position of the Paleogene volcano-sedimentary complex as well as their lithological features and evolution Goranov (1989) described them as a lower molasse. The collisional volcanism is subaerial to submarine, polyphase with four-fold alternation between acidic and intermediate volcanic products (Ivanov, 1960).

Erosion and redeposition of the pyroclastic materials and formation of the epiclastic rocks were first described in the region of Kralevo, Malak Izvor and Dolno Botevo, Haskovo district, NE Rhodopes by the authors. The latest sdudies in the East Rhodope Depression showed the presence of the epiclastic rocks on large territories. The epiclastic rocks yielded from the pyroclastic rocks, related to the episodes of acidic volcanism have been most precisely sedimentologicaly studied. The epiclastic rocks are mainly medium to coarse sandstones and breccias and breccia-conglomerates according to their grain-size parameters and the texture varies from medium trough coarse sand to granule. They are poorly stratified and medium to thick bedded. The intercalated rocks are typical marine sediments marls, bentonites, sandstones, cherty microcrystalline rocks and microcrystalline and reef limestones. The underlying rocks are predominantly acidic vitroclastic rocks or clinoptilolitic zeolitites and tuffs. Very important and characteristic is the clear erosional contact between epiclastic rocks and underlying rocks. The overlying rocks are reef limestones, with transitional contact and limestone interbeds, or acidic pyroclastic rocks, with erosional contact.

The epiclastic rocks are composed mainly from redeposited pyroclastic fragments (55-90% of the rock volume) and small quantities of biofragments and authigenic minerals (montmorillonite and calcite).All detrital fragments are poorly sorted and angular to slightly rounded. The rock fragments are represented by non altered volcanic glass shards and pumice pieces, andesites, rhyolites, clinoptilolitic zeolitites, metamorphic rocks. In the previous published study the authors have described a specific type of epiclastic rocks redeposited zeolitic rocks, composed mainly from clinoptilolitic zeolitites fragments. Under the microscope biotite, plagioclase (oligoclase), sanidine, quartz, apatite, zircon, magnetite, titanite, rutile and rarely amphibole, pyroxene and muscovite can be seen. The matrix is built up from silty or medium to coarse sandy pumice pieces and glass shards and rarely from mineral grains or fragments (biotite, sanidine, oligoclase, quartz). Its quantity varies from 5 to 30% of the rock volume. The matrix is filling type or very rarely basal type. The cement in the epiclastic rocks , where seen, is fine-grained, montmorillonitic, contact type and/or spary calcite, poikilitic, basal or corrosive type. The texture is not washed, grain-supported. Under the microscope siliceous and calcareous biofragments are defined. The siliceous fragments build up to 5% of the rock volume and are planctonic diatoms and spiculs from siliceous sponges. The calcareous biofragments are from bentic and planctonic foraminifers and rarely from blue-green algae (Lithothamnium), echinoids and giant foraminifers (Nummulites).

There were very suitable environmets in the Paleogene East Rhodope Depression for the epiclastic rocks forming. The rapid erosion and redeposition of the non welded to slightly welded acidic pyroclastic and clinoptilolitic rocks were facilitated by the steep slopes of the marine basins and the active volcano-tectonic processes. The newly formed debris deposits were stamped and preserved with either products of the next episode of volcanism or reef limestones.

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THE ROLE OF MOSCOW GEOLOGICAL SCHOOL IN THE STUDY OF THE STRUCTURE AND DEVELOPMENT OF UKRAINIAN (CENTRAL) CARPATHIANS

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The history of geological study of Carpathian region and, in particular - of Ukranian (central) segment of Carpathian arc during 20. century was in many respects controlled with repeated changes of the political map of Europe. Up to 1918. the territory of Ukranian Carpathians (UC) was incorporated into the Austro-Hungarian empire and its geological structure as well as the same of Carpathians on the whole was interpreted in the terms of "nappe conception" elaborated by austrian geologists who had studied the geology of the Alps (W.Ulig etc.). Between the first and second world war, after the downfall of Austro-Hungary, the northern slope of UC (Eastern Galicia) was studied by polish and their southern slope (Transcarpathian Ukraina) - by czechoslovak geologists who continued to develop the tectonic ideas of austrian school. In result of the Second World War the Eastern Galicia, Northern Bukowina (earlier belonged to Romania) and Transcarpathian Ukraina were joined to Ukrainian republic incorporated into the Soviet Union. At last and the end of 1991., after the disintegration of USSR the territory of UC represents the part of independent Ukrainian republic.

The period from 1946. up to 1991. was the important and fruitful stage in the geological study of UC. Its territory there was two times subjected to systematic geological mapping, there were elaborated the detailed stratigraphic schemes of Mesozoic and Cenozoic for all tectonic zones, based on the mycropalaeontological data, was discovered the history of orogenic volcanism, studied the complicated tectonic development of UC etc. The greatest contribution into the knowledge of geology of UC during this period was made by two outstanding geological schools Lwowian one, with acad. O.S. Vjalov at the head, which included the scientists of Lwow University and several geological and oil geological institutes, and Moscow school, represented mainly by the group of geologists of Moscow Geological prospecting Institute (MGPI), and of Moscow University headed correspondingly by prof. A.A. Bogdanov (1907-1971) and by prof. V.I. Slavin.
The Carpathian geological expedition of MGPI, organised by Bogdanov which included many outstanding (at that time young) russian geologists (M.V. Muratov, Ju.M. Puscharovsky, D.P. Naidin etc) had for the first time accomplished in 1945-49. the systematic geological mapping of the all territory of U.C. in the scale 1:200 000. In accordance with ideas of fixism predominant in that time in soviet geology Bogdanov and his colleagues tryed to reduce the role and scale of nappe deformations and horizontal movements of the crust in the formation of the northern (flysh) megazone of UC and had interpreted their tectonic structure as an asymmetric meganticlinorium consisted of outher and inner anticlinal zones and central synclinal zone between them. In 1958. after the joint excursion with Czechoslovakian colleagues in Slovak Carpathians, A.A. Bogdanov, V.E. Khain and M.V. Muratov had tryed to spread analogous ideas on the inner megazone of Western Carpathians and to support in the discussion between D.N. Andrussov and M. Mahel the view of the latter. But for the future, after the detailed acquaintance in the field with the structure of Southern (Romanian) Carpathians, as well as Scandinavian Caledonides etc, A.A. Bogdanov and his colleagues had returned to the "classical" nappe interpretation of the UC and Carpathian folded system on the whole.

In 70ths the several Years expedition of Moscow University headed by prof. V.I. Slavin and included many scientists of its geological faculty (S.L. Afanasiev, V.E. Khain, N.V. Koronovsky, M.G. Lomize, E.E. Milanovsky etc.) had accompilished the detailed (in the scale 1:50 000) geological mapping of different zones of UC (flysh zones, zone of Carpathian cfiffs, northern part of Marmarosh massiv, Vygorlat-Gutai volcanic ridge etc). In result of these investigations our notions concerning many important problems of structure and geological development of UC there were considerably deepened and detailised and the real role of nappe-deformations in their structure was restored. The achivements of soviet geologists in the study of the problems of UC geology were demonstrated in 1977. on the Congress of CBGA in Kiev and numerous geological excursions accompanied it.

A NEW VIEW OF NEOGENE MAP OF SERBIA

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The Neogene geological map of Serbia is more older than 30 years. The time and tehnology of geological veiws and investigations are from 60^{th} years of 20^{th} centaury and today is already uncertain and unenforceability map. Nondefination stratotypes of Paratethys during the elaboration of the Basic Geological Map, faunistic similarity of the ending caspibractics sediments of the Paratethys with limnic sediments from neighbour areas, and inconstancy of sedimentological models came to the some contradictory results.

The bigest number of the building, tehnological and others objects built on the Neogene surfaces. Agriculture, forestry, wather resources, traffic and raw materials (oil, coal, gas, nonmetallic minerals etc.) have many connection with these formations. In the new geological investigations of the Neogene of Serbia included different methods: paleomagnetic, biostratigraphic, paleontological, sedimentological, remote sensing, neotectonics, mineralogical, petrological, geodesy etc. Through the interdiscipline study these methods have the same aims: better chronological control and better known of geological evolution, distance and ungle of geodynamic movements, depths of the beasement, mineral perspective.

In general veiw the Neogene of Serbia composed by two separate parts: Quaternary (south part of Pannonian basin) and Neogene basin (some isolated basins into five different geotectonic units). New map will be prepare without Quaternary deposits.

Since the Early Miocene, Ottnangian Karpathian time, through Badenian, Sarmatian, Pannonian, Pontian until the end of the Pliocene time the paleogeographic eminences continuous changed. Changeability of the lakes and seas sediments, communications between salt and fresh wather, depositions of limestones, sandstones, marls and clays we can use for a studies of sedimentary cycles, the role of Milankovitch orbital modulation and climate regimes during the past 20 Ma.

The formation is basic working concept of the new map. Based on researces of isolated basins by complex analyses, the most precise correlation between the distant areas are possible. Finally, the systematically studies of the Neogene basins of Serbia, especially their central part, to enable Formation Geological Map 1:200 000.

GEOLOGICAL MODEL OF THE MACVA HYDROGEOTHERMAL SYSTEM

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ABSTRACT

Macva is a large alluvial plain in Serbia, between the Drina and the Sava Rivers, some eighty kilometers west of Belgrade. Geotectonically, it lies on southern margin of the Pannonian Basin where it joins the Dinarides. Paleorelief of the Pannonian Basin has many shallow and deep depressions filled with Neogene and Quaternary sediments. Macva is situated over one of depressions. Regional geophysical data indicate southern Macva as the deepest depression area. The greatest thickness of Neogene and Quaternary deposits in it is about 1500 meters, and the smallest about 200 meters in central Macva. Neogene and Quaternary sediments are alternating gravels, sands, and clays. Geothermal anomalies in Neogene sediments end previous hydrogeothermal investigations indicate thermal water-bearing Triassic limestone beneath Neogene sediments throughout the whole Macva region. The paleorelief of Neogene sediments in Macva was discovered only in 1981, when the first geothermal well BD-1 was drilled. At the well site, the paleorelief is composed of karstified Middle Triassic limestones more than 200 meters thick. Karstified limestones of the Middle and Upper Triassic were found in boreholes BB-1 and BB-2 at Bogatic, and Triassic dolomite in BBe-1 at Belotic. Borehole BMe-1 at Metkovic did not enter the paleorelief, but ended in Neogene sediments. Exploratory geothermal borehole BZ-2 is the deepest (1500 m) in Macva. Neogene and Quaternary deposits at its site have a thickness of 287 m. The paleorelief is composed of thermometamorphosed sandstones and siltstones of unknown age and Neogene plagiogranite. The age of plagiogranite by K/Ar method is about 35 million years, These rocks verify their earlier assumed presence in the paleorelief of Neogene sediments in Macva (Milivojevic and Peric, 1984). Besides these magmatic rocks, drilling in BB-2 revealed a 50 m meters thick series of ignimbrite. Its K/Ar age is about 30 million years. Triassic carbonate sedimentary rocks are of Alpine development type, thus thickness can be up to a thousand meters, like in the Dinarides. This has been verified by magnetotelluric and electromagnetic methods. Rocks in the paleorelief nearest to the surface are located in Cer Mt. area and at the town of Sabac. Rocks in the Cer Mt. area are Devonian-Carboniferous schists. All these rocks have a periclinal bed dip to the north, which is a consequence of intrusion and rising of the Cer granitoid pluton. The pluton's extent on the surface is about 70 square kilometers. Magmatic activity in Cer Mt. area evolved in several stages; thus the K/Ar age of the granitoid and its vein rocks is 7-17 million years (Milivojevic and Peric, 1986; Milivojevic, 1992). Near Sabac, rocks of the Neogene paleorelief are exposed in the small area. These are Lower Triassic limestones and sandstones.

The highest measured temperature of the thermal water is 78 °C at a depth of 610 meters in Triassic limestone. The highest temperature expected in the aquifer on the basis of hydrochemical geothermometers, is about 100-110 °C. Natural conditions in Macva are favorable for intensive exploration of geothermal energy. Based on local geology, hydrogeological and hydrothermal characteristics, the calculated thermal power of Macva region is approximately 150 MW. Neogene sediments overlie a karst reservoir in Triassic limestones, which can be tapped at a high rate for heating houses, food production and industrial uses. A conductive geothermal anomaly, the highest in the Pannonian Basin (thermal water of 75 oC found in the borehole BB-1 at the depth of 412 m), was detected above the reservoir in central Macva (Milivojevic and Peric, 1987). This makes Macva the Yugoslavian, and Serbian, "Red Spot", as the Pannonian Basin as for Europe (Horvath et al., 1979). The hydrogeothermal resources of Macva have not yet been used, but there is an interest for it. A design was prepared for 25 hectares of green houses for production of vegetables, fruits and flowers. The project cost estimate is about U.S. Dollars 43 million.

WATER SUPPLY IN VOIVODINA REGION

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The aim of this article is to describe the reason and the way to the research of groundwater in Voivodina as a most rational resource for water supply.

Water supply in Voivodina is still exclusively from groundwater resource. This is the northern region of Yugoslavia with a surface of 21,506 km^2, on the lowest ground of Panonian Basin /63 asl/ and settled by more than 2 035 000 /1981/ inhabitants. Here, on a sector of 291 km /1367-1076/ of Danube river /10%/ meet its main tributaries: Drava, Tissa, Sava and Morava from about 39 % of total Danube catchement area. The minimal flows from 2,622 m^3/s /km 1367/ to 5,202 m^3/s /km 1076/ provide practically unlimited quantities of surface waters. But surface water has more deficiencies in Water supply.

Voivodina was ever famous of a possibility to reach everywhere drinking water from digged wells. At the end of last century there was started dilling of deep tubewells. These are wells with under pressure water which is become a thought of a best drinking water in region.

Before the second World War, no one settlement in Voivodina bad public waterworks. Promptly after the war it was started preparing of designing and construction of public waterworks. Search of water resources showed that deep groundwater could be tolerated without conditioning as well of some overdoing the drinking water standards. Yield of deep wells wasn't everywhere satisfactory. Results of drilling were very different at many localities even neighboring.

Because of a certain Fe concentration in sub-surface water in whole Voivodina it must be treated. Therefore it was supposed, for waterworks, in the first place to use deep groundwater. Only for large waterworks it was used treated sub-surface groundwater from wells along river banks with abundant infiltrated river water.

At that time "Institution for townplanning, public works and dwelling of Voivodina" was the only, researching water supply and sanitation in frame of land use and town planning. At the same time "Nafta-Gas" was institution for research and exploatation of oil and gas so that its team of graduated geology engineers: Dragan Nikolic, Djordje Marinovic and Branko Kosanovic made "Structural Hydrogeological Map of Voivodina - Regional study of possibility for water supply" according the conception of "Town planning institution"

In this Map are registered the main splits, depressions and elevations of basis of Neogen as bearing of sandy layers reach undergroundwater resources, with main longitudinal profiles.

Neogen is vertically divided in two zones by continual waterproof clay layer, yellow, easy remarkable.

Upper "A" zone with under pressure groundwater is more convenient by yield i.e. by tickness of particular sandy layers with fine and middle-granulated sand. Sandy aquifers in the "A" zone are nearly always proper Artesian, fed by sub-surface groundwater. Ware in "A" zone differs of lower zone what is established by detailed investigations for many waterworks. At many localities at Carpathian and hilly edge Panonian Basin they are deep groundwater's of best quality similar to source waters.

Aquifers in lower "B" zone are generally thinner but more frequent structured of fine sand. Usually water is yellow, very soft 1-2 /dH°/, with iodine and high oxygen consumption from $KMnO_4$ of humin acids. There is a locality /Torda/ with Selenium in deep groundwater. In deeper depressions of Neogen basis water can be of higher temperature, not very convenient in public waterworks.

After edition of printed "Structural Hydrogeological Map of Voivodina" it was supposed to follow the geological and hydrological investigations by observations of water level and water quality in deep wells. But in the meantime was unfortunately investigated hydrological structure of aquifer of sub-surface groundwater.

That's right that "Structural Hydrogeological Map of Voivodina" didn't present the first groundwater aquifer. Boring for investigations oil and gas and deep drinking water had not registered adequately sub-surface groundwater aquifer. Detailed investigations for large public waterworks were more useful.

Aluvion along the left Danube bank is formed of coarse sand and of gravel, somewhere even to 60 m thick and along Sava river of middle and fine sand 20-40 m thick. This provides a rational use of the infilltered river water with a diminished Fe content. But this water, as mentioned, as very sub-surface groundwater must be treated what is economical only at abundant resources. So were developed the large regional water supply systems around Novi Sad, Sremska Mitrovica and Ruma. Distant methods of geological investigations were applied at the Danube sector upstream and downstream, for waterworks Novi Sad.

Today some 80 % of settlements in Voivodina provide waterworks using deep wells. Water is relatively of good quality, under a sanitary inspection control.

The main default of deep groundwater in itergranular structure is normally, a limited yield for large consumers. Some wells demand water treatment because of higher Fe content. Treatment of this kind of deep groundwater is with higher and more expensive technology than that of sub-surface water. It is similar to that of river water. For further development of public waterworks is going to lay conduit from some further and better water resources, than local.

There must be mentioned that in Voivodina there are some localities with some higher yield, from deep wells, of excellent quality as for the town Vrsac, Bela Crkva, Sid and others.

Neven Miošić*

HYDROGEOTHERMAL POTENTIALS OF BOSNIA AND HERZEGOVINA

Abstract

Various geological, geophysical, hydrogeological and petroleum-geological exploration data and thermal and thermomineral springs of waters suggest existence hydrogeothermal potential in the regions north of the irregural line connecting the towns Bihać-Konjic-Foča on 40% of the territory of B&H. Potentials are formed in rocks of various chronostratigraphic age and lithology in different depths from the surface. They are represented by warm and hot waters of different genesis, predominantly meteoric origin and with a large variety of physico - chemical composition of waters and gases. In most cases potentials are renewable resources. The most common and water most abundant are the limestones of all geological periods and among them particularly of Triassic period. Potentials are characterised by irregular distribution, concentration, specific location, conditions and possibilities for use.

Elements suggesting geothermal potential or increased hydrothermal anomalies in B&H are manifested by geological-tectonic, geophysical, geomorphological-neotectonic, seismological and hydrogeological indications. The territory of Bosnia and Herzegovina, as a complex geological environment, is characterised by about 350 thermal and thermomineral water springs and wells in about 100 deposits, which are direct manifestations of geothermal energy. Thermal waters are exploited inadequately to their quality, indications, yields and possibility of use from only 30 deposits.

According to drilling data temperatures in Posavina and Semberija at 1.000 m depth are from 42 to 62°C, at the depth of 2.000 m from 82 to 103°C, at 3.000 m 111 to 154°C, while at 5.000 m 194 to 220°C. Geothermal gradients as the conductive terrestrial parameters varies for the potential geothermal territory from 25 to 50 mK/m, while these convective parameters can be increased at similar depths even for 40%. Heat flow values vary from 60 to 125 mW/m^2.

Indicative quantitative directly measured factors of geothermal potentiality in B&H are: the most hottest spring is the Ilidža-Sarajevo with 56°C, the hottest artesian well is Do-1- Domaljevac with yield Q=25 l/s, wellhead temperature t=96°C, maximum geothermal gradient is 66°C/km, maximum heat flow is 126 mW/m^2, depth 1275 m, the highest temperature is 177°C at the greatest depth 3913m of the Br-1 well-Brvnik.

On about 80 locations of thermal springs and wells at present can be utilised without additional exploration works, 170 MW_{therm} with single output from 0,1 to 15 MW_{therm}. It is possible on 60 localities to the depth of 500 m get 600 MW_{therm}.

Renewable potential of hydrogeothermal systems for doublet (production and reinjection) well system for depths down to 3.000 m expressed as <u>heat in place</u> is 1,4x10^{9}TJ, <u>identified resources</u> are 385x10^{6}TJ, <u>possible reserves</u> 190x10^{6}TJ and <u>exploitative reserves</u> are 125x10^{6}TJ; the last amount is equivalent to the power of 4,3x10^4$MW_{thermal}$ per century of continuos exploitation.

Key words: hydrogeothermal potentiality indications, Bosnia and Herzegovina, conductive and convective geothermal parameters, hydrogeothermal systems, hydrogeothermal potentials, resources and reserves

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TRACING GEOTHERMAL FLOW PATTERNS IN PLATE COLLISION ENVIRONMENTS, BY MEANS OF THE NA-K-MG GEOTHERMOMETER

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Baile Tusnad and Baile Herculane are two geothermal areas in Romania located next to active plate margins. In such environments the geothermal system heat source can be a relatively shallow, cooling pluton, with a deep, hot water reservoir located above it. World-wide experience in similar areas, of mountain topography, indicates that the natural discharge of the deep reservoir usually occurs as lateral outflows, directed toward surface outlets located several kilometres away Interpretation based on the combined Na-K-Mg geothermometer is used to delineate the outlets supply directions. By corroborating additional information (overall structural setting, shallow thermal gradient holes, magnetic anomalies), inference is made on the location of the assumed deep reservoir and associated pluton.

QUATERNARY MALACOFAUNA OF TOPOLOVIK AND GOLUBAC (NORTH-EASTERN SERBIA)

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Quaternary deposits of the neighbourhood of Topolovik (Veliko Gradiste) and Golubac comprise a thick series of loess and quicksand. The loess contains markedly numerous and diverse malacofauna, which will provide a basis for determining the Quaternary bounds and also contribute to our understanding of the origin of loess. In the area of Topolovik, Quaternary sediments overlying Pliocene sediments contain terrestrial fauna of molluscs (gastropods). These layers are more than 10m thick.

The neighbourhood of Golubac and the town itself lies partly on Badenian and partly of Quaternary formations. The appearance and composition of these sediments can best be seen on the road cuts near the Danube banks and on the profiles in the wider area of the town. The Quaternary overlies transgressively the marine Upper Badenian. It is most manifest and best preserved north-west of the stadium. In the lower part it contains sands 2m thick with the fauna of fluvial and terrestrial origin. Overlying them are loess sediments more than 10m thick, containing terrestrial fauna.

The fossil material investigated will assist reconstruction of palaeoecological and palaeogeographical characteristics of the Quaternary sediments of eastern Serbia.

IS THE APULIA UNDER THE DINARIDES ?

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Closing of Jurassic Tethys-ocean between Africa and Europe, started with the splitting of Apulia and faster drifting to Europe. Apulia moved forcefully and with its deep-promontory UNDERTHRUSTED deeply under the oceanic crust included the OCEANIC LITHOSPHERE, and maybe the uppermost parts of the MANTLE (Dewey J.F., 1976). All this material Apulia pushed on itself and charged on itself i.e. OBDUCTED ON ITSELF, carried and brought to the subduction zone under European margin.

For Dinarides it means that the Mesozoic carbonate platform obducted on itself: Durmitor, Lim, Pester and Golija -- drifted to Vardar-Kopaonik zone, i.e. to the former subduction zone under the European margin, respectively under Serbo-Macedonian mass (Rhodope massif).

The well-known tectonic Dinarides cross-section (Fig. 1 - after Aubouin et al., 1970) shows: that the zones of Durmitor, Lim and Golija are only the parts of one large mainly limestone nappe in which base Paleozoic schists are present - while the Vardar - Kopaonik zone is strongly different. It is known that the ophiolites of Zlatibor are very thin (Milovanovic B. and Mladenovic M., 1968) and according the regional geophysical results - it can be concluded that the ophiolites of Pester are very thin too (Fig.2). It is obvious that the Triassic-Jurassic limestones are also very thin, what is very probable and for Paleozoic schists, because they were cut and included by Apulias promontory ie. by the Mesozoic carbonate platform, which is present under these schists, as is shown on the reinterpreted Auboin's cross-section at Fig.2. The Vardar-Kopaonik zone belongs to the subducted belt, which extends toward Belgrade and to South, bands to Albania and continues across Greece. The Golija, Lim and Durmitor zones belong to the obducted belt (which includes whole the Inner Dinarides), extends Albania and Greece. The Vardar-Kopaonik zone (Fig.2) is a remnant of the Jurassic subduction zone, with the very deep ultramafites (according to the regional geophysical results). It is confirmed by the newest geological results: in this zone near village Leposavic there are Jurassic BASALTOID rocks: "depleted "arc type" basalts IAT\VAB characteristics, which were formed on oceanic crust above subduction zone" (Memovic et al., 1995).

The Vardar-Kopaonik zone is totally different from the Vardar zone in the Vardar valley between Pelagonides and Serbo-Macedonian mass. There are NEITHER Jurassic ultramafitic belts, NOR bigger ultramafitic formations. Only a few little formations on the both old masses are PRE JURASSIC (Michailidis & Soldatos, 1995) and not numerous ones in the Vardar zone between the masses are Paleozoic (Hiessleitner G., 1951\52) and they are only the FRAGMENTS from the both old masses: Pelagonides and Serbo-Macedonian mass.

The Mesozoic carbonate platform is visible from Adriatic to Durmitor - flysch, then sinks under the Inner Dinarides and extends to the subducted belt. Acceptance the terms *obducted and subducted belts* as also Mesozoic carbonate platform under the Inner Dinarides means the acceptance of *continental collision mechanism*, which simplifies logical explanation of many fundamental geological problems of Balkan peninsula.

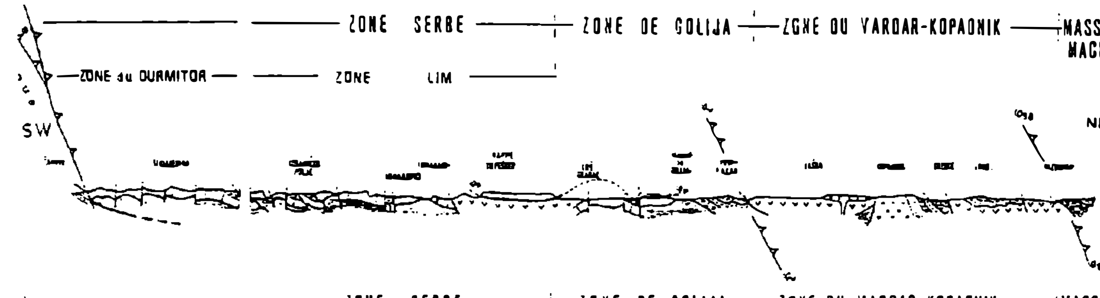

Fig. 1

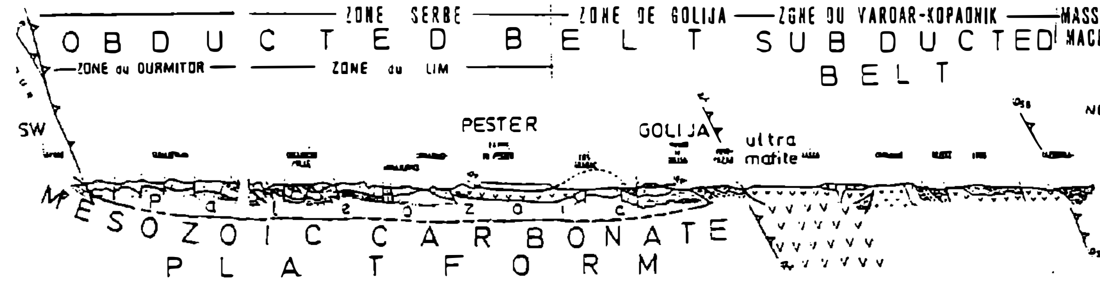

Fig. 2

UNDERTHRUSTING AS THE ACTIVE FACTOR AND OBDUCTION AS THE PASSIVE FACTOR IN THE CONTINENTAL COLLISION MECHANISM

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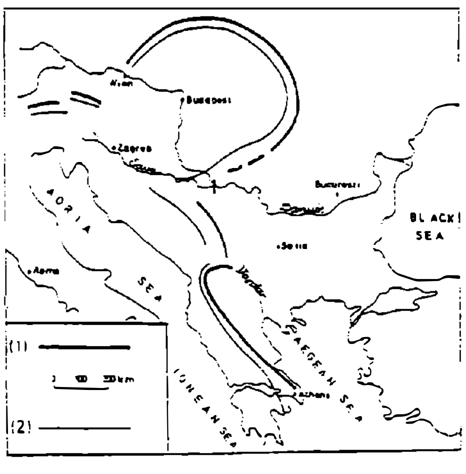
Continental collision mechanism is the same global phenomenon. In that sense, (seems paradoxally) the most active moving role always has so called passive continental margin which is forcefully UNDERTHRUSTING -- deeply under the oceanic crust including the OCEANIC LITHOSPHERE and maybe the uppermost parts of the MANTLE (Dewey J.F.,1976). All this material the passive margin is pushing on ITSELF and charging ON ITSELF i.e.OBDUCTING on ITSELF, carrying and bringing to SUBDUCTION ZONE under active continental margin. Here finishes the collision and begins the closing as well as after that: the SUTURING. During general uplifting and shallowing of the ocean, the ocean lithosphere (consisting also parts of the MANTLE) is:

- in subduction zone going downwards - therefore uplifting and cooling are very slow - in long time, what caused strong depletation - giving predominantly HARZBURGITE,
- in obduction zone going upwards - therefore uplifting and cooling are very fast - in short time, what caused slight depletion - giving predominantly LHERZOLITE.

Remnants of the former subduction and obduction zone are visible today as two belts (with ultramafites and other lithospheric material), so for them we suggest the terms: "subducted belt" and "obducted belt", and their main features are given in the following table:

	SUBDUCTED BELT	OBDUCTED BELT
Predominantly	Harzburgite	Lherzolite
Depleted	Strongly	Slightly
Emplaced	In long time	In short time
Cooling rates	Slower	Faster
Closing temperatures	670^{0}C	1100^{0}C
Pressure of equilibration	19-23 Kbar	25 - 36 Kbar
Generally position	Subvertical	Horizontal
Gravity	Maximums	Non remarkable
The chromspinel	Highly ferrous	Less ferrous
The chromspinel	Mg-poor	Mg - rich
Economic Cr Concentrations	Strong	Week
Ophiolites	The root ophiolites	The rootless ophiolites
Type	Island arc --- low Titanium	Oceanic --- high Titanium

These data are mainly after Maksimovic Z. & Jovanovic L. (1988) and Ndojaj I. - Ofioliti, 1991,16(1),49.



The ALPINE SUTURE ZONE
The traces of two ultramafite belts:
(1) subducted, (2) obducted.

After the continental collision, closing and the suturing, the both belts appear one next to another, and they are slightly recognizable.Their extension is several thousand kilometers long, indicating the recent boundary of the formercontinents,ieSUTURE ZONE. TRACE of the suture zone of the Jurassic ocean is given by "micro-oceans" with JURASSIC ultramafites: Pindos, Mirdita, Zvornicki, Transilvanian, Meliata and the ultramafitic belt in Alps. In Vardar zone of the Vardar river valley,there are several small ultramafitic formations: they are PRE JURASSIC in age. It confirms the newest subduction zone place in Albania: under Korab Mountain—NOT in Vardar valley (Becaluva et al.1994). The active underthrusting and the passive obduction are world known: The Alpine obduction by Arabian margin, the Caledonian obduction by Newfoundland margin, and the recent obduction on New Caledonia and New Guinea are caused by active Australian CONTINENT MOVING toward North and Northeast.

THE COMPARATIVE DEEP STRUCTURE OF THE WESTERN, EASTERN AND SOUTHERN CARPATHIANS INFERRED FROM GRAVITY MODELLING

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The rise of the Alps and Carpathians together with the incredible high seismic activity of the Carpathian Bending Zone (Vrancea seismogenic area) are dramatic aspects of the on-going orogeny in Central and Eastern Europe. The Carpathians, the Pannonian and Transylvanian basins provide excellent opportunity to study of the convergence of lithospheric plates which is followed by evolution of the extensional basins. To contribute to this study we present an analysis of long-wavelength gravity field by local isostatic equilibrium and 2D gravity modelling. Some earthquake seismology information is also included, especially for the Bending Zone of Eastern Carpathians. This approach offer the opportunity to determine several deep density models for interpretation of the lithospheric structure in the Carpathian-Pannonian-Transylvanian region.

Lithospheric density models were constructed constrained along selected profiles crossing the investigated region. They were designed in order to have a good coverage of the exciting areas but also in order to advance towards a three dimensional picture of deep structures in this realm. Available existing geological and geophysical data were used. Some of them are as following: deep reflection and refraction seismic profiles, new information on the gravity anomaly, maps of heat flow, published geological cross-sections of the crust, maps of the sediments, crustal and lithospheric thickness and topography.

The results of the gravity modelling demonstrate that the large scale lithospheric structure of the Carpathians obtained by refraction and reflection seismic profilings are compatible with gravity data. Gravity models illustrate changes in the degree of continental convergence in the Carpathian-Pannonian-Transylvanian region, and modification to the lithosphere due to the plate convergence and subsequent Pannonian and Transylvanian basin extension. Density modelling also indicates that a crustal root is still present under the Eastern and Southern Carpathians and in the junction zone. On the contrary , this is not observed in the Western Carpathians. The continental convergence after oceanic closure suggests values of about 50 km in Western Carpathians, where low topography, thin crust and a narrow low Bouguer anomaly are characteristics. Eastern and Southern Carpathians are possibly covering the European continental passive margin. Here it is a possible intermediate value of continental convergence, of about 90-130 km. The Eastern Alps are by contrary showing high topography, thick crust and a broad region of low Bouguer anomaly, suggesting about 175 km of continental convergence after the oceanic closure.

It is interesting to note that in the Carpatho-Pannonian-Transylvanian region the shallowing of the asthenosphere appears to be extended over a much broader region than crustal thinning, because it is probably related to the high thermal state of the Pannonian basin. It is indicated that the crustal structure underneath the Carpathians may not have been significantly affected by the Neogene extension.

Finally, some fundamental questions are taken into account. Is the Tethyan astenosphere mobilized by colliding continents? If so, to what extent are more distal plate and subduction system topologies coupled to the astenosphere displacement? Collision-induced astenosphere extrusions could eventually explain magmatism and slab-rollback, and allow thermal interaction with thickened lithosphere substrate.

ZEOLITIC VOLCANIC TUFFS JITIA-MÂNZĂLEŞTI AREAS (Buzău District), FINTEŞTI-PIETROASELE, AND SOUTH DRAJNA (Prahova District)

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The Langhian (Lower Badenian) shallow marine sediments from the Muntenia Subcarpathians include widespread occurrences of dacitic-rhyodacitic tuffs, the marker of an intense volcanic activity.

Depositional structural features (such as parallel bedding) show thickness from several meters to as much as 30 m (mainly in Jitia-Mânzăleşti area).

Our chemical data reveal a dacitic to rhyodacitic tuffs.

X-ray diffraction and T.D.A. analyses show the predominance of the vitric amorphe compound. Microscopical study reveal a composition of vitric shards, very fine grained ash and crystalloclasts (quartz, feldspar, biotite), a variable ratio of allogen siliciclasts (muscovite, hornblende), anthigenic and secondary compounds (zeolites, calcite, limonite).

The originally vitric material in the tuffs, especially fine ash, may be partially or completely diagenetic altered (mainly in Jitia-Mânzăleşti area).

The main diagenetic altered products of these tuffs are zeolitic minerals.

Textural evidence indicates that the zeolites formed directly from the silicic glasses by a solution-precipitation mechanism, in strongly alcaline environments (pH = 9,5-10). Typical size of zeolites consists of micronic and submicronic crystals.

The increased salinity and alkalinity of the water trapped in the pores of the tuffs during their deposition and the tectonic deformations have been, probably, the major factors that controlled the zeolitic diagenetic processes.

GEOCHEMICAL STUDY OF THE POTENTIAL SOURCE ROCKS AND CRUDE OILS FROM THE EASTERN CARPATHIANS OUTER FLYSCH AND FROM THE PANNONIAN BASIN, ROMANIA

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The East Carpathians Outer Flysch and the Pannonian Basin contain known commercial hydrocarbon reserves in Romania.

Geochemical studies and thermal modeling were integrated with geologic data to identify the source rocks and to suggest the hydrocarbon generation histories.

Rock-Eval pyrolises of outcropping samples from two organic-rich black shale sequences (Oligocene Lower dysodiles and Miocene Upper dysodiles) of the Tarcău nappe and of the Marginal Folds nappe from the East Carpathians Outer Flysh yielded up to 11% total organic carbon. The rich-organic horizons contain type II to II/III kerogen.

But it is simplistic to assume an exclusive Lower Tertiary origin for all the oils from this area. Many Tertiary crude oils probably include an overprint of high-maturity hydrocarbons from Mesozoic sources.

Source-biomarker parameters were used for reconstruction of depositional environment. May be observed a large variation of the anoxic character in time and in space.

The thermal modeling shows that burial at depths of about 5,000 m of Oligocene sediments is necessary for a significant oil generation.

In the Pannonian Basin maturity biomarker parameter studies were carried out on rock samples from some deep wells in an attempt to directly observe the onset of oil generation in the Tertiary sequences. Tertiary oils to source rocks correlation and to distinguish the depositional environments.

Two different oils populations have been characterized applying biomarker techniques.

In the Pannonian Basin the thermal modeling shows that the oil generation onset of the potential Badenian source rocks appears possible at depths of about 3,000 m.

Geotechnical failures at the sites of the fortresses along the north coast of Patra gulf, in Western Greece.

Moraiti E.[1] & Christaras B.[2]

The gulf of Patra, is located in the central part of Western Greece, consisting one of the most seismic areas in Greece. However, the importance of this gulf for navigation and military purposes as well as the morphology of the landscape contributed to the construction of castles either along the coast or on the top of the hills, near important cities. Their history is not only related to the Byzantine and post Byzantine time but also to the ancient period.

The existing geological and tectonic conditions cause damages to the walls and natural stones, in relation to the high seismicity and relief of the area. Thus, landslides, rock falls, settlements as well as weathering of the building stones, resulted by the activity of the marine spray are very common at these monuments.

In the present investigation, the observed geotechnical failures were studied in the following monuments:

1. _Antirhio - Rio Fortress (Fig.1, 2):_ It consists of two castles located at both sides of the gulf. *Antirio Fortress (Fig. 1)*, located at the north coast, is founded on loose quaternary sediments, laying over sandstones and limestones of Eocene. Some of the damages observed at the walls are related to settlements and other geological phenomenna. The continuation of this fortress, at the south coast, is called *Rio Fortress (Fig. 2)*. It is founded on quaternary deposits, such as clay, sand, gravel etc. The walls of the monument present important fissures related to settlements of the above mentioned loose sediments.

2. _Naupactos Fortress (north coast, Fig. 3):_ It is located on the Ionian flysh, whre many sliding phenomena are occurred, causing damage to the walls.

3. _Ancient Kalydon (north coast, Fig. 4)_: The ruins of the castle are located at the right side of Evinos river. Geologically the area is composed by the flysh of Gavrovo - Tripolis zone.

4. _Oeniadae (Trikardocastro, north coast, Fig. 5):_ The castle is constructed at a physically fortified site, near the delta of Acheloos river. The walls, are mostly damaged. The theater is constructed with Ionian limestone. Many of the sculptures are eroded and damaged.

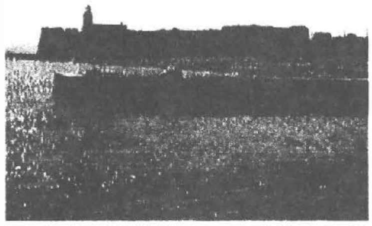

Fig. 1 Antirhio

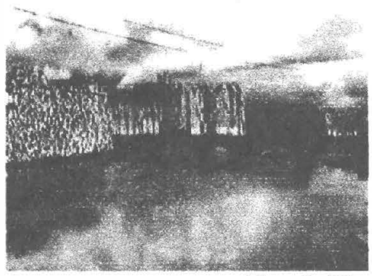

Fig.. 2. Rio.

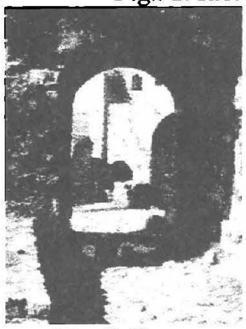

Fig. 3. Naupactos

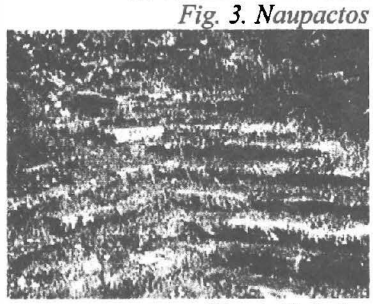

Fig. 4. Kalydon

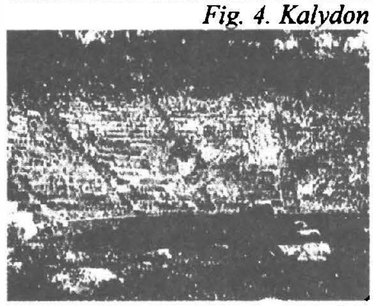

Fig. 5. Oeniadae

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RECENT ACTIVE TECTONICS OF THE WESTERN ADRIATIC PLATE: GEOPHYSICAL CONSTRAINTS

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HISTORY OF THE CARPATHIAN-BALKAN GEOLOGICAL ASSOCIATION

ABSTRACT

The "Carpathian Geological Association" was founded in 1922, at the XIIIth International Geological Congress in Brussels, by representatives of Czechoslovakia, Poland, Romania and Yugoslavia.
Between the two World Wars only three congresses were held. It was at the 3rd Congress in Prague (1931) that Hungarian geologists were present for the first time. At the XXth International Geological Congress in Mexico City (1956) it was decided to reconstitute and enlarge the Association. It was at this moment that Hungary joined the CBGA, along with Bulgaria and the USSR. After the IV. Congress of the CBGA (Kiev-Lvov, 1958) congresses took place every second year, after 1969 every fourth year only. Hungary hosted a CBGA Congress in 1969. Austria joined the Association in 1977, while Greece in 1989.

At the congresses the geologists of the host country presented the achievements of the geological research performed on the pertinent sector of the Carpathian-Balkan mountain system in form of summarizing lectures and field trips. Furthermore, the representatives of the other member countries also reported on their new research results.

In the year 1958 six Standing Committees were set up. Later six more have been added. These deal with the fields of Stratigraphy, Sedimentology, Palaeontology, Tectonics, Mineralogy and Igenous Petrography, Metamorphism, Geochemistry, Geophysics, Hydrogeology, Enginering Geology, and Geochronology. These are supposed to coordinate the joint efforts in those fields from one congress to the next. The Standing Committees for Tectonics, Petrography, Geochronology, Sedimentology, Hydrogeology and Engineering Geology compiled and printed several important generalized maps of the region, while the Geophysical Commission contributed considerably to the knowledge of the crust by measuring and interpreting geophysical profiles.

The CBGA contributed also to the activities of other international organisations. E.g. at the CBGA Congresses there has also been a possibility to harmonise the activities of the European map-compiling commissions of the International Geological Congress (in Geology, Metallogeny, Hydrogeology etc.) The Tectonic Map of the CBGA Region served as a basis for the production of the Metallogenic Map of the COMECON. A considerable number of IGCP projects also organised meetings in the framework of CBGA Congresses.

CHLORITOID-BEARING BLASTOMYLONITES IN THE RODNA MOUNTAINS

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The Rodna Mountains consist of a pile of alpine and prealpine basement nappes considered to represent the deepest crustal section exposed within the East Carpathians. The thrust planes of the Subbucovinian Unit over the Infrabucovinian Unit are marked by chloritoid-bearing blastomylonites. The blastomylonites possess mylonitic foliation (which frequently transposes an older metamorphic foliation) and a stretching lineation associated or not with a parallel mineral lineation. They are formed on low- or medium-grade rocks and are characterized by the parageneses: quartz + sericite + opaque minerals chloritoid; quartz + chlorite + chloritoid + sericite kyanite; quartz + chlorite + sericite + albite + carbonate. Minerals of an older assemblage are in disequilibrium with the new ones and are only found as relics or deduced from theoretical considerations: quartz + feldspar + biotite + muscovite +/- garnet. Sometimes relic structures may also be preserved, evidenced by microfolded opaque mineral films and trails. The mylonitic assemblages resulted under conditions of high shear strain and important element mobilisations, according to which carbonate- and/or chloritoid bearing rocks resulted. In blastomylonitic rocks chloritoid crystallizes whenever a relative enrichment in Si and Al takes place at the expense of alkalies, a source of Fe is present and f_{O2} favours the state of bivalent iron (conclusions based on chemical analyses). With respect to the last deforming event, chloritoid may be: a) *prekinematic,* eventually generated during an earlier phase of mylonitisation, followed by microfolding and renewed shearing (chloritoid crystals are deformed in the hinge zone of microfolds and are partially chloritized or sericitized); b) *synkinematic* (rotated crystals and "rosettes" with $S_i \neq S_e$, sometimes with pressure shadows); c) *postkinematic* ("swarms" and "rosettes" of segregated chloritoid, which substitute an older assemblage, having $S_i = S_e$); d) *bistadial* (synkinematic crystal cores with $S_i \neq S_e$, overgrown by inclusion-free rims).

The study of blastomylonites in the Rodna Mountains emphasizes the following conclusions: the blastomylonitic alignments may have different thickness, ranging from tens of meters (in alpine shear zones) to hundreds of meters (in prealpine shear zones); the blastomylonites are localized along the alpine thrust plane between the Subbucovinian and Infrabucovinian Units, as well as along some prealpine planes within the later; the chloritoid-bearing blastomylonites permitted to map new shear planes or to change thc trace of the already known ones; the blastomylonitic rock associations always contain mylonitic black quartzitcs (with frequent relic mineral boundaries, outlined by rutile needlcs included in quartz). We often found metrical, concordant lenses of segregated chloritoidites. There are carbonate-bearing mylonites too, in which carbonates are seen to replace the main, relic mineral (excepting the opaque minerals or partly relic chloritoids). It could be proven that chloritoid-bearing rocks do not belong to a specific lithostratigraphic level within the Palaeozoic sequence. They could be formed everywhere and on every metamorphic scries in the strong deformation zones, in adequate chemical background and in the physical stability field for chloritoid.

COMPARATIVE ANALYSIS OF THE EMPLACEMENT OF ORES IN THE ZIDAROVO, VURLIBRIAG AND ROSSEN ORE FIELD, BULGARIA

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It is made an attempt for the first time for comparison of the mineralogical features of the ores in the three major ore fields from Varna-Burgas depression.

The three phases defined are as follow: plutonic, hydrothermal and supergenetic. During the hydrothermal phase have been separated 10 stages of mineralization: epidot-chlorite (pre-ore); chalcopyrite-bismuthine (first ore); hematite-chlorite; galena-sphalerite-chalcopyrite (second ore); quartz-carbonate-zeolite; gypsum and 19 mineraloparagenetic associations.

Some more characteristic distinctions are following below:

1. In Rossen ore field have been established nickel and cobalt content minerals, which are missing in the other ore fields.

2. In Zidaro ore field the copper-lead-bismuth and copper-bismuth "sulphosalts" are prevalent. In the Vurlibriag they have been represented by richer range of minerals. In Rossen ore field has been established only one bismuth sulphide - bismuthine and "sulphosalts" virgin bismuth, tellurides and selenides have not been diagnosticated. Lead-bismuth and silver-copper-lead bismuth "sulphosalts" are characteristic for Vurlibriag ore field and these "sulphosalts" have not been established in Zidarovo and Rossen. The earliest bismuth mineralization (bismuthine→tetradymite→virgin bismuth) has been established in Zidarovo and Vurlibriag but in Rossen ore field - only bismuthine have been fixed.

3. For Vurlibriag ore field the stage of quartz-chalcopyrite could be defined 6 mimeraloparagenetic associations which are as follow 1. quartz-chalcopyrite, 2. bismuthine, 3. cosalite, 4. aikinite, 5. emplectite-wittichenite, 6. berryite-matildite.

4. Growth of the selen presence in the isomorph form in depth has been observed whereas in the upper levels it is missing.

5. In the minerals from Zidarovo and Vurlibriag have been established silver and for Rossen ore field it is as electrum, gold and galena.

6. Growth of the quantity in the direction East-West (from Rossen to Vurlibriag, Zidarovo and Bakadgick) has been observed in the distribution of gold, shpalerite and galena.

We could note as stable associations chalcopyrite-bismuthine, zeolite-carbonate and in a smaller grade galena-sphalerite-calcopyrit (missing in Rossen), epidot-quartz.

As a specific association it is marked quartz-molybdenite-scheelite in Rossen, which has been observed in some other ore fields in the region of Malko Turnovo and the ore deposits Prohorovo.

PIEMONTITE PORPHYROIDS FROM VALEA SEACA, TULGHES GROUP (EAST CARPATHIANS, ROMANIA)

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Although piemontite has been reported from the East Carpathians (in some manganese deposits) its occurrence in the metarhyolite porphyroids of the Cambrian Tulghes Group is quite uncommon. Piemontite from Valea Seaca occurs in association with quartz, phengite, albite and garnet. Its unit cell parameters (determined from X - ray powder data, after 6 cycles of least - squares refinement, based on 35 reflexions) are: a = 8.903(7) Å, b = 5.671(3) Å, c = 10.132(7) Å, β = 115,12(4)°. It has about 1 apfu Mn^{+3} and 0.03 - 0.06 apfu Fe. Mn^{+2} replaces calcium at a concurrence of 0.23 - 0.26 apfu. Piemontite has grown on a spessartine, preserved as a relict phase. A newly formed Al-epidote - Fe-clinozoisite (0.29 - 0.42 apfu Fe, 0.02 - 0.35 apfu Mn) developed crystals of its own or coated the piemontite. The phengite (cel_{25-28}) seems to be contemporaneous with the epidote. Albite (An_1, $Or_{0,5}$) has formed metasomatically on former plagioclase and K - feldspars.

The garnets has formed at the contact between the Cambrian rhyolites and the percolated carbonaceous sediments (the nowadays black quartzites, locally enriched in Mn). The presence of garnet would be an evidence of metasomatism implying the Cambrian rhyolites of the Tulghes Group (the only one yet known in the East Carpathians). Subsequently, water - rich, oxidizing fluids determined, in a first stage, the piemontite formation on the expense of the garnet, and, in a later stage, the growing of epidote.

Phengite barometry (Massonne and Schreyer, 1987) indicates a minimum pressure of about 7 Kb. Al in quartz (Dennen et al., 1970) and plagioclase - muscovite geothermometry (Green and Usdansky, 1986) indicates temperatures of about 300° C. These values are significantly different from those determined by sphalerite barometry and pyrite - arsenopyrite thermometry (3.6 - 4.4 kb and 380 - 450° C, Rosu et al., unpublished data) 50 km northwards. Assuming the risk of misfitted determinations (Green and Usdansky's geothermometer is not calibrated below 490° C) our data may suggest that the last mineral - forming event was influenced by a major fault or thrust.

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RARE ALKALI METALS (Li, Rb, Cs) AS METALLOGENETIC INDICATORS

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The present geochemical data from the literature and those obtained by us reveal the possibility of using the rare alkali metals in metallogenetic potential appreciation. Therefore, we can use the Li, Rb, Cs contents from the rocks or from the respective rock-forming minerals and some of the geochemical parameteres as metallogenetic indicators. The rare alkali metals are lithofile elements, typical for granitoid rocks, granitic pegmatites, alkali rocks and metasomatites. This paper presents the importance of the rare alkali metals in metallogenetic potential appreciation in the granitoids and granitic pegmatites. On this purpose were used the following geochemical parameters, calculated for these rocks and for some of their minerals: (Li/Mg) 10^3; F · (Li+Rb)/(Sr+Ba); (Rb/K) · 10^3; (Cs/K) · 10^3; (Ba+Sr)/Rb; (Sn/Li) · 10^3; (Tl/Rb) · 10^3; Rb/Ba; Rb/Cs. These geochemical parameters and the subsequent diagrams confirm the fact that during the endogenous metallogenetic processes, lithium presents affinity with Mg, Al, F, Sn and Rb, and Cs with K, Ba, Tl. The high level of (Rb/K) · 10^3 are characteristic for the mineralized granitoids (Sn, W, Mo, Li etc.): Altenberg (81,3); Zinnwald (67,5); Cinoveč (18,3); Krušne Horý (23,6); Hnilek (18,3); Tîrnăauz (15,3); French Central Massif (29,5); Transbaikalia (14,3) etc., compared to the low values calculated for the sterile granitoids: Altai (4,5); Tian Şan (4,8); Tuva (2,0); Transbaikalia (3,5); Stratoni (3,6); from Romania: Danubian units (4,2-4,7); Getic units (2,0-4,2); Bârzava Massif - Apuseni Mts. (3,4); North Dobrogea (2,2-5,0) etc. The value F (Li+Rb)/(Sr+Ba) is high (430-62.000) in the rare metals' granites and low in other geochemical types of unmineralized granitoids (6-300), according to Tauson (1977). The geochemical affinity of Li for Sn and the substitution $Li^{+}_{VI} + Sn^{4+}_{VI} \rightarrow (Mg,Fe)^{2+}_{VI} + Al^{3+}_{VI}$ in biotite, allows us to use the value (Sn/Li) 10^3 as a metallogenetic indicator. This aspect is confirmed by the high values of (Sn/Li) · 10^3 present in the biotite from the fertile granites (Sn, Mo, W): Krušne Horý (25,5); Poproš (85,1); Transbaikalia (46,2) etc., and the low values calculated for the biotite from the sterile granites (4,6-10,7).

Granitic pegmatites are a classic example of source for rare elements: Li, Rb, Cs, Be, REE, Nb, Ta, Zr, Hf. The metallogenetic potential for rare metals of the different types of granitic pegmatites such a abyssal class, muscovite class, rare elements class, miarolitic class (Solodov et al., 1980; Şmakin, 1983; Černý, 1992 etc.) from India, Canada, U.S.A., Russia, Romania, Mongolia etc., is appreciated using the following geochemical parameters: (Rb/K) · 10^3, (Cs/K) · 10^3, (Tl/Rb) · 10^3, Rb/Ba and diagrams: $c^{Mus}_{Li}/T(°C)$; $c^{Mus}_{Rb}/T(°C)$; $c^{Mus}_{Cs}/T(°C)$; $c^{Mio}_{Rb}/T(°C)$; $c^{Mic}_{Cs}/T(°C)$; $Li/(Al_{IV} + Al_{VI})_{Mus}$; $Rb/(K/Rb)_{Mus}$; $Ba/(Ba/Rb)_{Mus}$; $(Mg:Al:Li)_{Bi}$; Li/Pyrope etc. The obtained results show high values of those parameters in rare metals' pegmatites and in rock-forming minerals. In the diagrams, the analyzed samples are placed into two different fields.

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CONTRIBUTIONS TO INDIAN GEOLOGY BY EUROPEAN PIONEERS IN THE NINETEENTH AND TWENTIETH CENTURIES - EARLY STAGES.

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The establishment of the various Survey Departments took place in stages in India during the East India rule and HM's rule later in the nineteenth and early part of the twentieth century. Indeed, it was to investigate in to coal resources of India that led to the formation of the Geological Survey of India. The Trigonometrical Survey was initiated in the twenties of the nineteenth century and it went on till the last quarter. The Archaeological Survey, the Statistical Survey, the Marine Survey and the Geological Survey were started during this period. While the majority of the personnel were from England, there were a good number of Europeans, from geological and non-geological fields, that contributed to the developments of these Survey Departments. Among these must be mentioned Albrecht von Kraft von Delmensingen, Antoine Francis Alfred Lacroix, Albrecht Spitz, Carl Diener, Emil Stoehr, Edm. von Mojsisovics, Franz Kossmat,Fritz Notling, Ferdinand Stoliczka, Ferdinand von Hochstetter, Henri Douville, Ottokar Feistmantel and Wilhelm Waagen. There were also pioneers of Indian geology outside the ranks of the Geological Survey of India to which those mentioned above belong. La Touche's Bibliography of Indian Geology(1917) and Dr. H.J. Carter's 'Geological Paper on Western India'(1857) list these pioneers, including Laidlaw, Voysey, Dangerfield and Herbert, not, of course, excluding the most eminent geologist in India prior to Thomas Oldham, Capt. T.J. Newbold. It is proposed to enumerate the works of these distinguished perons and their contributipns to Indian Geology.

NATURE CONSERVATION THE INDIAN SCENE

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The Indian region(8^o-30^oN and 60^o-97.5^oE) with a total area of 329 million hectares is very rich in natural hritage and biological diversity. It is estimated that about 45,000 species of plants occur in this country. The vascular flora, which forms the conspicuous vegetal cover, itself comprises 15,000 species, of which more than 60 per cent are endemic and have so far not been reported anywhere else in the world. The endemic species and genera are largely concentrated in two principal biogeographical regions of India, viz., the Himalayas(about 4200 species) and Peninsular India (about 2600 species). India has a coastline of about 6,000 km with an area of 20,13,410 sq.km of exclusive economic zone(EEZ) and a shelf area of 4,52,060 sq.km. The ocean resources are both living and non-living. India has been fortunate in having about the richest and most diverse natural heritage in the world, but there lurks the danger of this heritage being eroded. The interest in conservation is not sentimental but the rediscovery of a truth well-known to our sages. During the last decade and a half, the Government of India and several research institutions, scientific societies and private individuals have got involved in taking steps to conserve this natural heritage. The plans for conservation included establishment of a network of scientifically managed protected areas, inlucind the Gene Sanctuaries, National Parks, Biosphere reserves and other areas to cover representative and viable samples of all significant biogeographic subdivisions within the country. That the Government declined clearance to the Silent Valley Project in Kerala in the eighties in order to protect the natural heritage of that region is a clear evidence of the intent of the government towards conservation of natural heritage.

Metalogenic features of volcanic rocks of two ophiolitic belts of Albania

Dr. MUSTAFA Faruk
Geological Survey of Albania

As is known in Albania there are two ophiolitic belts with specially petrologic features. It is thought that the geneses of them is formed by different deeps of a subduction area with eastern dip. On the whole the metallogenic distinction of ophiolitic belts is a evident one, but the change is very clear in the respective volcanite.

- The volcanite of western belt,basal and diabasic ones are reached with Ti, has a lower metallogenic potential. *There are met some Cu-S and rarely Cu-Zn-S ore deposits, with limited dimensions,* massive or disseminated ones. In the volanic cutting, mainly of the pillow facies, are setting in a discordant way and without any rule in the cutting. The mineral bodies are setting inside the limited areas with metasometic, hydrothermal, intensive metamorphism (chlorite, quartz, carbonate). For these volcanite it is a characteristic thing the presence of hydrothermal, quartz-sulphur veins that often have the high values of Au at the arsenopirit form and rarely as a native.

- Volcanite of eastern belt, are basaltic-andesite-dacite poorly with Ti and they have a greater metallogenic potential. Here, there are met a great number of deposits and ore performances of massive and disseminated kind, which on the whole are setting according to a determined area in a general cutting of volcanite. The developed, reached and complex mineralisation is in the upper middle and middle-acidic part of the cutting .

All the rules of above mentioned mineralizations are presented in the respective colûmns and cuttings, fulfilling so the purpose of a poster.

Petrology of volcanic rocks of two ophiolitic belts of Albania

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It is well known the fact that from the geological point of view, Albania represents an area where the magmatic rocks are widespread and several mineral deposits are related to them. Among of them, volcanic rocks and mutual deposits of Cn, Zn,S, Au, etc. are with a particular interest.
Also, it is known the presence of two ophiolitic belts with different petrologic features. The lecture submitted has the purpose to evidence just these changes. Considering a wide material of the author and the other Albanian, foreign studiousness are represent clearly the changes in all petrologic problems. There are analyzed geological, petrologic, petrochemical and metalogical features for both ophiolitic belts. The main factories of distinction are considering the lithologic-facial (petrologic) and metallogenic ones which are expressing clearly even in the terrain. Geochemical features doesn't express exactly the genetically belonging for one or the other belt, especially not at a local form (with particular tests). This is explained by heterogeneous spread of titano-magnetite as a resource of Ti, the only distinctive, clear petrochemical element. On the whole both belts are distinguished by the Ti content , western belt is characterized from a higher content of Ti than the eastern one. In the lecture there are given the cases of the direct, normal relations of two vulcanite's kinds. Both of them are covered from the same volcanogenic - sedimentary radiolitic bed of the middle Jurassic. Considering especially these last facts, the author, differently by the other studiousness, thinks that both of ophiolitic belts are the production of the subduction generated from several deeps. The certain one is the follower of eastern belt from a subduction area in which are met boninite as the rocks that determine among the others this type.
Volcanic rocks of two ophiolitic belts have the several features and potential of ore bearing. Mineralisations of western belt with a high content of Ti are setting without any rule on cuttings and horizon of support, but there are on a irregular manner. There are known a little number of small deposits of the pyrite -massive and disseminated calcopirit. While in the vulcanite with a low Ti content, it is concentrated the mineralization of more important in some deposits of calcopirite and prit-calcopirite-sphalerit with greater dimensions localized in the determined level of the profile.
The lecture is illustrated in a understanding way by the litologo-facial columns, graphic and several petrochemical coefficient , cuttings.

TEMPERATURE CYCLES IN THE PALEOCLIMATE FEATURING THE SALGÓTARJÁN BROWNCOAL FORMATION IN HUNGARY (EARLY MIOCENE)

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The Miocene (Ottnangian) seams (I-V) found in the Borsod basin in North Hungary and belonging to the Salgótarján Browncoal Formation, including the sequences, (Bohn, et al. 1995) between them were examined on a palynological basis. As shown by our examination the local climate that prevailed at the place of development of Ottnangian browncoal formed on Taxodium swamp forest Myrica and Cyrilla swamp schrub must have been definitely warmer than the climate that featured the rest of area of Hungary, (Nagy, 1990).

During the time Salgótarján Browncoal was formed the mean annual temperature is supposed to have varied in the range from 14.5° C to 24°C. The higher temperature values coincided with the period of coal formation. Considering that in the browncoal seams the vegetation was featured by propagation of tropical species /Sapotaceae, Araliacae, Engelharia), the development of coal semas of different thickness was linked this temperature cyclicity of 3°C as a maximum, (Korpás-Hódi et al. 1997) the greatest increase in temperature might have occured during the period of Seam V, whereas the lowest temperature might have prevailed at the time of Seam II formed later.

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ACCESSORY RARE EARTH MINERALS IN SOPRON HILLS, W-HUNGARY

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The Sopron Hills, the easternmost outcrop of the Eastern Alps is built up mainly by polymetamorphic pre-Variscan(?)–Variscan–Alpine complexes containing mostly mica schists and orthogneisses metamorphosed in greenschist facies. Near village Brennberg pre-Alpine mica schists of amphibolite facies are preserved. In small amount grey quartzite formed from mica schist, white quartzite and leucophyllite (Mg-Chl–Ms–Qtz phyllite), both formed from gneiss during the Alpine cycle are also found. The following REE minerals have been identified in the above mentioned rock types: monazite, xenotime, rhabdophane, florencite, sporadically allanite and cheralite. The REE-phosphate minerals were analysed by EMPA (distinction between monazite and rhabdophane based on the measured oxide totals), whole-rock REE contents of some samples were determined by INAA.

Monazite is most abundant in mica schists and grey quartzites found in the western part (Brennberg, Vöröshíd quarry), and is rare or absent in the eastern part of the Sopron Hills. Gneisses and leucophyllites contain usually few, small monazite often included in apatite indicating magmatic origin. Xenotime is less frequent, its occurrence changes parallel with monazites. Rhabdophane can be found in most gneisses and rarely in schists; florencite appear in certain quartzite and leucophyllite samples; these two minerals could not be found together.

From quantitative mineral analyses the followings could be concluded: 1) Most monazite grains in gneisses and leucophyllites, especially those included in apatite, have higher negative Eu-anomaly ($Eu/Eu^* < 0.35$) than in schists and grey quartzites ($Eu/Eu^* = 0.4 - 1$). 2) The Y-content of monazite increases with metamorphic grade in mica schists, and – in average – it is slightly higher in gneisses. This is in accordance with experiments of Gratz & Heinrich (1997). 3) In monazite Ca and Th change together, Ca ≈ Th. 4) In most rhabdophane Ca > Th; the Y and other HREE contents are higher, the Eu-anomaly is less negative than in monazite. These grains could not have originated directly from monazite alteration.

Changes of occurrence, abundance and composition of the REE-minerals compared with the whole-rock REE-contents allow us to draw conclusions about geochemistry of REE during certain metamorphic processes.

The investigations were sponsored by Hungarian National Science Fund (OTKA) program T 015993.

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PLATFORM PROGRADATION AND SEA-LEVEL OSCILLATION CONTROLLED SEDIMENTATION IN A CARNIAN INTRAPLATFORM BASIN, BALATON-HIGHLAND, HUNGARY.

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In the Carnian (Early-Julian) the Pelsonian Composite Terrane (and within it the Balaton-Highland) was situated between the Southern Alps (Lombardy and Dolomites) and the Northern Calcareous Alps. The main features of the sedimentation at that time were determined by terrigenous input and platform progradation. For the Early Julian between large platforms a relatively deep (500-600m) basin can be interpreted in the studied area. The basin was almost complitely filled up by the Early-Tuvalian due to terrigenous input and platform progradation. In the last phase of the basin upfilling marl and limestone layers were deposited depending on the relative stand of the sea-level (Sándorhegy Formation). The overlying Main Dolomit was formed under shallow marine conditions showing only minimal topographic inequalities.

The basin succession was studied by detailed microfacies investigation in the Nosztor-Valley (Csopak, Balaton-Highland). The following main microfacies belts can be distinguished: (A) intertidal-subtidal low energy zone (Main Dolomite); (B) intertidal-subtidal high energy zone, platform margin area; (C)shallow basin or bench, low energy zone; (D) upper and middle slope facies; (E) lower slope facies; (F) normal and hypersaline basinal facies; (G) shallow subtidal zone, high energy lagoon area; (H) facies of stagnant, hypersaline, anoxic basin with no water-circulation. The basinal and slope facies are mostly made up by fragments of pelecypods, gastropods, forams but also echinoids, crinoids and holothuroids. A few reworked oncoids are also visible. The high energy zone is characterized by intraclasts, peloids and various bioclasts (partly coated mollusks and echinoderms, algae, a few sponges and stromatoporoids) of platform origin with sparry cement. The anoxic facies are characterized by various cyclic laminaes with tempestite intercalations.

Drowning of the platforms was mainly caused by the terrigenous input during transgression and the progradation took place in the highstand intervals. The anoxic layers indicate the global lowstand and the basins were formed by sills holding up the normal saline water inflow.

Progressive accretion of the basin led to shallowing and decrease of the slope angles by the end of the Julian. These intraplatform basins behaved as carbonate ramps for environmental changes. The LST of the Car3 depositional sequence is marked by anoxic layers and the following TST is characterized by marls-clayey limestones. The platform progradation almost filled up the whole basin in the HST. The end of the depositional sequence cut by an erosional surface and a transitional zone towards the Main Dolomite.

The Carnian sequences of the Balton-Highland shows a good relation with the Dolomites. The Sándorhegy Formation is a good analogy for the Dürrenstein Formation (Dolomites) although its different lithology.

ALPINE TYPE MAGMATISM RELATED PEBBLES FROM THE BAKONY MOLASSE (HUNGARY): CONTRIBUTION TO THE UPPER-OLIGOCENE PALAEOGEOGRAPHIC RECONSTRUCTION

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In the Upper-Oligocene (Egerian) several heteropic facies associations are stretching from west to east of the Pelsonian Composite Terrane. In the west, some 800m thick cyclic alluvial sediments (Csatka Formation) overlies Eocene with erosional surface and continuously transform into a fine clayey-silty bathial marl (schlier) in the east. The sequence of the formation is mainly built up by pelitic rocks but coal-bearing layers and coarse alluvial pebbles also occur.

In the material of the latter some interesting magmatic pebbles were found in Dudar, coal-mine (NW-Bakony Mts., Hungary). Statistical comparisons showed a wide range of pebble diameter, sphericity and roundness decreasing from west (avg. 20cm) and variety of types from metamorphic to limestones in the west, on the other hand increasing number of igneous pebbles in the east (20%) (Fig. 1.). The latter can be distinguished intrusives (tonalitic) and effusives (rhyolitic-series, dacitic-andesitic-basaltic-series) groups. In the rhyolitic rocks there are lot of remelted quartz phenocrysts in glassy or microholocrystallic groundmass. Tonalitic samples include normal zoning, sometimes remelted plagioclase and strongly altered amphibole and biotite phenocrysts. In the dacitic pebbles there are some large remelted plagioclase and quartz, in some places biotit phenocrysts in microholocrystallic groundmass. The most frequent pebbles fall in the andesitic group including plagioclase, altered amphibole and piroxene phenocrysts. Basaltic samples are crumbled and altered generally, but also fresh pebbles were collected. These rocks contain large plagioclase, amphibole and pyroxene phenocrysts.

Representative magmatic pebbles of the groups (except for rhyolites) were analysed for major and trace elements by XRF and INAA and some of them for K/Ar dating. The results of analysis give us an interesting relationship between the four groups:

K-Ar dating for the dacitic-andesitic-basaltic-series indicates an age of 30-35 Ma suggesting that the magmatic activity of the source area has taken place in Oligocene. The age of rhyolitic-series rocks are Triassic (210-220Ma).

- All of the analysed samples fall into the field of calc-alkaline volcanics on the K_2O-SiO_2 diagram. Similarly to this fact the samples show us a calc-alkaline origin on the AFM diagram, probably subduction related magmatism.
- Harker diagrams of major and selected trace element of rocks indicate a linear trend, which is charasteristic for fractional crystallisation.
- Chondrite-normalised trace and REE diagrams for representative samples show close patterns, so these rocks have the same origin.

The plagioclase and amphibole phenocrysts originate from 720-950°C and 2.5-6.5kbar. The pressure decreases from basaltic to tonalitic composition.

Although reliable geochemical and K/Ar data are not available we suggest that from consideration of statistical results the magmatic intrusion of the Zala-Basin might be the mother-rock of the magmatic pebbles.

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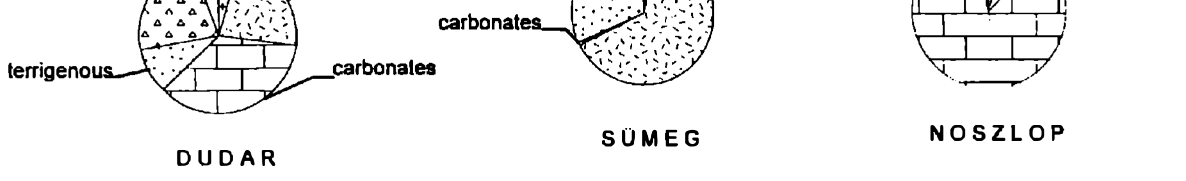
Fig. 1. Statistical comparison results from some successions of the pebbles.



INNOVATIVE DIRECTIONS OF THE FLUID INCLUSIONS USAGE FOR RECONSTRUCTION OF MINERAL-FORMING CONDITIONS IN OIL-GAS-BEARING SEDIMENTARY PILES

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Being the relic records of the mineral-forming media, the fluid inclusions in minerals are widely accepted as paleoenvironmental indicators in many fields of geology especially those concerning natural products of the Earth's deep-seated defluidisation like hydrothermal ore deposits. Some possible ways of fluid inclusion studies can be also considered in relation to oil-gas-bearing provinces, and are briefly outlined as follows:

PTX-parameters restorage for katagenic and hydrothermal mineral-forming processes. Recently initialized investigations are concerned with reconstruction of mineral-forming conditions for vein-stockwork katagenic-hydrothermal mineralization bearing in mind restorage of the katagenesis environments and its influence on the distinct thermobaric and geochemical haloes formation around hydrocarbon deposits. Irrespective of hydrocarbon-bearing fluid generation source origin these fluids being introduced from the depth into the sedimentary pile appear to have higher temperatures and would affect the temperature equilibrium previously attained in the host pile. Thus, integrated effect of such the fluids influx would release in primary minerals transformation as well as mineral-forming medium fluid phase changing. The remnants of the latter being initially trapped during katagenic reworking would be highly modified later due to partial dissolution, renewing and recrystallization of the minerals. Resulted fluid inclusions "store" important information on the state, patterns, composition, pressures, temperature and density of the fluids contributed to vein-stockwork mineralization. All these features allow to use fluid inclusions to reconstruct hydrocarbon-bearing fluid system parameters as well as to provide some tracing of fluid motions and interactions with oil-gas-bearing rocks.

Furthermore, gas-saturation level, variability and hydrocarbons composition in the fluid inclusions are directly related to hydrocarbon amounts have been transferred through the rocks as well as to the thermobaric and geochemical conditions during motions of these hydrocarbons. From this point of view, the local oil-gas field potential can be evaluated by increase patterns of the ratios between hydrocarbon concentration in the vein-stockwork mineral fluid inclusions, and the host rocks, while direct exploration tools can be suspected from particular value of this ratio.

Fissures discrimination by their timing and determination of the age of fissure-type hydrocarbon-containing rocks. In oil-gas-bearing provinces the most favourable sites for economically important fissure development should be expected from regional extension stages or environments (rifting) when relative equal conditions have had existed for both shear and rupture fracturing. It seems likely vein-minerals fluid inclusion studies should allow to discriminate suitable fault-fissure systems of the lithosphere-extension regimes and stages by means of comparative analysis of the records from known rifting and collision environments. From the other hand, these investigations could also provide necessary information about deep-seated closed fissured transformation into permeable and even open ones during subsequent uplift and lithostatic pressure erosional download.

In addition to the mentioned directions we also expect some progress in fluid inclusions usage for:
- source region determination for typomorphic clastic minerals (and their associations);
- evaluation of the clastic matter transportation paths;
- correaltion and stratification of the paleontologically unsubdivided piles.

GOLD MINERALIZATION IN THE DONETS – CARPATHIAN TECTONIC ZONE

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The main areas of gold mineralization in Ukraine are situated along with the Latitude 48 N including 6 ones (from the E to the W): Southern Donbass, Middle Dnieper, Kirovograd, Middle Bug, Middle Dniester and Carpathian. They coinside in spase to the eastern continuation of transregional tectonic zone is known as Franko-Podolian step (Bubnov,1960), separating outside-Alpine Europe from the Mediterranean region. The zone includs Czech-Ukrainian stripe of Precambrian basement uplifts well-defined during Phanerozoic periods and testify to long tectonic activity (Nalivkin a. al.,1964). The reconstruction of Pre-Riphean unity of basement uplifts as well as some new ideas about the metallogeny of Ukrainian Shield (USH) are published (Nechaev,1981;1998).

In Southern Donbass area Au-Ag-sulphide veined ore is related to the southern part of Donets riftogen and eastern part of Azovian block of USH where Variscian folding and magmatic processes display great activity. Epigenetic mineralization formed in the carboniferous potential Au-bearing black shales in which Au accumulation was the result of erosion Early – Precambrian ore complexes of USH.
Middle Dnieper area correspond to the eastern part of Archean craton in which gold mineralization is related to greenstone belts including as well volcanic -plutonic as potential Au - bearing BIF. Two epigenetic stages of gold minemlization are fixed: 3.0 –2.9 b.y. and 2.7 – 2.5 b.y. The first stage is rich in As and S, sometimes in Mo, and the second stage distinctions are mineralization of Te,Bi,Pb,Sb,Ag,Hg or sulphosalts of Cu,Pb,Ag,Sb without tellurides. The basal horizon of Proterozoic strata southern to Krivoy Rog presented by Au–U–bearing conglomerate and sandstone aged by 2.6 – 2.45 b.y. Probably as a result of their regeneration is veined Au–U–sulphide ore aged 2.1 b.y. and jounger in the adjacent Proterozoic folding belt inheriting epicratone depression.
Kirovograd area just coincide to these structures. Main gold ore in the area localized in fractured and cleavaged granitizated gneiss both side of longitudinal system of granite (2.07 – 2.01 b.y.) and rapakiwi – anorthozite (1.75 b.y.) plutons. Au–Bi – As mineralization aged less than 1.68 b.y. and cross rapakiwi. The first generation of gold is disseminated in arsenopyrite and lollingite, and the second is free with a little sulphides of Fe,Zn,Cu,Pb,Bi. Spatial relationships between gold mineralization and scheelite - bearing tactites is similar to the situation in the Kashpersky Mtns (Moravek,Pouba,1987).
Middle Bug area present of the western, Podolian, part of Archean craton undergone as tectonic destruction and granitization about 2.0 b.y. ago. Gold deposits are related to the fracture zones in: 1.- mafic-ultramafic rocks, serpentinized and carbonatized, and then skarned; 2. – granitoids, including amphibolite-gneiss relicts aged about 2.7 b.y. Gold-skarn ore type aged about 1.9 b.y. whereas gold- quartz ore type was telescoped after secondary amphiboliantion (1.85 b.y.) and biotitization (1.62 b.y.).Regeneration of gold mineralization related primarily to Late Archean greenstone complexe is supposed. Gold ore is very poor in sulphides and as distinct from Middle Dnieper cratone is isolated from sulpho-arsenide Ni-Co ore. In gold-tellurium assotiation is found a new mineral: the substitution product by thallium of calaverite, ternary chalcogenide $Au_{1.03}Te_{0.61}Tl_{0.35}$ named as nechaevite in the memory of V.A.Nechaev, well-known geologist of Ukraine.
In Middle Dniester area gold placer (with cinnabarite) are known as well as Vendian stratified mineralization of sulphide Fe,Pb,Zn, and Cu, barite, fluorite and potential Au-bearing black-shale formation. In the basement of USH scheelite-bearing skarn telescoped with polysulphide Fe,Cu,Zn,Ni,Co,Pb,Ag,Bi,Sb,As and thallium mineralization is found.
In Carpathian area, in Rachov field, gold ore poor in sulphides and tellurides related to the Vendian spilito-keratophyre and black-shale formations intruded by Variscian granite; the situation is similar to gold deposits Czelina and Mokrsko in the Bohemian massif(Moravek, Pouba,1987). In Beregovo field epithermal Au-Ag-sulphide ore localized in the volcanites of Neogene, and was conditioned by tectonic-magmatic activization (Naumenko a.al.,1987). The analogues mineralization in volcano-plutonic belts as far as known inherits areas of gold productivity the preceding metallogenic periods.

Besides the gold ore-forming stages indicated above in the stratigraphic sequence of Ukrainian Earth crust, from Archean to Quaternary, there are number of intermediate potential Au-bearing levels. Outside Ukrainian territory deep-seated latitudinal tectonic zone Vienna-Munich separate the Bohemian Massif from the Alpine folding system, including Hoch Tauern gold deposit. In such a way comparative investigation of gold mineralization formed into vast time range and in different geological situations is unique opportunity to perceive geodynamic and ore-forming evolution.

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BAIA SPRIE - MARAMUREŞ DEPOSIT; ABSORBTION OF THE GOLD ASSOCIATED TO THE MINERALS FROM COAL

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Baia Sprie deposit was exploited many thousands years ago. The first written informations of the mining from Baia Sprie was in 1141 years. Since, the Baia Sprie deposit is confirmed in official documents of the all administrations. Baia Sprie is a geological structure model which was researched more than 200 years austrian, german, hungarian and romanian researchers. Especially, Baia Sprie is a famous deposit because its polymetallic mineralization is a natural collection, which has more than 82 minerals. Baia Sprie area is formed by Neogen age formations (Pannonian sedimentary deposits and other younger rocks,magmatites,hydrothermal altereted products and post-Pannonian polymetallic mineralizations).The Pannonian sedimentary deposits are made up by marls,sandstones,volcanogen-sedimentary rocks and bituminous coals-anthracites.The principal maceral group from coals is the vitrinite (predominantly collinite). All Pannonian formations are crossed by veins predominantly formed of chalcopyrite + pyrite + galena + sphalerite + bornite + tetrahedrite + haematite + adulare +baritina+other interesting minerals, quartz + gold and calcite. It was descovered the natural coke and pyrocarbon in the coals which are in contact with mineralization of Baia Sprie structure (Nedelcu,1997).

Two aspects are very important at the contact of the polymetallic mineralizations with Pannonian sedimentary deposits. In the first, in the "Valea Herneanu/Herneanu Valley", at the zone of number 5 shaft, XIV Gallery Mine, the polymetallic sulphides and gold mineralization crossed the Pannonian sedimentary deposits with coals. In some places of sedimentary deposits, the polymetallic mineralization has substituted the marls and the clays but not the coals. The coals rested as some strong light "round-pillows" and were very crossed by the quartz + gold and calcite. Because of the temperature and pressure of hydrothermal solutions, the organic matter has lost volatiles (CO_2,CH_4 and other easy hydrocarbons) and it was transformed in high reflectancy vitrinite (mean reflectance of vitrinite, in oil, Rm Vi = 1.00-3.00%). This high reflectance of vitrinite and other qualities of coals (V^{daf}=27-10%;C^{daf}=85-90%;H^{daf}=4.45-3.10%;O^{daf}=7 10-1.30%;Q_s^{daf} = 8000-8400 kcal/kg) characterise a bituminous coal-anthracite stage. Often, the quartz+gold and calcite have replaced the vitrinite. At the same time, the vitrinite was substituted by pyrocarbon and isotropic natural coke.But the pyrocarbon has not well formed "con in con " structures in coals from "Valea Herneanu" These pyrocarbon structures were formed at an initial stage only.They no are in an advanced stage,as in meta-anthracites from anchimetamorphism zone (for instance,in meta-anthracites from Liass formations of Armeniş-Râul Lung-Râul Alb, Schela-Gorj and Cloşani areas). In the anchimetamorphites with meta-anthracites from Romania, it is to note an association of pyrophyllite +pyrocarbon +strongly anisotropic natural coke+semigraphite+very high reflectancy vitrinite, Rm Vi=4.00-7.51% (in oil) and other important observations (Nedelcu,1996).In these meta-anthracites from anchimetamorphites, the pyrocarbon was formed in very large "con in con" structures. The temperatures of pyrocarbon+anisotropic natural coke+pyrophyllite association was formed at under 400° C (350-400°C,more exact;Nedelcu,1996). It was a fortune association of pyrocarbon,anisotropic natural coke,semigraphite and pyrophyllite,in Armeniş area, because the equilibrium conditions of the pyrophyllite formation are very precised in the petrology studies.We estimate that,the only initial stage of pyrocarbon and isotropic natural coke (in bituminous-antracites stage only) at "Valea Herneanu/Herneanu Valley" was formed under 300° C (more exact 250-300°C), according to the percentage of V,C,O analysis of coals, Rm Vi=1.00-3.00% and the geothermometrical determinations per inclusions of quartz and pyrite (Nedelcu,Pintea, 1993).This was the temperature of quartz+gold association wich has replaced the vitrinite from coals, at "Herneanu Valley" This association of organic and inorganic matter it was a fortune natural event and in the same time the good coincidence of the determinations of formation temperature. In the quarry "Dealul Minei/Hill Mine" zone, the Pannonian sedimentary deposit with coals are crossed by quartz+gold and calcite,too. The quartz+gold and calcite replaced the vitrinite. But, the pyrocarbon and natural coke were not formed and qualities of the coals are of the bituminous coals stage only (V^{daf}=44% , C^{daf}=80%; H^{daf}=5.3%; O^{daf}=11%; Q_s^{daf}=8000kcal/kg, RmVi=0.60-0.70%).The gold from hydrothermal quartz was analysed in microscopic (1-5 μ m) and chemical methods (1.34 g/t of coal, pyrometallurgic analyses; 3.6g/t of quartz by γ spectroscopy; it is very known the investigations in gamma spectroscopy of platinum-group element and gold in the eocene coals deposit from the Blakeburn opencast mine, south-central British Columbia, Canada, E.van der Flier-Keller, 1991). The temperatures of quartz+gold and calcite solutions were in range of 100-150°C.

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UNEXPECTED MINERAL ARBORESCENT – TYPE MICROSTRUCTURES RELATED TO PYRITE OF SOME NEOGENE ORE DEPOSITS OF ROMANIA

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SEM – EDAX study on mineral microinclusions in pyrite of some Neogene ore deposits of Romania exhibits unexpected mineral arborescent – type microstructures. They consist of submicronic cubic crystals of different mineral species ordered in a 2D or 3D arborescent network. So far it is not quite clear if these microstructures were growing along crystallographic planes of pyrite (i.e. cleavages, crystal lattice), but obviously they respect the cubic syngony of the " mother " crystal. Usually these microstructures are developed in the following hypostases: a) within the crystal, b) interlayered with crystal growth beds, c) on the crystal faces, d) on/or along crystal crack planes. They are common for the pyrite of some Neogene porphyry copper ore deposits of the Metaliferi Mountains (Valea Morii, Spiros, Musariu, Voia) and of the Tibles Mountains, as well as for the hydrothermal polymetallic – auriferous veins related to them (Valea Arsului, Bradisor, Carpen, Larga, Hanes). Such arborescent microstructures were also made evident in the pyrite crystals of intrusive breccia structures, both in the Metaliferi Mountains (Baia de Aries) and in the Gutii Mountains (Kelemen – Baiut).

EDAX analyses on submicronic crystals of arborescent type structure show a various chemical composition, as follows: Fe sulphides, K chlorides and K – Fe – Cl, K – Fe – Au – Cl complexes. These chemical compositions are sometimes quite similar to that of mineral microinclusions trapped as daughter phases in the same pyrite crystals of the porphyry copper ore deposits (i.e. K - Fe – Cl cubic microinclusions of the Valea Morii pyrite). All that show the important role plaid by Cl in course of the evolution of magmatic and high – temperature hydrothermal fluids, as a transport agent of metals like K, Fe, Au, Cu etc. Thus, it seems that Cl presence could give us the answer about the so – called " transition domain " between magmatic and hydrothermal domains. In these circumstances, the mineral arborescent – type microstructures could represent a real typomorph marker for genetic link between epythermal and porphyry copper ore deposits related to some Neogene subvolcanic structure of Romania.

CHROMIUM-RICH MINERALS IN THE ECLOGITES FROM THE SOUTH FĂGĂRAŞ MOUNTAINS

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Chromium-rich kyanites in nature were first described by Ozerov et al (1936) in the corundum and kyanite deposits of Upper Timpton region of Yakutia as "a green chrome-kyanite with 1.81 percent Cr_2O_3" Lately, Sobolev et al (1968) reported 18 (?) mole percent Cr_2SiO_5 (12.86 wt% Cr_2O_3) in kyanite from a grospydite nodule from Yakutia. Seifert and Langer (1970) synthesized kyanite with 24 and 31 mole percent Cr_2SiO_5 at 20 and 30 kbar respectively in equilibrium with eskolaite. They gave the lower stability limits of chromium-kyanites in the presence of excess Cr_2O_3 and SiO_2 showing that the Cr_2SiO_5 content of the kyanite is not temperature dependent.

The median amphibolites in the Topolog "Formation" (Gheuca, 1988), Făgăraş Mountains, Romania, consisting mainly of mica gneiss, but including various gneisses and amphibolites, contain scattered eclogite lenses. Sometimes the silicate phases in these eclogites have a high-Cr content

The mineralogical composition of the eclogites consists in a uniform garnet-clinopyroxene-quartz assemblage, more or less overprinted by retrogression. Abundant kyanite is in most instances also present; some samples may contain zoisite or phengite. Minor amphibole, rutile and chromite are quite widespread. Frequent well-developed radial cracks around quartz inclusions proves an episode of considerable heating in the final stages of the eclogitic assemblage formation. Calculated equilibrium conditions show a clockwise path, with peak presuress at 2.1-2.6 GPa and a high-pressure near-isobaric heating episode (from *ca.* 650° C to over 750° C), in agreement with sharp Fe-Mg garnet zonation and radial cracks around quartz inclusions (Săbău & Negulescu, *in press*).

An unusual **Cr-rich omphacite** appears together with Cr-kyanite and chromite. It may form nodules up to 1 cm in the common eclogite matrix. In hand specimen these nodules have a characteristic bright grass-green to apple-green colour, while in thin section Cr-omphacite displays a conspicuous pleochroism in yellow-bright green hues. Symplectites around Cr-omphacite are narrower than those around the normal omphacites.

Kyanite is usually abundant, even making up monomineralic layers. Quite seldom, but at several locations, an unusual **Cr-kyanite** appears which may associate with Cr-bearing omphacite. It has a strong (bluish) emerald-green pleochroism with a patchy character and encloses or abuts on chromite grains. Cr is unevenly distributed within individual grains and among different crystals. Maximum measured Cr-content reaches 11.71 % Cr_2O_3 , which corresponds to 12.87 mole percent Cr_2SiO_5, one of the highest contents recorded in natural kyanite. The structural formula, recalculated from microprobe analyses assuming 3 cations and charge balance p.f.u., is $Al_{1.7321}Cr_{0.2574}Fe^{3+}{}_{0.0057}Mn^{3+}{}_{0.0013}Mg_{0.0021}Ca_{0.0004}Na_{0.0004}K_{0.0005}Si_{0.9865}Al_{0.0135}O_{4.9965}F_{0.0026}Cl_{0.0009}$.

Chromite ($Cr_{1.53}Al_{.45}Fe^{3+}{}_{.02}Zn_{.03}Fe^{2+}{}_{.83}Mn_{.01}Mg_{.11}Ca_{.01}O_4$) forms small inclusions in the Cr-richest zones of silicate minerals, from which diffusion haloes originate. The textural relationships among Cr-rich minerals indicate lack of larger-scale equilibrium, as the chromite grains obviously constitute inherited grains from the premetamorphic material, which failed to react with other phases. Therefore it is to assume that the Cr-saturation of the silicate minerals was only occasionally reached in the analysed samples.

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SEDIMENTARY EVOLUTION AND CHANGES OF FOSSIL ASSEMBLAGES IN THE SW. PART OF THE CARPATHIAN FOREDEEP IN MORAVIA DURING THE LOWER MIOCENE

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In the surroundings of Znojmo, where the Eggenburgian marine transgression penetrated first, the marine coast was formed by the deep-weathered crystalline rocks, predominantly with highly differentiated relief configurations (ridges, depressions). A more significant progradation of the sea basin occurred in places with relatively slight coastal slopes (the Čejkovice region) in comparison with areas of relatively steeper slopes (the wider surroundings of Znojmo). During the Eggenburgian marine transgression, a complicated system of particular basins formed in this area. These basins had highly complicated shoreline contours and a variable mutual communication, as well as a communication with the open sea. Practically all characteristics of the marine environment with the exception of temperature were highly variable in all of these basins, indicating highly unstable sedimentary conditions in general. The sea was predominantly shallow (to about 40 m) and warm (temperatures corresponding to subtropics). The molluscan fauna responded to these changes with a great variability in number of genera, species diversity and dominance, marine and slightly brachyhaline assemblages being substituted repeatedly by brachyhaline ones. In general, considerably extreme conditions in the marine environment are also manifested in the fact that only relatively poor molluscan assemblages occur in this area. Flora growing on the land also documented the relative proximity of the shoreline. Due to the salinity oscillations as well as occasional higher evaporation influences, the coasts of individual sea gulfs and lagoons were repeatedly salted, enabling in places the growth of a relatively rich halophilous vegetation. The changes in the evaporation intensity and dilution of the seawater due to precipitation and fresh water inflows from the land were documented by the presence of fluctuations in the Chenopodiaceae and Ericaceae families. The growth of the salt meadows developed in time and space to the various growth stages of the coal swamp stations, and in places, even flora growing directly in the fresh water appears. Abrupt spatial and temporal changes of the palynospectra reflect a great variability of environmental conditions on the shore. Flora generally confirms a warm climate and moreover abundant xerophilous elements, very similar to the recent Mediterranean floras, occurred in places.

The marine transgression reached the surroundings of Miroslav later than the Znojmo area, because the progradation of the sea basin was generally accompanied with the shoreline transfer to the north. In the wider surroundings of Miroslav, the sea shore was flatter than in the Znojmo area, and also not so articulated into ridges and depressions. In the Miroslav area, the marine sedimentation penetrated the deltaic sedimentation. Furthermore the accumulation of a great amount of sediments took place, and the coastline became more even. Consequently, any relative sea level changes in this area had a far greater spatial reach in comparison with the surroundings of Znojmo.

Also in the surroundings of Miroslav, it was possible to study the very boundary between marine and continental environments. The sea in this area was shallow and warm, originally with relatively high dynamics and salinity (however these factors fluctuated in time and space), although later on, there was a general drop in the dynamics and the salinity due to the deltaic sedimentation which took place. The effects on molluscan assemblages due to these changes are similar to those from the Znojmo area. With regard to the fact that the molluscan assemblages from the Miroslav area are comparable with those from the shallow-water facies from the wider surroundings of Znojmo, we can suppose that a similar sedimentary environment persisted in the vicinity of Miroslav. The flora documents a warm climate, water salinity oscillations and the proximity and changing characteristics of the shoreline. In places, the substrate on the coast was - by analogy to the Znojmo area - considerably salty, enabling the growth of halophilous vegetation. Later on, the coast changed its character, and moorlands and swamp margins appeared. The water in them was essentially uninfluenced by waves and currents. The origin of these swamps was of course - in contrast to the Znojmo area - connected with the environment of the delta.

In the final stage (Ottnangian), the deltaic deposition left the studied area, and a reduced supply of the sedimentary material as well as the finishing of the delta body progradation followed. The delta platform was flooded by the sea and in the following transgression stage, the sea probably penetrated further to the north into the area, where the immediate influence of the sediment accumulations and of the smoothing out of the relief had not manifested itself. Thus its shore acquired again more broken contours (gulfs, lagoons). The so called Rzehakia sands form a part of the sediments representing this evolutionary stage.

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Small-volume basaltic pyroclastic flow deposits related to phreatomagmatic explosive eruptive centers at the Fekete-hegy Volcano, Balaton Highland Volcanic Field, Hungary

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The Fekete-hegy Volcano is located 20 km north of the shoreline of Lake Balaton, Hungary. The volcanic sequences are related to the Balaton Highland Volcanic Field alkaline basaltic volcanic province, which was formed in late Miocene time. Physical volcanology studies and mapping as well as geophysical investigations pointed out the importance of phreatomagmatic explosive activity during the eruptive history of the region. Previous geophysical studies (geomagnetic and gravimetric) carried out that the main eruptive centers must have a deep excavated root zone and maar structured basement (Németh, et al., 1997). Evidence of small-volume pyroclastic flow deposits were given by recent mapping and field studies, which probably were emplaced in the early history of volcanic activity of the region. The pyroclastic flow deposits are alternating with cross bedded, matrix rich, block bearing lapilli tuff, like pyroclastic surge deposits with mantle bedding co-surge fall-out tuff layers. The main bodies of the pyroclastic flow sequences consist of grey, massive, compact lapilli stone beds. There are no any significant evidence of grading or inner sedimentary structures nor welding in the individual beds or flow units. The flow units always contain high proportion of ultramafic nodules like broken, or rounded gravel-like lherzolith fragments, and broken olivine, pyroxene megacrystals, which doesn't show any significant layering. They contain extreme high proportion of broken fragments of the the whole known underlying sedimentary sequence. The main part of the pyroclastic flow unit has an erosional contact to the underlying Pannonian (late Miocene) river gravel beds. The contact zone contains high amount of picked up accessory lithics from the gravel beds. The proposed pyroclastic flow deposits contain several well developed gas segregation pipes (max. 1.5 m long, 15 cm wide) wich are filled by lithic lapilli. The juvenile fragments are usually micro-vesiculated. Glass shards are slightly palagonitized. The present ridges represent former river-valleys occupied by the pyroclastic flows, described above. Interpreting the gas segregation pipes areas as distal pyroclastic flow sites the eruptive centers are situated in the northwestern side of the Fekete-hegy Volcano region, probably where the large phreatomagmatic centers situated.

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THE ROLE OF NORTH GEMERIC ZONE (GEMERICUM) IN VARISCAN AND ALPINE TECTONIC EVOLUTION OF THE CENTRAL WESTERN CARPATHIANS

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The North Gemeric zone represents the outer northern rim of the Early Paleozoic complexes of Gemericum, dividing this tectonic unit from northward lying Veporicum. The basement of North Gemeric zone is created with mafic metasedimentary and metavolcanic (Early Paleozoic?) piles of Rakovec complex, resp. Rakovec nappe. They are interpreted as incomplete ophiolitic suite of Paleotethys (Grecula, 1982), resp. products of back-arc development (Ivan, 1996). The Rakovec complex tectonically overlies mainly flyschoid Gelnica complex. The Late Paleozoic rocks in the North Gemeric zone (Carboniferous Dobšiná Group and Permian Krompachy Group) were originally interpreted in autochthonous position as cover of the Rakovec complex. Later interpretation of the remnant basins (Grecula, 1994) locates the Late Paleozoic sedimentation to oblong sedimentary basins originating in transpressional-transtensional régimes during Late Variscan convergence. The Triassic, mainly carbonatic, sequences present in the North Gemeric zone were interpreted in autochthonous position. The findings of rocks belonging to the Meliata development in the eastern part of the North Gemeric zone (Folkmár Suture) led to the interpretation of northern branch of Meliaticum (Kozur and Mock, 1997). The obducted parts of Cimmerian accretionary prism (the Bôrka nappe; rooted in the main Meliatic suture zone on the south of Gemericum) were known only in the western Gemericum (Mello et al., 1997). Their allochthonous position on Gemericum and the effects of transpression/transtension were demonstrated in mesoscale on various lithostratigraphical units (Németh et al., 1997).

Our recent field mapping, structural/deformational mesoscopic studies and petrotectonic research disclosed the presence of tectonites corresponding to those known from the Bôrka nappe also in the eastern and even in the northern parts of Gemericum (the Slovinky area). In both cases they are situated beneath the Triassic carbonatic masses. The new results allow only allochthonous interpretation of Triassic carbonatic sequences as a part of Silicicum. New tectonic interpretation of the North Gemeric zone suggests four tectonic storeys. The lowest one in the North Gemeric zone is represented with the Early Paleozoic Gelnica complex. The first allochthonous storey represents the Rakovec complex. Newly distinguished Bôrka nappe (third storey) divides Paleozoic Gemeric sequences from the uppermost, Silicic, tectonic outliers. The piling of three allochthonous tectonic units in the space of North Gemeric zone was caused by the compressional stress oriented N-S. The main driving force was the convergence and collision of north-located Cadomian-Caledonian-(+Hercynian during Alpine orogeny) Laurasian plate, in the studied region represented with Veporicum, with south-located Gondwana. The main compression was accompanied, resp. gradually changed into transpression and transtension. These changes were caused with oblique convergence and collision due to the barrier effect of Veporicum.

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THE PALEOZOIC EVOLUTION OF THE EASTERN ALPS SEEN THROUGH $^{40}Ar/^{39}Ar$ AGES OF DETRITAL MICA, SANDSTONE MODE AND GEOCHEMISTRY

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The principal goal of the project was to monitor the tectonic evolution of various types of Paleozoic sedimentary basins of the Eastern Alps (Austroalpine and Southalpine units) with $^{40}Ar/^{39}Ar$ ages of detrital white mica. This was done by dating of concentrates of 2-6 grains and single grains in the Salzburg $^{40}Ar/^{39}Ar$ laboratory which has been set up during the course of the project. The age determination of white mica was accompanied by analyses of detrital mode of sandstones, geochemical characteristics, and chemical characterization of white mica and feldspar by microprobe. Ca. 450 sandstones samples of Ordovician to Late Carboniferous age were counted using the Dickinson-Gazzi method. The results show a large variation of sandstone composition through time and space. Variable sources in some regions argue for new geodynamic models for these regions, especially for Silurian-Devonian successions of the Graz and Gurktal nappe complexes. However, in a regional scale, the tectonic evolution of Southalpine and Austroalpine units was similar. The following principal results were obtained:

The lowermost Middle to early Late Ordovician sandstones record combined volcanic and mature sources interpreted to record extension in a supra-subduction zone environment. Detrital mica ages consistently record Cadomian sources which argue for a close linkage to Cadomian/Panafrican terrains. The development switched to very mature Late Ordovician to Middle Devonian sandstones deposited in epicontinental and later passive continental margin settings and a still Cadomian hinterland. However, major proportions of sandstones, which were deposited in distal portions of Late Silurian to Early Devonian deep sea fan enviroments of the Graz and Gurktal Paleozoic units, are extremely immature, rich in feldspar, volcanic and few low-grade metamorphic clasts. These sandstones are interpreted to record the proximity of another terrestrial source region respectively passive continental margin which we call here "Morgon" margin.

Lower Carboniferous syn-orogenic flysch deposits are exposed both, within Southalpine and Austroalpine units. Both areas mainly comprise graywackes with a large proportion of acidic and intermediate volcanic and sedimentary clasts. $^{40}Ar/^{30}Ar$ white ages of the Carnic Alps range between ca. 410 to 360 reflecting a "Caledonian" source. Similar ages have been reported from various nappes of the Grauwackenzone within the Austroalpine unit. These graywackes are interpreted to form the infilling of a trench which formed during accretion and early stages of collision between Gondwana-derived and microplates accreted to the southern sectors of the Central-European Variscan orogen. Furthermore, the sandstone compositions of the Early Carboniferous Nötsch Group are dominated by metamorphic sources and are, therefore, entirely different from the synorogenic flysch sequences. Thus a palaeogeographic linkage between the Nötsch Group and synorogenic flysch sequences appears to be unlikely.

In both Austroalpine and Southalpine regions, post-orogenic Late Carboniferous molasse-type sequences are quartz-dominated, more or less free of feldspar, and rich in detrital white mica. New $^{40}Ar/^{39}Ar$ ages from both, the Gurktal nappe complex, and Carnic Alps are within the range of c. 315 and 300 Ma suggesting throughout rejuvenation of sources during the Variscan orogeny. Similar ages have been reported from the Veitsch nappe and the Permian sequences of the eastern Grauwackenzone. Low time intervals between the $^{40}Ar/^{39}Ar$ ages reflecting cooling of exhuming crustal rocks in central zones of the Variscan orogen and depositional ages indicate rapid exhumation and denudation. $^{40}Ar/^{39}Ar$ ages of overlying Permian sandstones are more variable in ages ranging between ca. 320 and 280 Ma. This is interpreted to reflect a higher diversity of denudation levels in respective source regions.

These new data combined with biogeographic data from the literature indicate that most Alpine Paleozoic units represent parts of an exotic terrane which accreted to an active continental margin of the Central European Variscides during Variscan orogenic events. Throughout crustal rejuvenation in a very broad zone suggests that the Variscan orogeny represents a Himalaya-type orogen within which exhumation of middle-deep crustal levels dominates the structure.

NEW RESULTS ON BIOSTRATIGRAPHY, SEDIMENTOLOGY AND EVENTSTRATIGRAPHIC SIGNIFICANCE OF CRETACEOUS STRATA OF THE OLONOS-PINDOS ZONE, GREECE

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An integrated sedimentological, event- and biostratigraphical study sheds light on the development and controlling factors of deep-marine siliceous, siliciclastic and calcareous deposition in the Mediterranean Tethys during Cretaceous times. In the area of western Greece, the Pindos Zone exposes thrust-imbricated turbiditic and (hemi-)pelagic sediments derived from an elongate basin of the Apulian passive margin. Recording and analysis of selected profile sections along a north-south-axis in western continental Greece and the Peloponnissos allow the reconstruction of the Cretaceous basin history emphasizing the chronology of tectonic and stratigraphic events. Based on radiolarian and foraminiferal age data, the event-stratigraphy is supposed to provide an important tool for correlation within the peri-adriatic realm.

In the Lower Cretaceous to Coniacian prevail apparently thin siliceous facies with a marked red/green-cyclicity. Within the Valanginian-Lower Cenomanian interval of the Pindos Mountains five major Green Levels associated with organic-rich black shale layers (up to 10 % $C_{org.}$) were found. Radiolarian assemblages indicative of an Aptian-Albian age of the upper three levels (3,4,5) with a Lower Aptian age of Level 3 hint at a correlation with Oceanic Anoxic Events (OAE 1 and OAE 1a respectively). Furthermore, in the Barremian-Lower Aptian, clastic beds reveal a special clast association of volcanogenic origin regarded as traces of the early mid-Cretaceous volcanism.

The bulk of sediment in the sharply contrasting Upper Cretaceous section is of calci- and siliciclastic origin with mass wasting proved to be most prominent in several discrete phases (major redepositional events): The upper Lower to Middle Cenomanian and the Middle Turonian to Early Coniacian radiolarite facies can be punctuated by mass-flow deposits containing *Conicorbitolina conica*, locally followed by siliciclastic turbidite facies (up to 90 m). Palaeocurrent analysis proves western and northern source areas. These mixed calci-/siliciclastic units are interpreted as reflecting tectonically-induced falls of relative sea-level, causing platform collapses and subsequent terrigeneous and, in the higher Turonian, organic-rich replenishment. In contrast, the higher Upper Cretaceous basin-fill (Platy Limestone Formation, ca. 300 m) resembles a rapidly accumulating carbonate sedimentary regime due to enhanced peri-platform input indicating a high productivity in the coeval platform margin. The thick uppermost Santonian to Maastrichtian interval represents a rather uniform slope apron- and basin plain-setting. Foraminiferal, in part organic-rich wackestones (bio-events; e.g. *elevata* event), formed within oxygen minimum zone conditions, appear within fine- to coarsegrained turbidite facies that show vertical stacking patterns of different orders (e.g. low- to high frequency thinning- and thickening upward sequences) and a eastward directed proximal-distal trend conforming with palaeocurrent data. Major redepositional events in the Upper Santonian, the Lower and 'mid'-Campanian and the Lower Maastrichtian (*gansseri* zone) are interpreted as recording renewed phases of tectonic activity along the platform-slope margin. The upper and most prominent turbidite cycle of the *gansseri* zone indicates rapidly prograding slope facies and basin filling in the course of the transition of the former erosional to an accretionary slope.

BREGU I BIBES MINERALIZATION, TROPOJA OPHIOLITIC MASSIF, ALBANIA. AN UNUSUAL EXAMPLE OF PGE-MINERALIZATION IN OPHIOLITES

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Tropoja ophiolitic massif is located in the Northern part of Albanian ophiolites, just at junction between two ophiolitic belts of Albanides (Eastern and Western ones). The exposed ophiolite lithostratigraphical section of this massif is approximately 2.5-3 km thick, but according to the geophysical data, the Tropoja massif goes on up to 14 km in depth. This fact may argue the issue of the ophiolites within Mirdita basin.

Four types of PGE (Platinum Group Minerals) mineralization are distinguished in Tropoja massif. Three types are related to the mantle, whereas only one occurs in cumulates. Regarding, the economic value, and the scientific one, the mineralization type found in cumulates is of the first hand importantce.

PGE mineralization associated always with high metallurgic chromitites, is situated in the contact zone between basal dunites and pyroxenites (Stoberda area). The chromitite ores show low Ti and Al content. Numerous PGE-rich chromitite outcrops related to pyroxenite-dunite contact are found (Pode, Bregu i Bibës, Shpati i Dajçit, Maja e Dajçit, Zherke and Kunji i Tregut). The most important is the Bregu i Bibes object located in the Eastern part of this area. Rich-Pt concentrations are a characteristic (Pt-content is up to 12 ppm and Pt/Pd ratio may reach up to 86). The spectrum of this mineralization type shows a positive trend, of a very strong Pt-anomaly, that contrasts to low Pd, Au-values. The existence of a positive correlation between Cr_2O_3 and PGE contents in ores is the most remarkable feature of this mineralization.

There are several common features between PGE-rich levels into stratified intrusions and PGE-rich zone of Bregu i Bibes area, as following: a)-SiO_2 saturated magma; b)-location of PGE mineralization's level in the contact zone between two different lithological units; c)-the development of magmatic breccias; d)- pegmatite structure of the host rocks; e)- close relation with the chromitite ores.

PGM (Platinum Group Minerals) found in Tropoja Ophiolitic Massif are divided in two main groups: Alloys (68% of them) and other minerals as sulphides, sulphoarsenides, arsenides and telurides (32 % of them). In alloys group, isoferroplatinum is the most widespread (about 45%), while in second group, laurite constitutes of 65 % of minerals. Except the authentic PGM, BM-alloys (Cu native and awaruite) and BMS (Base Metals Sulphides) (millerite, pentlandite, chalcopyrite, heazlewoodite and bornite) of high PGE-content are found. PGE-content of these minerals is a solid solution.

The origin of this mineralization is supposed to be magmatic. Later, the mineral associations are complicated as consequence of reaction between ancient PGM (alloys) and Pd, Te, As and S-rich recent residual fluids.

SEQUENCE STRATIGRAPHY AND DEPOSITIONAL SYSTEMS IN BADENIAN AND SARMATIAN DEPOSITS IN THE PANNONIAN BASIN (ROMANIA)

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Cenozoic tectonic events within the Carpathians, followed a major Cretaceous compressional deformation that affected the internal parts of the belt. During Cenozoic time, these areas of Cretaceous deformation acted roughly as rigid blocks, and their differential movement was accommodated by large strike-slip faults

Four subbasins were formed in Pannonian basin, in Romania: Carei, Abramut, Socodor, Tomnatec.
The style of sedimentation within each subbasin was also influenced by the proximity to the thrust front. These differences can be explained by differences in the subsidence rate of the basement after extension and by the proximity of each subbasin to the sediment sources in the Carpathians.

In Badenian time, topographic relief of the basement led to the development of small emergent islands, where no deposition occured, surrounded by areas receiving clastic sediments.

The sedimentary formations of the Badenian-Sarmatian are products of two transgressive-regressive cycles. Because of a restricted terrigenous influx, in Badenian time, in deep subbasin (Abramut, Tomnatec) there were terrigenous marine depositions (sandy-pebbly) and biogenic limestones of littoral and shallow water origin, which were deposited along the margins of the subsided area. The Badenian clay was deposited in the hemipelagic zones.

Uplift of the basement resulted in formation of brackish water lagoon where gypsum-bearing deposits accumulated along the basin margin (Archid zone).

In Late Badenian and Sarmatian, regression is suggested by a decrease in water depth, the predominance of littoral and deltaic facies rocks and shallow water facies. A characteristic sedimentary deposit is brackish water, coarsely crystalline limestone that shows a gradual transition to silty and shaly rocks in the areas of greater water depth.

The thickness of Badenian beds exceeds 1000 m in deep subbasins, and the thickness of Sarmatian beds exceeds 300 m only in areas where the rate of subsidence accelerated in Badenian time.

ON THE MECHANISMS OF THE NEOGENE SUBSIDENCE AND THE PANNONIAN UPLIFT OF THE TRANSYLVANIAN DEPRESSION

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The first molasse deposits of the Transylvanian Depression (TD) appear in the Early Badenian (~17 Ma). The full expression of the depression is achieved during deposition of the Dej tuff followed by the deposition of the Badenian salt formation. The active subsidence continues till the Upper Pliocene (~5 Ma) with intervals of enhancement (Sarmatian, 13 - 11.5 Ma) and intermission (11.5 - 10 Ma). A general uplift of the region started at the end of the Lower Pannonian (~5 Ma).

The shape of the Neogene depression is roughly circular with radius 60 km with sediment thicknesses increasing toward the centre where it reaches more than 4000 m. The surface heat flow density is relatively low with a minimum of ~35 mW/m^2 at the centre of the depression. Correction for the effect of Neogene sedimentation increases the heat flow by ~5 mW/m^2 A system of roughly circular faults active in Neogene borders the basin.

The cause of the Neogene subsidence is believed to be lithospheric extension somehow related to the contemporary fan-like thrusting of the Moldavides in the East Carpathians. The β-factor at the Dej Tuff level is small ($\beta \leq 1.05$) and insufficient to explain the observed subsidence. However, β-factors obtained from the throw of faults are always smaller than the true β-factor. Here the fact that fault throws suggest a small β-factor is taken as an indicium that the real β-factor is also small.

One- and two-dimensional extension models have been invoked to explain the Neogene subsidence of the TD. These approaches fail because a too high β-factor is required to yield the necessary subsidence. This in turn yields a too large thermal anomaly, which dissipates too slowly to be consistent with the present day thermal structure. The TD has a length scale in all directions, which is similar to the thickness of the lithosphere and calls for three-dimensional modelling. As a first approach we invoke a rheological lithosphere model of radial extension to model the Neogene subsidence. The Pannonian uplift is modelled by radial compression.

Radial extension produces the same lithospheric thinning for a β-factor which is only the square root of the β-factor required in one- or two-dimensional extension. This solves the problem of achieving the necessary subsidence for a β-factor between 1.1 and 1.2. Furthermore, the thermal anomaly is not very large and dissipates quickly in three-dimensional thermal conduction. The Pannonian uplift requires only weak compression because the cessation of extension in itself causes elastic and isostatic rebound producing uplift.

Geodinamic analysis Quaternary sediments in urban area

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Quarternary are sediments (loess, sand, gravel, clay, sends clay) is very deformity medium where we must build.

Building of objects in quarterly sediment's to require very large canation, because we building, in elasto – plastic medium. At permanent dynamic strain (factory, intesivity traffic, changeable level ground water) to lead into nonstability soil, and all the endanger objects (nonlinear settle, demolition and destruction soil, to sink of ground).

Many geophysical and geotehnical investigations made possible to build geodynamic model whish will best represented physic – mechanical and frequency characteristic of soil, in which we will building our object. The quality of geodinamic model depends on the ways of applied geophysical and geotehnycal investigations (fields "in situ" and laboratories) estimations and correlations. One of possible verifications of approved geodynamic model is the usage of microtremor as an initial ware for dynamic analysis. In this case we hare recovered excellent results in aluvion areas and target areas of loom and lommchay Performa's. The application of microtremor these analysis was based on Kobayashys researches – the multi – reflections soil layers over bedrock.

To be known that the soil is natural the filter of frequency. Some of the frequency will be amplicated and some atemieted.

If we building the objects to know interaction between soil and object, can we to exist quietly, economic urban areas.

STRUCTURE AND EVOLUTION OF GOTSE DELCHEV AND RAZLOG GRABENS, SOUTHWEST BULGARIA

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Gotse Delchev and Razlog grabens are situated in the Southwest part of Bulgaria, surrounded with the highest mountains on the Balkan peninsula. The grabens are formed as a result of regional extensional environments, typical for back-arc zone of the Aegean island arc. The flanked structures are normal faults and strike-slip faults dipping 60-90°. Part of them are old structures, activated during the Neogene-Quaternary stage, others are formed during it.

The main fault structure is Ossenovo-Ribnovo fault zone striking 150-160°, with listric normal faulting to SW during the Paleogene. The Mesta half-graben was formed, with alluvial-lake-marsh deposits, coarse grained predominantly. During the Neogene the movements transformed to dextral strike-slip, accompanied with newly formed antithetic normal and strike-slip faults. Their propagation led to generation of the Gotse Delchev and Razlog pull-apart basins. The meridional Bachevo (Damyanitsa) fault is the main antithetic structure of the Razlog graben, with footwall to East and sinistral strike-slip with more than 1km for the Neogene. The Gotse Delchev normal fault is the analogous for the graben of the same name. Its strike is 130° with NE footwall.

The oldest sediments in both grabens are Meotian and Pontian in age. They are represented by sands, silts and clays with lenses of conglomerates, beds of diatomite and coal. These alluvial and lacustrine sediments show not so intensive tectonic movements along old and newly formed faults in extensional environments. During the Late Pontian sedimentation has changed radically. Over the sandy-clayey deposits gravel-pebbly conglomerates accumulated with rapid transition in Gotse Delchev graben and break in Razlog graben, with expansion of the area. This change in deposition marked intensive movements along the boarding faults and total uplift of the area - alluvial deposits covered the lacustrine ones. The deposition of alluvial and alluvial-fan material only continued during Dacian and Romanian.

In the beginning of the Quaternary the changing of the tectonic conditions reflected in forming of the meridional Ognyanovo-Ilinden fault zone (controlling the deposition in the Gotse Delchev graben) and the Predela fault (strike 110°), that crossed the Razlog graben and displeased the alluvial and alluvial-fan deposition during Quaternary to west in a transverse half-graben with falling to the North. In Pleistocene time coarse breccias are formed on the graben slopes as well as big alluvial-fans. The disintegrating neighbour rocks determined their composition. This coarse-grained deposition marked a new stage of intensive uplift.

The geodetic data as the river cutting with ledge forming show that the uplifting of the hole area continued up to nowadays. The high seismic activity of the region confirms the movements on the boarding faults.

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TECTONOSTRATIGRAPHIC TERRANE MAP OF SOUTHEAST BULGARIA

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A tectonostratigraphic analysis is made of a part of the collage zone in the south-eastern periphery of the Moesian microplate. Data from authors' investigations and from anew interpreted published and unpublished reports are used. Methods and terminology in Coney et al. (1980), Keppie (1981), Jones et al. (1983), Pirgam & Davies (1987) and Stavskij et al. (1991).

On the base of this analysis rock assemblages were distinguished, with their spatial and temporal relationship and tectonostratigraphic terranes (TST) and units (TSU) as well. The boundaries are faults and/or thrusts for the terranes and thrust-faults for the units. The genesis and the geodynamic setting of the rock assemblages, their composition and relationships are shown on a terrane assemblage diagram. The time and manner of amalgamation (accretion) of TST and TSU were recorded, each to others and to the microplate, and the tectonic and geodynamic evolution of the space around its southern margin was traced.

The present-day outcropping relationships of the Late Alpine TST and TSU are shown on a sketch, with the time of the last (Late Cretaceous-Bartonian) fold-thrust deformations. From South to North the following TST and TSU are defined on the territory of SE Bulgaria: Sakar and Strandzha TST (with the Early Cretaceous Veleka exotic TSU), Stara Zagora and Sveti Iliya TSU, Burgas TST, Sarnena Gora TSU and Kamchiya TSU (including the Early Cretaceous East Balkan exotic TSU).

Sakar and Strandzha TST have different in origin, high metamorphic Precambrian basement, the first one a part of a microcontinent and the second consisting of oceanic crust fragments in deep water siliciclastic sediments. Subduction processes with oceanic island arcs (VIA) and related basins in Cambrian and Devonian, ocean-continent VIA with abundant granitoid intrusions in Late Devonian and Early Carboniferous and collision in Late Carboniferous - Early Permian, accompanied with acid volcanic activity and intrusions, stitched up the two terranes in a new, composite one and to the Moesian microplate, in Early Mezozoic being part of Pangea passive margin. The transgression of Palaeotethys to the West and the partial disintegration of this margin due to rifting, reflected in Triassic and Jurassic successions of carbonate platform and deep water shelf-slope respectively. The rock assemblages of Veleka exotic TSU (parts of Palaeozoic VIA and Triassic deep water sediments from a passive continental margin) and East Balkan exotic TSU (consisting of Triassic and Low-Middle Jurassic trough sediments only, with olistoliths) and their deformation in Early Cretaceous marked the beginning of geodynamic changes. The passive margin transformed to an active one as a result of the opening of Neotethis ocean to the South. Burgas TST includes parts of an ensialic VIA, formed by subduction to the North in Coniacian-Campanian time. Its stopping in the end of Campanian with continuance of the oceanic opening reflected in fold-thrust deformations in the end of Cretaceous and during Palaeogene (culmination in Middle Eocene). The investigated TSU are superimposed thrust sheets of the fold-thrust belt formed. They consist of parts of the Upper Cretaceous VIA, the back-arc basin and their basement. Three types of basins were related with the fold-thrust belt: a foredeep in front of it (Low-Middle Eocene succession in Kamchiya TSU; Upper Eocene sediments in front of the Chudnite skali dislocation), with marine flish-like sedimentation, the latest the most coarse; piggy-back basins (Upper Eocene Daskotna and Obzor basins), continental coarse-grained sediments are typical; extensional-transtensional pull-apart basins behind it (Palaeogene-Neogene-Quaternary Burgas and East Rhodope basins; Quaternary Prossenik basin) with mixed continental-marine sediments, with coal. Since Miocene the investigated territory has been under extensional conditions behind the Aegean VIA, attended by intensive erosion and planation.

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CHARACTERISTICS OF NEOGENE LACUSTRINE BASINS IN SERBIA

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During Oligocene to Pliocene, lacustrine sedimentation in Serbia was connected to several tectonic cycles which differ from each other in different tectonic phases that influenced development of lake basins, and in the time of forming of those lakes and their sedimentary fill.

According to the majority of opinions , the oldest lacustrine cycle is connected to the end of Oligocene – Lower Miocene, the next one to Middle-Upper Miocene, and the youngest one to the end of Upper Miocene – Pliocene. In certain basins only one lacustrine cycle is developed, whilst in others two, with or without interruptions in sedimentation. It is characteristic that in certain lakes can be observed the change of lacustrine and marine sediments of Badenian age. This paper deals with characteristics of several lacustrine basins of Oligocene-Lower Miocene and Middle-Upper Miocene age.

The common characteristics of Oligocene-Lower Miocene and Middle-Upper Miocene lacustrine basins in Serbia and their sedimentary fill are: huge influence of volcanic activity (especially in Middle-Upper Miocene basins); change of humid and arid periods of sub-tropic paleoclimate; stronger or weaker lake water stratification; facies distribution (alluvial, swamp, marginal lake, and intrabasinal lake facies). The temperature of lake water, obtained from isotopic analyses, is similar, both in older and younger basins, and varies around 25°C, occasionally lower.

The differences that appear are connected to the distribution patterns of some main depositional clastic and volcaniclastic systems which fed detritus into the basin, rate of sedimentation, lowstand and highstand lake stages, hydrologic closed or open lake system phases, and the occurrences of economically interesting deposits, or products of alteration.

Economically interesting are deposits of sedimentary magnesite, zeolite, clay, borate minerals and coal. Besides them, there are often occurrences of characteristic carbonates: trona, shortite, and others (mostly their molds). Products of alteration (mostly of volcanic glass) are zeolite, clinoptilolite, analcime, montmorillonite, searlesite etc.

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LEVEL OF ECOLOGICAL VIOLATIONS BY LEAD AND OTHER INJURIOUS ELEMENTS IN GROUND OF BELGRADE TERRITORY

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The effect of motor vehicle emissions containing the trace elements Pb, Cu and Cr ass well as SO_4 and pH in surface sediments is investigated along motorways and streets in Belgrade. It was collected 72 samples from roadside drains and soil on green surfaces along roads. Samples were analyzed on heavy metals pollutants. Relatively high content of Pb, Cu and Cr was found.

Samples were collected during summer time in fair climate conditions without rains In laboratory samples were over-dried at 60° C, powdered and fractions less than 100 nm used for analyses. Samples were digested in HNO_3 and determined by Atomic Absorption Spectroscopy. Standard analytical error was about ± 5 %. Following is a table of results obtained (in ng/g).

Table 1.

Metal			Background level		pH	SO_4
Pb	- range	30-1330	23	- range	7-8.6	0.2-0.48
	- mean	105		- mean	7.35	0.32
Cu	- range	30-316	18			
	- mean	77				
Cr	- range	35-220	16			
	- mean	89				

Generaly, polutions by heavy metal in road sediments is resulted from use of petrol enriched by lead and very poor municipal drainage system. Decrease in heavy metal concentrations is very high in samples taken from "green surfaces" along motorways (about 50 m distance from main road profile), showing that this pollution is not widely distributed. The ratios among heavy metal (Pb, Cu and Cr) is nearly 1:1:1. The unhealthy development can be remedied by the introduction of unleaded petrol to the transport and providing an adequate municipal drainage system.

THE PROBLEMS OF UNDERGROUND WATER PROTECTION FROM OIL CONTAMINATION

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At present, underground water accounts for a great part of potable and process water-supply in Ukraine (approximately 16 million m^3/d, which amounts to 28% from total water-supply), since underground water using doesn't require its refinement due to its good natural quality, which certainly would result in more intensive underground water using in future.

However, regular and accidental oil leakages and spills may cause a large groundwater contamination, which would make worse water-supply conditions in Ukraine.

Within Ukraine intensive oil field prospecting and exploration are carried out, oil production comes to approximately 4.0 million tones per year, and six refineries and three fuel and lubricant material factories are running. The pipelines with length of 3 400 km and 339 oil storehouses, where is more 11000 different reservoirs and tanks with total fuel capacity more than 5.2 million tones, are operated. Extensive oil using exerts extremely negative influence on the underground water quality.

Today, underground water contamination with oil takes place in Kherson, Lugansk, Poltava, Lutsk, Uzin etc.

More 120 big water-intake-well systems (their total operating underground water storage amounts to 3.8 ml m^3/d, which is 25% from explored storage) are situated within real or «latent» contamination areas. As to the latter, it means oil penetrating into porous media for infiltration, and its current migration towards water-intake wells.

The general problem of underground water protection from oil contamination is to reveal oil migration mechanism within and below the unsaturated zone, in particular, to develop the procedure for process physics investigation and mathematical models, as well as to determine parameters oil migration predictions need. The significant problem of underground water protection is contaminated underground water cleaning by means of oil product pumping, as well as biodegradation. The paper presents investigation results with respect to underground water protection from oil contamination, which were obtained at the Institute of Geological Science of NAS of Ukraine and the National University.

THE CONDITIONS OF UNDERGROUND WATER FORMING WITHIN THE SOUTH-WESTERN PART OF THE CRIMEA

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The investigated territory is situated within the south part of the Alminskaya depression, which is a large structure unit at the Plane Crimea. The northern boundary goes along the Alma river. Both the southern and most part of the eastern boundary go across the Foothills region, coinciding with middle Mioscen deposit outline. The western boundary goes within the at the distance of 20 km from the shore front. A flow model, which includes active water-transfer zone (from the ground surface to the Majkop clay layer), was developed for this territory.

Carried out model experiments allowed to evaluate underground water forming conditions in this region.

The principal source of underground water storage forming is a lateral water inflow from the Foothills, where underground water feeding is a result of precipitation recharge. Flow discharge constitutes a downward areal flow across regionally spreading low Sarmat clay within the continental part of this territory as well as the shelf water area, and, also, upper river valleys, where is no Sarmat deposits.

By today, Sarmat aquifer resources in fact have been exhausted due to operating water-intake. This conclusion is confirmed with observation data, which point out underground water quality has been made worse. The assumption of sea water intrusion into the Sarmat aquifer would be real. Middle Mioscen underground water resources, which is forming generally within the Foothills region by means of precipitation recharge, are established to be 17–22 thousand m^3/d. At present, water-intake amounts to 0.8–1.4 thousand m^3/d. Lateral underground water outflow from the continental part of this region should be considered as a potential reserve of operating resources. Moreover, model results demonstrated a part of middle Mioscen resources, which is entering the overlying Sarmat aquifer as upward flow across the low Sarmat clay layer, can be taken.

Increasing water-intake from the middle Mioscen aquifer would allow to decrease real water-intake from the Sarmat. It would result in sea water replacement from out the littoral water-intake well area. Furthermore, predicting underground water head increase in Sarmat aquifer within the littoral shelf water area would result in hydraulic barrier effect, which would prevent from sea water entering into the middle Mioscen aquifer.

LACUSTRINE DIATOM FLORA FROM NEOGENE BASINS ON THE BALKAN PENINSULA

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Recently, many papers have appeared on the origin, evolution and biochronology of the lacustrine diatoms. The interest in diatom biostratigraphy is growing rapidly, especially for the continental neogene deposits, due to the high diversity and dominance of diatoms there and the lack of other stratigraphic marker fossils.

This study provides a brief summary of present-day knowledge about the evolution and distribution of lacustrine diatoms on the Balkan Peninsula during the Middle/Late Miocene - Early Pliocene (4 - 16 Ma). Numerous samples of lacustrine diatom bearing deposits were collected from 27 localities of the Balkan Peninsula. Three localities were additionally included on the basis of literature data. Some samples were outcrop material, and the majority of them were from core-drills. Unfortunately, the investigated deposits represent brief periods of geologic time and they are poorly dated. Absolute ages are lacking and the chronology is based only on palaeontological records (pollen, carpoflora, macroflora remains and mammals). Only the long-term experience of using diatoms in Neogene stratigraphy made it possible to identify regional biostratigraphic units based on this group organisms. The diatom zones may be regarded as complexes (assemblages, thanatocenoses), including index-genera and index-species of class Centrophyceae (Bacillariophyta). The planktic genera of class Centrophyceae are more useful for biostratigraphy than are benthic diatoms which have a more localized distribution determined by depth, substrata, etc. The biostratigraphic zones based on these index-genera and index-species are regarded as a stratigraphic interval characterized by a diatom assemblages of a stable taxonomic composition and structure.

The applicability of fossil diatom thanatocenoses to assist in Neogene stratigraphy is dependant on the palaeoenvironmental changes and lake history. On the basis of the ecological data of diatom taxa and the ratio diatom frustules and other siliceous microfossil group - chrysophycean stomatocysts, trophic phases in the lake evolution of the basin are determined. The distribution of the Centrophycea's genera in the lake sediments depends on the range of the trophic phases in the lake evolution. Different type of diatom assemblages develop simultaneously in the basin during the Late Miocene Early Pliocene depending on the different trophic status. These comprehensive studies determine two types of diatom floras developed in palaeobasins: 1. "*Aulacoseira* species" type and 2. "*Actinocyclus* species" type. The biostratigraphic age determination of the Neogene sequences should be in combination with well established palaeolimnological records.

M.E.Ogorodnik

Interregional correlation of terrigenous Jurassic of the Precarpathians.

Lower and Middle Jurassic terrigenous deposits of the Precarpathians (Podolets, Medenychy, Kokhanivka and Yavoriv suites) are widely correlated by palynological data with the adjoining regions of Europe (Poland, Germany, Romania), the southern (the Crimea, Predobrogea) and eastern (the Donbas) regions of Ukraine, and also with the remote regions - the Northern Caucasus and the Eastern Precaspian. The likeness of taxonomic composition of palynocomplexes of the mentioned regions is stipulated by their belonging to a single European Sinian paleofloristic area. The Precarpathians territory was a part of this area with its own history of development. The peculiarity of the region paleofloristic composition is in the fact, that this region is similar so to European as to Middle Asia provinces of this area.

Podolets suite of Lower Jurassic has off - shore - marine and marine genesis and is correlated with Hettangian Pliensbachian deposits of German basin (northern, southern and eastern Brandenburg, western Macklenburg) and Transcarpathian Poland. The characteristic feature of palynocomplexes is the presence of old Paleozoic spores and the species of spores and pollen, which are typical for Early Jurassic or are transitional from Rhaetic to Liassic. The mentioned regions were a part of Weast - European sedimentary basin, which was limited by continental massifs, and in the south it bordered with the Tethys ocean. This epicontinental basin (by D. Konik) was subdivided into several sedimentary basins, which were freely connected with one another during the history of their development. And it is possible that the Precarpathians was one of them. Medynychi suite of Lower Jurassic has subcontinental and off - shore - marine genesis and is correlated not only with West - European basin, but more - with the territories of Romania, the Donbas, the Northern Caucasus and the Eastern Precaspian. A special feature of palynocomplexes is the presence of characteristic spores, which appear or prevail in Toarcian. At the same time the connection of the sedimentary basins of Poland with Dnieper - Donets basin across the Tethys zone is supposed. Such a connection, most probably, was in the basins of the Precarpathians and Romania (the Eastern Carpathians). Kokhanivka suite of Lower - Middle Jurassic has off - shore - marine and marine genesis and is correlated with the deposits of West - European basin in the west, of Crimean and Predobrogean basins - in the south, with the Donbas - in thew east, and also with the Northern Caucasus and the Eastern Precaspian. In these deposits Toarcian, Aalenian and Bajocian - Bathonian complexes of spores and pollen were found. Since Middle Jurassic the deposits of the Precarpathians have a broader geographical correlation, especially with the southern regions. Yavoriv suite of Middle Jurassic (Callovian) has off - shore - marine and marine genesis and is widely correlated with all the regions mentioned above. In the palynocomplex the pollen of heat - and dry - loving plants prevails. It indicates at the beginning of the climate aridization at that time, and it was in general characteristic for the whole European - Sinian paleofloristic area.

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A CONTRIBUTION TO KNOWLEDGE OF THERMOMINERAL WATERS OF KOPAONIK AREA (Central Serbia)

ABSTRAKT

The occurrences and deposits of mineral water in Serbia are significant by number and by the proved and expected exploitable reserves.One of these regions, where many occurences are located, is the Kopaonik Massif, divided into the following units (regions):

1. The Zapadna Morava valley (Cacak-Kraljevo-Vrnjacka spa), where can be expected or has been registered (14 occurrences) along the margin of the deep Tertiary basin.

2. Takovo-Kotlenik area and an area north of Sjenica, where thermomineral water can be expected in Mesozoik deposits (6 occurrences).

3. Western part of Kopaonik Massif, where occurrences (6) of mineral water are associated with Paleozoic rocks in Lucani-Guca area and the west of Novi Pazar.

4. Trstenik-Krusevac-Veliki Siljegovac area and general Varvarin area, where can be expected or has been registered (19 occurrences) in Paleozoic rocks under Tertiary deposits.

5. General Novi Pazar and Blazevo-Vrnjacka spa areas, where thermomineral water is associated with Paleozic rocks under Mesozoik deposits (11 occurrences).

6. Thermomineral water occurrences (10) on western Kopaonik slopes

The abundance of mineral, thermal and thermomineral waters in the Kopaonik Massif is unmeasured.These waters are of extremely good guality, among the best in Yugoslavia and possibly in a wider region.The chemical composition of the waters is peculiar, not yet properly studied.The hydrochemistry is heterogeneous, a consequence of complex geology s. l. and hydrogeology of the Kopaonik Massif.The prevailing type of water is HCO_3-SO_4-Cl or Na-Ca-Mg-K with variable contents of the constituents. Prevailing microelements are Li , Sr, Rb, Cs, and some others, on which some „waters are classified as rare,, medicinal,, waters.The above statements support the caracterization of the region as one of the most attractive for exsploration of mineral water resources.

Mineral, thermal and thermomineral resources have been explored in thirty, out of eighty, localites.

Their temperature varies from 15°C to 40°C.The highest water temperature is 78°C in Josanicka spa. Low-mineralized waters are those of Josanicka and Ovcar spa, Gornja Trepca (about 0.5 g\l), and highly mineralized waters of 1-6 g\l are those Kursumlija (about 2 g\l),Lukovska spa (1.5-1.7 g\l),Rajcinovica (2.99-5.6 g\l), Veluce (2.8 g\l) ,Vrnjacka (2.9-3.5 g\l).

THE PALEOGENE OF THE PODHALE BASIN POLISH (INNER CARPATHIANS)

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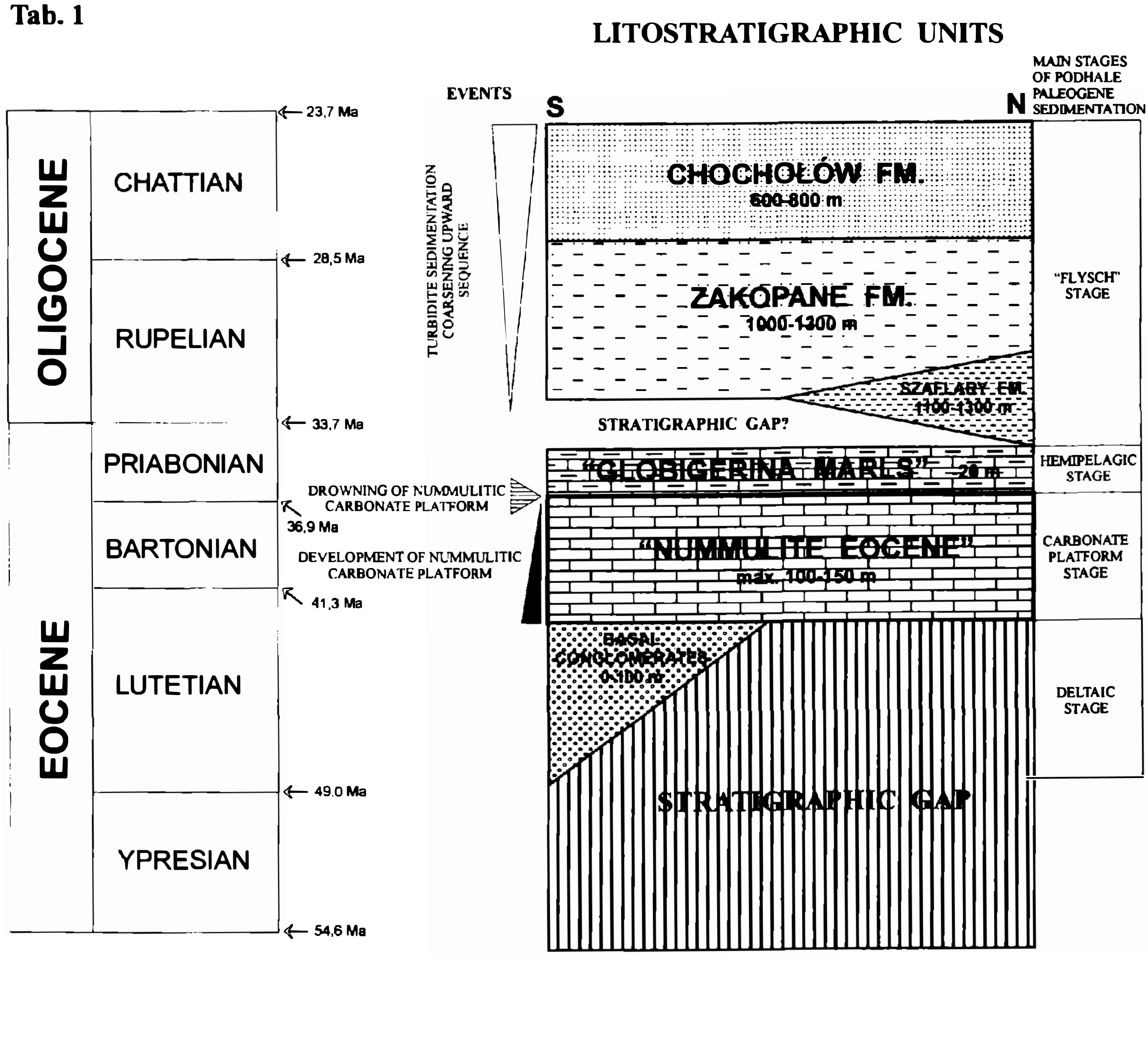
The Paleogene deposits of the Polish part of Inner Carpathians (the Tatra Mts and the Podhale Basin) represent four distinct facies: the pre-Late Lutetian basal conglomerates, the Bartonian-Earliest Priabonian sublitoral nummulitic limestones, the Priabonian hemipelagic marls with planktonic foraminifera, and the Oligocene turbidite clastics. Foraminifera are the longiest studied microfossils of these facies. Assemblages from the nummulitic limestones are composed predominantly of large species. The presence of: *Nummulites millecaput*, *Grzybowskia multifida*, *Discocyclina sella*, *Spiroclypeus carpathicus*, indicates Bartonian- Earliest Priabonian age for this subdivision. The distribution of biofacies follows the Arni's model. The subjacent gray hemipelagic marls contain abundant planktic taxa together with few deep water bentics such as *Nuttallides trümpyi*, *Heterolepa perlucida*, *Pleurostomella subnodosa*. Numerous *Globigerapsis index*, *Porticulosphaera mexicana*, *Turborotalia cerroazulensis* and single representatives of *Cribrohantkenina inflata* and *Globorotalia cocoaensis* suggest Priabonian, P 15 - P 16 zones. The Podhale flysch group is subdivided into: the Szaflary Fm., the Zakopane Fm. and the Chochołów Fm. Foraminiferal and assemblages of the Szaflary Fm. suggest at least late Eocene age. Foraminifera of the Zakopane Fm. comparable to those of the Lower Krosno Beds of the Outer Carpathians indicate the late Rupelian age. Most frequent coccolith assemblages of the Zakopane Fm correspond to NP 24 zone. The foraminiferal faunas of the Chochołów Fm. are extremely poor and unsignificant. Isolated nannofossil data suggest for the top og the Chochołów Fm the age as young as the earliest Miocene. The Podhale flysch foraminifera are typical for Carpathian Oligocene flysch environment.

Tab. 1



REGIONAL ASPECTS OF GEOLOGICAL HAZARDS AND RISK IN SLOVAKIA, AND IMPACT MITIGATION

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Geological hazards as well as risks depends on various factors, a big part of which exhibits a regional nature. To the factors of regional nature belong: geologic and geomorphologic structure, climate, and geodynamical phenomena. A specific regional feature of the geology on the area of Slovakia is unhomogeneity and intensity of tectonic crushing of rocks. The most complex geological structure is in the areas of mesozoic suits and Klippen belt suffered of the Alpine tectonics, as well as along regional faults and in Neovolcanitic massifs where high irregularities and rock unhomogeneity prevail.

Natural geological hazards (earthquakes and landslides) have been studied systematically in the last decades, and their regional nature is recognised by geologists, as well as competent civil engineers. Macroseismic zonation is included in the national standard. A landslide registration, including delineation of landslides in the topographic maps in the scale 1:25 000 or 1:10 000. is to public disposal in the Geological survey of Slovak Republic. Climatic zonation is in the National Atlas of Slovak Republic in the scale 1:500 000. Data of individual meteorological observatories are to disposal at the Slovak Meteorological Institute. Regional geology is interpreted in various geological maps. There have been issued maps in the scale of 1:200 000 for all the area – lithologic-stratigraphical, engineering geological and hydrogeological. Parts of territory are covered by maps in the scale 1:50 000 to 1:10 000. There are a lot of data from drilling programs in the urbanized areas and in the areas of mineral resources. Their documentantion is evidenced by the Slovak Geological Survey and is to public disposal.

Among the risk factors of great importance there are :a. unsatisfactory understanding of a regional as well as local geology, and b. misinterpretation of the survey and investigation results. The degree of risk caused by these factors depends partly of the previous field studies and investigation, and mainly of the geological structure complexity .Both features exhibit regional aspects.
Specific hazards and risks are characteristic for particular regions. All kinds of slope movements occur in the mountainous areas, with some modifications according to geological structure. However, their higher frequency is linked to Flysch and Mesoyoic suits, neovolcanic rock masses overlying Neogene clayey and Paleogene flysch strata, and Neogene clayey sediments in hilly parts of basins. A risk of sagging is related to hilly region of lowlands covered with loess deposits, suffosion in sandy deposits of the lowland central parts, etc.

There are a series of projects helping to mitigate an impact of geologic disasters and risk taking into consideration regional aspects of their occurrence. The most significant there are purpose engineering geological zonation maps, maps of a landslide vulnerability, as well as regional aspects of site investigation for complex structure as there are pumped storage plants, tunnels, toxic and radioactive waste disposal etc.

This program realised from fifties up to this days, sponsored by the Ministry of Environment and recently also by the Slovak Electro-power enterprise co. and Slovak Road Management co., helps to mitigate hazard and risk impact very effectively. The other factor of hazard and risk impact mitigation is an experience of research institutions, geological investigation companies as well as civil engineering construction and companies with regional competency.

Of great importance for the hazard and risk mitigation is education of geologists and civil engineers in the universities, as well as policy makers in co-operation with central authorities. Experience has been implemented in the legislation for geological investigation as well as an environmental impact assessment. Development in rock mass classification and data-base is a prerequisite for improvement of the risk assessment and impact mitigation.

GEOLOGICAL MAPS IN ALBANIA

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The Geological Map of Republic of Albania on scale 1:200000, is based on the topographic map (*Fig1*). On the basis of the regional geodesical investigations the territory of the Republic of Albania is included within two trapezoidal areas. The greatest and determinant part of the territory is included in the quadrate named K-34 and the other representing a limited territory belongs to the trapezoidal area named J-34.

On the basis of the rules of nomination and the sode of terminology for further topo-geodesical detalisation, the territory of Republic of Albania is divided in several quadrates which begin with the smallest number from North and increase from left to right going to the South. For example the northerst extreme of Albania territory is included in the quadrate K-34-51 which inmediately on the right is followed by the quadrate K-34-52 and so in the direction south where the last quadrate is J-34-17. (*Fig. 2*). This is the topographical nomination of the highest region of the territory of Albania. Further, applying technical rules for further detalisation in the scales of 1:100000, 1:50000, 1:25000 and 1:10000 the geologic Topographical Map is divided in quadrates corresponding to these scales. Based on this topographic division are included 103 topographic maps on 1:50000 scale

The geological mapping and compilation of the geological maps of large scale (1:25000, 1:50000) are among the main of the Albanian Geological Survey (GJEOALBA). The scientific, technical experience and a rich mapping documentation there exist in our country regarding this problems. It is done a lot of cartographic work in Albania, in different scales, beginning with the scale 1.100000 and further with 1:50000, 1:25000, 1:10000.

Our Department has intensive contacts with the Albanian and foreign scientific institutions. The cooperation with the neighbouring countries is making a good start and the cooperation between different scientific disciplines in the practical sense is good. Therefore, the necessary basis to undertake a national program for the geological mapping are set.

The geological activity on the environmental protection has started and the first maps based on the standardization and sufficient knowledges were compiled and published.

The intensification of the field geological observations, the analyzing of the rocky and qualitative interpretation have influenced on the exactness of the geological mapping.

Therefore, the geological maps is necessary to reflect all the geological data as well as the major geomorphologic, hydrologic, geological-engineering and different other phenomena as caves etc...

THE OPHIOLITE COMPLEX OF VOSKOPOJA AND HIS RELATION TO THE ALBANIAN OPHIOLITE BELT

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The Albanian ophiolites form outstanding fully developed ophiolitic sections within the eastern mediterranean ophiolites. Generally they are divided in an eastern and a western belt, where the former show a SSZ, the latter a MORB signature, a subdivision mainly developed in northern Albania. The ophiolite complex of Voscopoja (113 km^2 surface) is located in the southernmost part of the Albanien ophiolites (of about 4500 km^2) and forms thogether with the complexes of Shebeniku, Shpati, Devolli, Vallamara, Morava and Bitincka the southern Mirdita ophiolites.

Contrary to the north Albanian ophiolites little has been published about the south Albanian ophiolites. We present here the first data from the south Albanian ophiolites including the Shpati, Vallamare, Devolli and Voskopoja Massif as well as the Morava and Shebeniku Massif. The former are interpreted as continuation of the western belt, the latter are compared to the ophiolites of the eastern belt.
The contrast between the western and the eastern ophiolites, well developed in northern Albania, is not so clearly recognizable in southern Albania.

Most of the ophiolitic sections contain harzburgite together with lherzolite in the mantle segment and plag - lherzolites in the ultramafic cumulate section. Troctolites are common in Devolli and Voskopoja. Pyroxenites are restricted to the Shebeniku Massif. Sheeted dikes are missing in all profiles. Only three ophiolites (Shpati, Vallamare and Voskopoja) contain a volcanic section directly overlying the ultramafic and/or mafic cumulate sequence. First geochemical data of the Voskopoja lavas indicate an intermediate geochemistry between typical MORB and island arc tholeiites erupted in a SSZ environment. This is documented by the enrichment of elements such as Sr, K, Rb, Ba and a small depletion of Ti. The Pindos ophiolite in Greece, a continuation of the south Albanian ophiolites, shows a SSZ genesis indicating that a geochemical variation from MORB to SSZ tholeiites not only exists between the eastern and the western belt, but also in a north-south direction along the main axis of the ophiolites on a regional scale.

GEOPHYSICAL SEEPAGE DETECTION AND MAPPING AT DRAU RIVER DAMS, CARINTHIA, AUSTRIA

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The hydropower plant Annabrücke on the river Drau has dams with a maximum height of 20 metres, with a base width of up to 70 metres. These dams are constructed of a gravel body with a bituminous liner covering the water side. The base of the liner is connected to a sealing wall reaching down to the lacustrine clays in 30 to 50 metres depth forming the base of the reservoir body. The dams are being hydraulically and statically supervised with a network of gauges.

Since 1995 a geophysical control system is being developed and tested. This is intended to complement the existing surveillance system. First operational experiences with this system show a significant improvement in the early detection of damage to dams and in the precision of locating these damages.

A preliminary study showed that conventional — „state of the art" — techniques (self potential, resistivity, geothermal and electromagnetic measurements) will give unequivocal results only in the minority of cases. Often ambiguous or uninterpretable results are encountered, due mainly to the following reasons:

- Due to the large width of the dam, the leakages often lie up to 40 metres offshore, so that the measurable effect of the anomaly may already have been attenuated enough as to be virtually undetectable.
- Gauges, metal inserts and lithological influences cause a complex disturbing field for SP measurements, which is strong enough to mask the significantly weaker amplitudes of streaming potentials. Experiments have shown, however, that these influences are drastically reduced when measurements are taken on the open water surface.
- Due to strong lithological inhomogeneities of the gravels used in the construction of the dam, the specific resistivities vary between 150 and 2500 Ohm.m, so that pelitic and water saturated gravels can be unequivocally distinguished only in a few cases.

To solve these problems, two measuring methods were added to the program which had hitherto not been used in the examination of dams.

To solve the locating problem, the dependency of induced polarisation from lithological composition of the sediment on the one hand and water saturation on the other hand — which is well known from literature — is being used. Chargeability is the parameter of choice for locating seepage, as the high degree of water saturation over a seepage results in a characteristic minimum anomaly across this zone.

The second method employed to solve the locating problem is a measurement of self potential on the open water directly above the areas of seepage. The system currently in use consists of a fixed reference electrode close to the shore that is connected via a cable to the measuring electrode onboard a GPS-controlled boat. With anomalies of ± 5mV, a stable resolution of ± 0,1 mV can be achieved.

The current state of research allows the conclusion that the general problem of locating seepage zones can be satisfactorily solved using IP and resistivity mapping along land side profiles on the dam. For detailed mapping, water based SP measurements are best suited. The further development of geophysical methods with regard to systematic surveillance of dams and the control of repair efforts are future goals of the project.

THE FACILITIES OF THE APPLICATION GIS IN EVALUATION OF THE ENVIRONMENT FOR CONSTRUCTION THE HIGHWAY D1 LAMAČSKÁ CESTA – STARÉ GRUNTY IN THE WEST PART OF BRATISLAVA.

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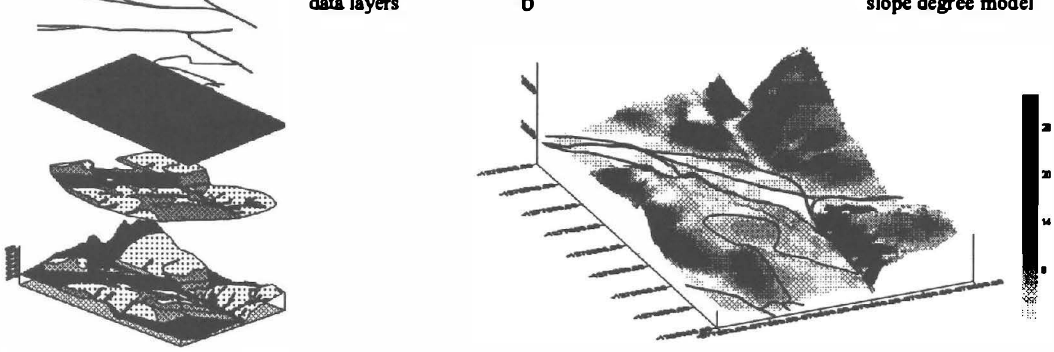
The geological knowleges and cooperation the geologists with the engineers whose project and realise the transport construction are very importatnt and prefering for long time. Further, the highway's parameters are often changed during preparation and projection of the transport construction. That's why it is necessary to have a possibility for preparing actual models of every new situation. The designers *and* engineering geologists can use the PC technologie and GIS systems to create models, to achieve the complex evaluation of some area, visualisation and interpretation of the space phenomena.

One of many definitions of GIS is „GIS is an organized collection of computer hardware, software, geographic data and personel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographicaly referenced information.

We used the methods of GIS for solving of the problems of transport constructions for the highway D1 Lamačská cesta – Staré grunty. The special purpose engineering geological map of the area was created by computer cartographie (digitalised in software TOPOL and visualised and printed in software MAPINFO). The simple, exceedet 3D terain model was constructed from the data imported to the software SURFER (Fig. 1 a). After converting data containing values of altitude with special program (which determined values of slope degree) the terain model with color scaling of degrees was created in program SURFER (Fig. 1 b). On the base of the comparation this terain model with geological conditions the areas susceptible to slope movement endangerous for transport construction were delimited.

Fig. 1

a data layers b slope degree model



The GIS presents suitable environment for solving problems, which require exstensive database and space analysis. We utilized this system for creating digital map containing some layers of geological and geographical data. These can be actualised and used for compiling another maps of the geoenvironment. The modeling of natural phenomena is one of the very importatnt spheres in the geoinformatic systems. In the future we expect the greater comunication of individual geosciences in formulation and solving problems of the space and dynamical modeling of natural phenomena

GEOTHERMAL REGIME, OIL AND GAS PRESENCE AND THERMAL WATERS OF THE UKRAINIAN CARPATHIANS

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Geothermal regime of sedimentary rock masses of the Carpathian region is predetermined by values of deep heat flow, by additional heat sources in sedimentary cover and the processes of conductive, convectively-conductive and convectively-diffusive thermal mass transfer.

On the base of processing of a great number of factual data (110 deep wells) the maps of background temperatures' distribution at a depth of 2000 m and average background geothermal gradients within the interval "neutral layer - depth of well bottom" on a scale 1:500000 were constructed for the first time. Space zonation of geothermal parameter distribution in the territory under study was established which testifies that every tectonic element of the Ukrainian Carpathians is characterized by its own geothermal regime. Within External zone of foredeep the temperature at a depth of 2000 m changes from the north-west to the south-east from 80°C to 40°C, background average geothermal gradient - from 3.5°C/100 m to 2.0°C/100 mand at Internal zone of foredeep - from 60°C to 40°C from 2.5°C/100 to 1.5°C/100 m. The Sumbir subzone of the Internal zone of the Pre-Carpathian foredeep is characterized by temperature values at a depth of 2000 m 45.0-50.0°C, and the Boryslav-Pokuttia subzone is heated much less (40.0-45.0°C). By geothermal data the actively conductive transverse dislocations are distinctly distinguished by positivegeothermal anomalies: the Drogobych - Shchyrets and Suchavsky faults and longitudinal Krakovets deep fault.

In the north-west part of the Folded Carpathians the temperature at a depth of 2000 m changes from 50.0°C on the boundary with the Internal zone of the foredeep to 85.0°C on the boundary with the Vygorlat-Gutin volcanic ridge, and in the south-east part from 45.0°C to 75.0°C respectively.

With in the Trans-Carpathian foredeep the Vygorlat-Gutin volcanic ridge in the same section is characterized by the temperatures from 85.0°C to 115.0°C and values of geothermal gradient 4.0-5.5°C/100 m. For the Chop-Mukachevo depression the values of temperatures 90.0-115.0°C and geothermal gradient 4.0-5.5°C/100 m are typical. In the Solotvino depression the temperatures at a depth of 2000 m change within 75.0-100°C, and geothermal gradient within 3.5-4.0°C/100 m

The main hydrocarbons' reserves are coincided to the Pre-Carpathian foredeep, and what's more the gas are drawn to the highly heated External zone of the foredeep and the oil ones - to low-heated Internalzone. Difference in temperatures in sections of the same name reaches 10.0-12.0°C. All discovered hydrocarbon deposits on regional temperature field are characterized by local positive anomalies, the value of which over oil deposits comes up to 3.0-5.0°C, and over gas ones - up to 15.0°C.

Thermal waters' distribution and their role in formation of geothermal regime in sedimentary cover and cover rocks of the basement is shown following the example of Trans-Carpathian foredeep. The main reserves of thermal waters are coincided to Paleozoic Lower Miocene, Novoselitsky and sarmation stratigraphic horizons. The depth of occurence of water-saturated beds changes from 600.0 to 3500 m, and temperature - from 35.0 to 150°C.

PESTICIDES CONTENT IN THE BOTTOM SEDIMENTS OF THE WEST NW PART OF BLACK SEA SHELF (O. ZMEINYJ).

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Gas chromatographic analyses were made with TSVET-500M chromatographs (Models 550,570). Average content of stable chloroorganic pesticides (COP) in west NW part of Black Sea shelf (o. Zmeinyj).

In bottom sediments samples contained 10^{-4} - 10^{-3} mg/kg DDT in 100% of cases.

HCCH ranged from 10^{-4} - 10^{-3} mg/kg in 100% of cases.

Aldrin was present in 18% of samples to the extent of 10^{-6} - 10^{-4} mg/kg.

Heptachlor was found in 75% samples varies from 10^{-5} - 10^{-4} mg/kg.

Treflan in 81% of samples varies from 10^{-6} -10^{-5} mg/kg.

Pesticides content in multicomponent marine system: surface water, bottom water, bottom sediment, etc. The dynamics of income, accumulation and further transformation of the pesticides in marine system was found to depend on the summary influence of the following factors: hydrodynamics(surface and bottom currents, it speed, trend), granulometric composition of bottom sediments , bottom contour, quantity pesticides incoming to littoral zone, trend wind, etc.

Negative pesticides influence on the ecological state of sea water area involves not only their incoming with agricultural pollution by water and agrarian ways, but also accumulation in the bottom sediments, as well as the secondary repeated transfer of contaminant mass from the sediments to the bottom water and biota.

THE EARLY CRETACEOUS TO PALEOGENE DYNAMICS OF THE MAGURA BASIN (WESTERN CARPATHIANS, POLAND)

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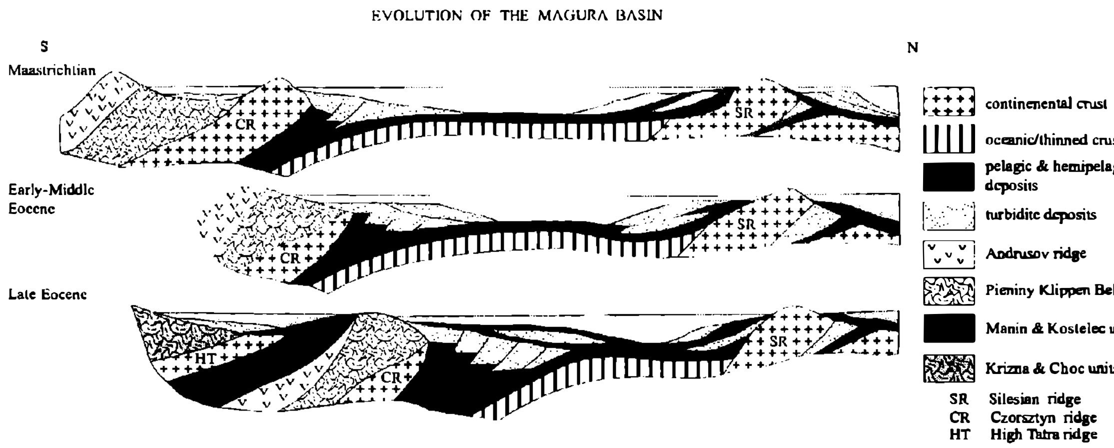
The Magura nappe, the largest tectonic unit of the Western Carpathians, is linked with the Rheno-Danubian flysch of the Eastern Alps. During the Early/Middle Miocene thrusting , the Magura nappe was completely uprooted from its substratum along the ductile Upper Cretaceous rocks. The Lower Cretaceous deposits (Barremian-Albian) have been recognised from a few localities in Southern Moravia and Poland. Older strata are known only from that part of the basin which was incorporated into the Pieniny Klippen Belt. Traditionally the Lower Oligocene Malcov Formation has been regarded as the youngest strata of the Magura nappe, though according to new data (Oszczypko et al., in print) the uppermost portion of this formation belongs to Late Oligocene /Early Miocene (NP 25/NN 1).



The Magura basin developed during the Liassic-Dogger rifting and was followed by the long-lasting Bathonian-Cenomanian (85 m.y) period of tectonic subsidence and basin expansion. At that time, sedimentation was dominated by the pelagic and deep-water deposits. The Cenomanian and Turonian (7 m.y) time was a period of unification of the sedimentary conditions in the whole basin of the Outer Carpathians. Radiolarian shales followed by red clays with intercalations of basinal turbidites were deposited below CCD. That type of sedimentation persisted in the Magura basin up to Campanian, when a considerable reorganisation of the basin took place. This was connected both with the inversion of the southern part of the Silesian basin, and with the beginning of the compression at the southern margin of the Magura basin. From the Campanian to Late Oligocene (60 m.y) the Magura basin, supplied both from the northern (extensional), and southern (compressional) margins (Fig. 1), was dominated by turbiditic sedimentation. In the Magura accretionary prism, which developed at the southern margin of the basin, three structural complexes can be distinguished: the Late Cretaceous-Paleocene, the Early to Middle/ Late Eocene, and Late Eocene to Late Oligocene, with angular unconformities between them. After the Late Oligocene and before Burdigalian the Magura basin was folded and thrust towards the north, what initiated development of the Early- Middle Miocene Carpathian peripheral foreland

INTEGRATED GEOLOGICAL-GEOPHYSICAL INTERPRETATION OF THE RZESZÓW - SMILNO PROFILE (WESTERN CARPATHIANS)

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The Rzeszów-Smilno 100km long profile is situated in the widest part of the Outer Western Carpathians (Poland and Slovakia). From NE to SW it crosses the southernmost part of the undeformed outer Carpathian Foredeep, the narrow zone of the folded foredeep Miocene unit, and the Western Outer Carpathian nappes. Completed integrated geological-geophysical interpretation was based on published maps, information from several deep wells, deep seismic profiling, magnetotelluric interpretation and gravity modelling. Deep seismic line was recorded by Geofizyka-Kraków (POGC) along the central part of the profile as a industry line with extended recording time (20 sec), and depth-converted with constant velocity (6km/sec). This line show large-scale structure of the Carpathian accretionary prism and uppermost part of their basement. Below them transparent zone of the upper crust was identified at depths of 13-21km in the north and 17-23km in the south. Magnetotelluric soundings provided information on high-resistivity horizon (top of crystalline basement). This horizon shows relatively flat-lying (about 3 - 5.5km deep) basement in the northernmost part of the profile, prominent low (down to 15 - 17km) that coincide with the gravity minimum in its middle part, and finally significant rise of the basement (up to 9 - 10km) in the southern part of the profile. Gravity modelling was based on large-scale structural models provided by other methods. Very good match was obtained between measured Bouguer anomaly and calculated gravity response of the model.

Interpretation of identified large-scale features provided new information on the present-day structure and geological history of this area. The Outer Carpathian accretionary prism that was formed during Middle Miocene compressional phase could be interpreted as a stack of flat overthrust nappes that form southward thickening wedge of variable thickness: from 2-2,5 km in NE up to 10-12 km in SW Structure of the Carpathian basement can be interpreted as a results of several stages of deformations related to Mesozoic extension and later Alpine collision. In northernmost part of the profile Carpathian basement is flat-lying, and in its central part significant low in the basement was detected. Its origin was interpreted as related to Mesozoic extension of the southern margin of the North European Platform and formation of passive margin. Therefore it can postulated that in this area relatively thick Mesozoic (Upper Jurassic to Cretaceous) and Palaeogene sediments could be present above the crystalline basement. They can be covered by older (Burdigalian) foredeep deposits. To the south from described basement depression significant uplift of the crystalline basement can be observed on MT data. This was interpreted as a result of thick-skinned basement-involved Early Miocene thrusting and inversion of the Mesozoic normal faults.

LATE EOCENE-EARLY OLIGOCENE DEPOSITS OF THE MAGURA NAPPE (WEST CARPATHIANS, POLAND).

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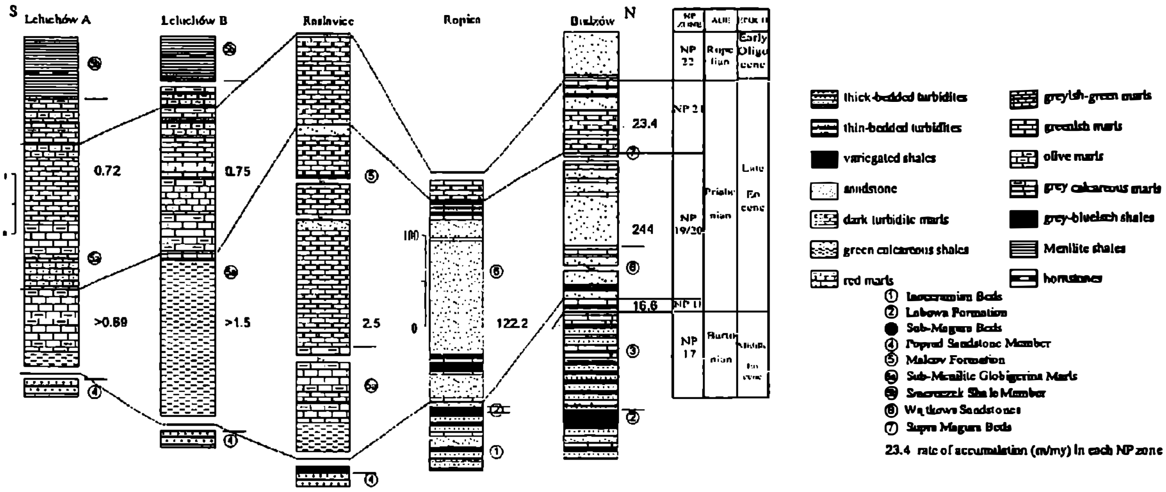
The Magura Nappe, the innermost unit of the Outer Carpathians, is subdivided into four facial-tectonic subunits: Krynica, Bystrica, Raca and Siary. In the Krynica, Bystrica and Raca subunits the youngest deposits belong to the Submenilite Globigerina Marls (SGM) and the Malcov Formation, whereas in the Siary Subunit they belong to Glauconitic Sandstones (Wątkowa Sandstones) and the Budzów Beds (Supra Magura Beds). The sedimentary record and calcareous nanoplankton of these deposits have been studied in Poland as well as in SE Slovakia (Raslavice Vyzne near Bardejov).



In the Krynica (Leluchów), Bystrica (Raslavice) and Raca subunits, SGM were deposited at the top of the Magura Formation (Lower-Upper Eocene). The samples taken from the Leluchów and Raslavice sections contain a calcareous nannoplankton assemblage which is, in the Leluchów section, assigned to zones NP 19-20 (Late Eocene), NP 21 (Late Eocene/ Early Oligocene) and NP 22 (Early Oligocene). In the Raslavice section, zone NP 19-20 was determined in the SGM as well as in the lowermost part of the turbiditic marls and sandstones which belong to the Malcov Formation. In the Siary Subunit the SGM are replaced by Glauconitic Sandstones and Supra Magura Beds. The samples obtained from the Wątkowa Sandstones (Budzów and Ropica) contained a calcareous nannoplankton assemblage which was assigned to the combined interval zone NP 19-20. The calcareous nannoplankton of the Supra Magura Beds, in the Budzów section, was assigned to zones NP 19-20, NP 21 and, in the Ropica section, to zone NP 21, only. During the Late Eocene time two sedimentary domains, with different rates of sedimentation, can be distinguished. The Krynica, Bystrica and Raca facial zones were dominated by a condensed pelagic deposition, whereas in the northern part of the basin (Siary Zone) an intensive deposition of thick-bedded turbidites took place, which derived from the northern margin of the Magura Basin (Silesian Ridge). It is possible that the deposition of the SGM in the SW part of the basin was interfingering with thick-bedded turbidites of the upper portion of the Magura Formation. On the bases of a preliminary nannoplankton study it can be assumed that the deposition in the Magura Basin persisted, at least, until Middle Oligocene.

ECOLOGICAL ASPECTS OF INVESTIGATION OF MERCURY IN ORE DEPOSITS OF THE DINARIDES (D) AND CARPATHO-BALKANIDES (CB)

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High toxicity of mercury (Hg) and its compounds exists even at the microquantities. Simultaneously, due to high migration potential, Hg has an active role in different processes of ore formation and it bacome enriched during various open-pit exploitation processes. Hence, Hg enters the atmosphere and hydrosphere not only because of metalurgical treatment of Hg ores, but due to its presence in ore concentrates of different metals. The ore concentrates essentially differ in their Hg content. Regularity of the Hg content in different ore concentrates is given in the monography of N. Ozerova (1986). Higher Hg concentrations are provided primarily by processes of degasation of the deeper parts of the Earth. Therefore the investigation of the presence of Hg has to be approached from the regional-tectonic point of view. Furthermore, the development of Hg-mineral concentrates is of essential importance.

Analyses of Hg distribution pattern in the studied regions of the D and CB are shown in the publications of Karamata et al. (1993), Ozerova et al. (1996) etc. Polymetallic, copper and antimony ore deposits of the D and CB (Serbia, Macedonia, Croatia, Bulgaria and Romania) were studied and orientation estimations of Hg contents for some of them, as well as evaluation of Hg transmission in atmosphere during the metallurgical treatment of ore concentrates. For some of the ore concentrates Hg-"thermofors" were also analysed; these have maximum Hg exolution during the continousely warming of a probe at 700 °C with contemporary registration.

These results are useful for estimations of Hg ores, planning of technological treatments of ore concentrates as well as protecting the environment, especially atmosphere and hydrosphere, from the toxical influence of Hg.

GOLD MINERALIZATION RELATED TO SOMESU RECE-VADULUI VALLEY SHEAR ZONE, GILAU MOUNTAINS, ROMANIA

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The gold occurrences situated between Somesu Rece and Vadului Valley, were considered either deep-seated veins (Bailor creek, Seaca Valley), or belonging to the Laramian metallogenesis (Tamita vein) until 1990. In fact a hydrothermal process associated to a shear zone from the northeastern part of Gilau Mountains generated them.

The Somesu Rece-Vadului area is made up of high-grade metamorphic rocks (Bihor unit) and high-grade, low-grade metamorphic rocks and granitoids belonging to the alpine thrusting belt. From west towards east the following nappes are to be found: Finis Nappe (Codru series and granitoids of Codru), Biharia Nappe (greenshists and red coarse-grained sandstone, Permian in age) and Muncel Nappe (Baia de Aries series).During Lower Paleozoic, in the ortoamphibolites of Codru series (Upper Precambrian) and in the greenschists of Biharia series (Upper Precambrian - Cambrian) the Codru' s granitoids were emplaced. The alpine thrusting belt was formed in the Austrian phase by the reactivation of older faults, which separated the Codru, Biharia and Baia de Aries domains. The ductile brittle deformation fractures of shear zone are generally parallel aligned to the alpine thrust faults, but they are older. The Somesu Rece -Vadului shear zone is a second tectonic structure related to a transcrustal fault located between the metamorphic belt and Transilvania's basin.

The evolution of the shear zone was accompanied by a three-stage hydrothermal activity, rich in SiO_2 and containing subordinate amounts of K_2O, CO_2 and metals (Au, As Cu, Zn, Sb, Ag). The shear zone underwent repeated events of ductile-brittle and brittle deformation, hydrothermal flow circulation and ore mineral precipitation close to metallogenetic model elaborated by Bonnemaison and Marcoux.In the first stage the ductile and brittle deformation which affected especially Codru's amphibolites and Biharia series's quartzites led to the forming of the black and white mylonitic bands, the latter accompanied by sericitization, carbonatization and the introduction of disseminated pyrite, chalcopyrite and sometime of arsenopyrite. The mylonitic bands had developed on three orientations: northwest to southeast (Seaca Valley, Bailor creek), north to south (Bodii creek, Obarsiei creek) and northeast to southwest (Cosorului creek, Vadului valley).

During the intermediate stage, the shearing movements caused openings in dilation zones that favoured the emplacement of the milky white quartz veins. The subsequent cataclasis and breccifiation process affected especially the vein's external portions that became favourable places for deposition of galena, chalcopyrite, arsenopyrite, sphalerite, stibnite, tetrahedrite, ankerite and native gold of high purity.

In the late stage of deformation and mineralization, within Tamita vein jamesonite, native gold and likely electrum were precipitated. Scattered samples collected from this vein indicated high contents of silver, which, are usually small in other occurrences. Generally, the gold occurs as small particles (0,01 -0,15 mm) around the jamesonite grains.

From structural-style point of view, gold mineralization consists of: white mylonites, weakly mineralised by pyrite, chalcopyrite, arsenopyrite, with low gold contents; grey quartz veinlets with nests of chlorite, calcite and fine grained pyrite and white quartz with small pockets of galena, sphalerite and chalcopyrite on the conjugated fractures sets; veins of milky white quartz with nests and veinlets of galena, chalcopyrite, sphalerite, pyrite, arsenopyrite, stibnite, tetrahedrite, jamesonite, native gold and ankerite, localised obliquely (Somesu Rece), or perpendicularly to the shear zone (Tamita hill); white barren quartz veins emplaced on the parallel fractures to the milonitization planes.

In the veins from Somesu Rece, gold of high purity is associated with chalcopyrite and in the Tamita vein, gold is associated with chalcopyrite and jamesonite, the latter one identified only here.

The geostatistical interpretations revealed positive correlations between Au and Pb, Cu and As.

The forming of the gold bearing veins was controlled by repeated ductile-brittle and brittle deformation within shear zone and the tectonic competence of the involved metamorphic rocks.

The ionic composition analysis by capillary electrophoresis method on the quartz and sulphides samples indicated deposition temperatures ranging from 184° to 250°. The pre-Laramian gold mineralization related to Somesu Rece -Vadului Valley shear zone was formed after the emplacement of Codru granitoids.

PRESSURE SPECIFIC BEHAVIOUR OF SOFT BROWN COALS FROM TRANSILVANIA COAL BASIN

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Works were carried out as part of a more complex study, in order to establish the valuing possibilities of low rank subbituminous coals - soft brown coals - from the coal basin Capeni Baraolt - Transilvania. In this respect we chose the binderless briquetting, to transform these coals into products with superior density of energy, more easily to transport.
We used coals physico-chemical composition and structure, pointing out the petrographic components which selectively interfere in the complex of actions favourable for the cohesion creating by briquetting. These coals very low rank was established by determining their content in: (free) humic acids, moisture and volatile matter, it was also determined huminite reflectance and petrographic composition, mineral matter included. There were studied five sorts of coals from different mines in the coal basin. The moisture content, top grain size and briquetting pressure were varied and were correlated with the obtained values for the tensile strength, compressive strength and storage stability.
The pressure behaviour of coals was specific and there were determined the influence factors in getting the best response for the briquettes strength. The researches outcomes, rendered in tables, diagrams and micrographs, revealed a good correlation between the rank and petrographic composition of coal and the briquettes quality.
The optimum proportion, from the briquetting susceptibility point of view, between the gelified and fibro-wooden structures of the components, is characteristic for each type of coal. In order to realise the best approach between coals particles, which benefit from molecular cohesion forces, it is necessary to have a reduced participation of the fibro-wooden constituents. These ones, especially textinite, are elastic materials, which increase the pushing back forces in spite of the superficial reinforcement process.
In our case, coals with high humic acids content and a petrographic composition, in which fibro-wooden structures (textinite + textoulminite), are in certain proportion inferior to the gelified ones (gelinite + corpohuminite), had a good behaviour to pressure. It follows the conclusion that, as part of petrographic components, some specific structures worked favourable for the appearance of superficial attraction and adhesive forces between particles. These structures offered a large contact surface, increased by crushing, and a more reduced rigidity which allowed particles plastic deformation by pressure. It is about of gelinite and corpohuminite porous structures and porous humic mass of attrinite and densinite. The latter represents a good binding material, cementing the grains and making, frequently, invisible the separation outlines between the coal grains in the briquette.
The response to the pressure action is influenced by the coal moisture too. The eng capillaries, making difficult the water evaporation, facilitate its participation in by pressure binding process.
The coals grain size represents another factor of influence upon their pressure behaviour. It offers a contact surface as larger as more advanced the grinding fineness is.
The pressure specific behaviour of these cols has not only a physical aspect, but a chemical one too: the briquette is a new product with a modified gel structure, where the fibro-wooden components play a reinforsment role only.In this sense we found differences in the electric conductivity of briquettes and coals.
The obtained results showed that the relation between briquette strength and structure had the best value for: 1800 kgf/cm^2 briquetting pressure, 14 -18 % moisture (depending on rank and petrographic composition) and - 0.2 mm coal grain size.
Under these briquetting conditions the obtained material concentration is of 1.4 - 1.6 times greater and the calorific value increased with 36 - 70 %, in comparison with those of the initial coals.

Key words: soft brown coals, binderless briquetting, rank, tensile and compressive strength, petrographic composition, micrographs, fibro-wooden and gelified components, calorific value, coal grain size.
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MINERALOGICAL, HYDROTHERMAL AND GEOCHEMICAL ZONALITY MODELLING OF THE ELLATSITE PORPHYRY COPPER-GOLD DEPOSIT, BULGARIA

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Ellatsite is one of the largest porphyry copper-gold deposit in the Central Srednogorie zone - a part of the Global Euroasian ore-copper belt on the Balkan Peninsula. The area is build up of Precambrian metamorphic rocks, Palaeozoic acid plutons and Mesozoic igneous rocks (Upper Cretaceous age). They include volcanics - andesites, tuffs and breccias and dacites as well as intrusive and subvolcanic rocks - diorites, granodiorites, quartzdiorites, quartzmonzogranodiorites.

Metallization is related to the intrusive and subvolcanic rocks. The ore bodies are with veiny-chapped form or irregular. The major ore minerals are: chalcopyrite, magnetite, bornite, pyrite. The minor ones embrace molybdenite, galena, sphalerite, hessite, native gold, silver, electrum, nickel-pyrite, cobaltiferrous pyrite. Some of the trace minerals are karrolite, bismutinite, tenantite, tetrahedrite, ramelsbergite. According to Dragov and Petrunov the ores contain palladium, merenskite, paladoarsenite, nickel-lineite, karolite, gersdorfite, native tellurium and bismuth, palladium bearing ramelsbergite. The precious metals such as gold, silver and platinum are presented in two forms in the ores. The first one is as their own minerals but the second - is as inclusions in the crystal structure of the other minerals.

The country rocks bordering ore deposits altered by fluids that have passed through them and with which the ores are associated. Differences in the compositions of intruded rocks caused considerable differences in alteration products. They were probably deposited in the following sequences: propylitic ⇒ potash feldspar's ⇒ quartz-sericitic. The initial minerals are partially or completely replaced of epidote, albite, chlorite, sericite, calcite and micas. Some minerals as quartz and orthoclase are unaltered. The founded clay minerals indicate low stage argillization. There are also significant carbonatization at various parts of the alteration zones. The availability of complicated transgressing and sequential zones of alteration shows that not all alteration zones my be useful as guides to ore deposits.

Endogenic geochemical zonality of the major ore-forming elements (Cu, Au, Mo) also the investigation of some significant ratios (Cu/Mo, Cu/AU) show the increasing of gold content through the upper mineralized strata. Simultaneously in the cigar-chapped ore bodies increase the indicative ratio Cu/Mo. The quantity of the molybdenum increases just to the boundary zones of the deposits as well as in the depth. Geochemical investigations are of great potential aid in the discovery of new copper-gold porphyry ores to the south-west and south parts of the same district.

The three dimensional models (mineralogy, wall-rock alterations and geochemistry) consider the most of geological factors accordingly. Their visible modelling allows us to get an approximately full imagination about the sequence of the natural events causing the deposits. The suggestion is that such models are of great significance in discovery if new ore-bodies (Sillitoe, 1990).

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CRETACEOUS PALAEOBIOGEOGRAPHY AND SOME INTERPRETATIONS OF ALPINE GEODYNAMICS

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The latest results of palaeontologic studies of Cretaceous deposits of the Carpathian-Balkanides, Inner Dinarides, Pannonian and some other areas have been used in a new approach to the interpretation of palaeobiogeographic relations in the Cretaceous Central Tethys. Highly relevant data have been acquired by research covering land palynomorphs (Middle Cretaceous in particular) and rudist fauna (especially Later Senonian).

ON MIDDLE CRETACEOUS PALAEOPHYTOGEOGRAPHY. Investigations of Middle Cretaceous palynomorphs (Hochuli, 1991; Pantić & Isler, 1988; Dulić, 1997; Dulić, in press; Pantić & Dulić, in press) supplied data for the reconstruction of the distribution of the palaeophytogeographic provinces pertaining to the Tethyan palaephytogeographic realm of the Central Tethys. From the north southward, the following provinces may be distinguished (Dulić, 1997):

the province of land vegetation on the archipelagoes along the northern margin of the Central Tethys – subtropic-humid climate (Carpathian-Balkanides),
the province of land vegetation on the newly formed island chains of the Central Tethys – subtropic to tropic climatic belt (Inner Dinarides) and
the province of land vegetation on the archipelagoes of the intraoceanic carbonate platform – tropic-arid climate.

ON LATE SENONIAN RUDIST PALAEOBIOGEOGRAPHY. The study of geographic distribution of Late Senonian rudist genera in the Central Tethys allowed the Mediterranean palaeobiogeographic provinces to be further subdivided. From the north southward, the following subprovinces may be distinguished (Sladić-Trifunović, 1986, 1987, 1995, 1996):

the Central Tethyan northern margin subprovince (= Carpathian-Balkanide Pontidian subprovince) – suptropic climatic belt (Carpathian-Balkanides),
the transitional subprovince (= Inner Dinaride-Hellenide-Anatolidian subprovince) – subtropic to tropic climatic belt,
the intraoceanic Adriatic-Tauridian subprovince – tropic climatic belt (Outer Dinarides and Taurides) and
the Central Tethyan southern margin subprovince (= Arabian subprovince) – tropic climatic belt.

GEODYNAMIC IMPLICATIONS. It is important to note that the separate palaeobiogeographic studies of Middle Cretaceous land flora and Late Senonian rudist fauna revealed similar distribution of palaeobiogeographic units in the Central Tethys during Middle Cretaceous (land flora) and Late Senonian (rudists). The congruence is also reflected in the interpretation of complex removal of certain crustal blocks. Certain blocks containing sediments with Cretaceous flora or fauna from one palaeobiogeographic unit today lie within those crust segments which during the Cretaceous were formed in different palaeogeographic areas. The migration of certain crustal blocks were affected by complex geodynamic events during the Cretaceous and/or Tertiary. So, for instance some blocks in the crustal segments in north Hungary contain Middle Cretaceous land vegetation remnants, which taxonomic composition and palaeoclimatic characteristics are identical to that of Middle Cretaceous land vegetation of some deposits in west Serbia (Inner Dinarides).

TECTONOSTRATIGRAPHIC TERRANES AND TECTONOMETAMORPHIC BELTS IN THE AEGEAN.

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The complex geological structure of the Aegean Region has been analysed on the basis of the distinction of several tens of tectonic units, each one characterised by its stratigraphy, tectonic position and tectonometamorphic history. Paleogeographic reconstructions of the Hellenides sector within the Tethyan realm are based on the stratigraphic data of the non or slightly metamorphic units and on the estimated protoliths of the metamorphosed units. The beggining of flysch sedimentation in each unit has been the main tool for establishing the relative position of the various units within the Tethyan realm when entering the tectonic front along the paleo-trenches of the evolving orogenic arc of the active European margin. The metamorphic units of the Hellenic arc have been grouped in three tectonometamorphic belts with different structure and history (Papanikolaou, 1984). Terrane analysis in the Hellenides and the Aegean Region (Papanikolaou 1989, 1996) has resulted in the distinction of nine tectonostratigraphic terranes, 4 of Tethyan oceanic origin (H_2 Pindos-Cyclades, H_4 Vardar-Axios, H_6 Circum Rhodope and H_8 Volvi-East Rhodope) and 5 of pre-alpine continental origin (H_1 External Hellenides Platform, H_3 Internal Hellenides Platform, H_5 Paikon block, H_7 Rhodope Massif and H_9 Vertiskos Massif). The overall tectonic structure of the Aegean region as shown on the N-S profile of Figure 1, indicates that the three tectonometamorphic belts do not coincide with the tectonostratigraphic terranes. Instead: (i) the internal T/M belt of Rhodope comprises four T/S terranes (two oceanic H_6 and H_8 and two continental H_7 and H_9), (ii) the medial T/M belt comprises four terranes two oceanic (H_2 and H_4) and two continental (H_1 and H_3) whereas (iii) the external T/M belt comprises only part of the continental terrane H_1 and possibly part of the oceanic terrane H_2. The tectonometamorphic evolution of each belt is unifying the history of completely different T/S terranes by overprinting and sometimes by obliterating all previous structures.

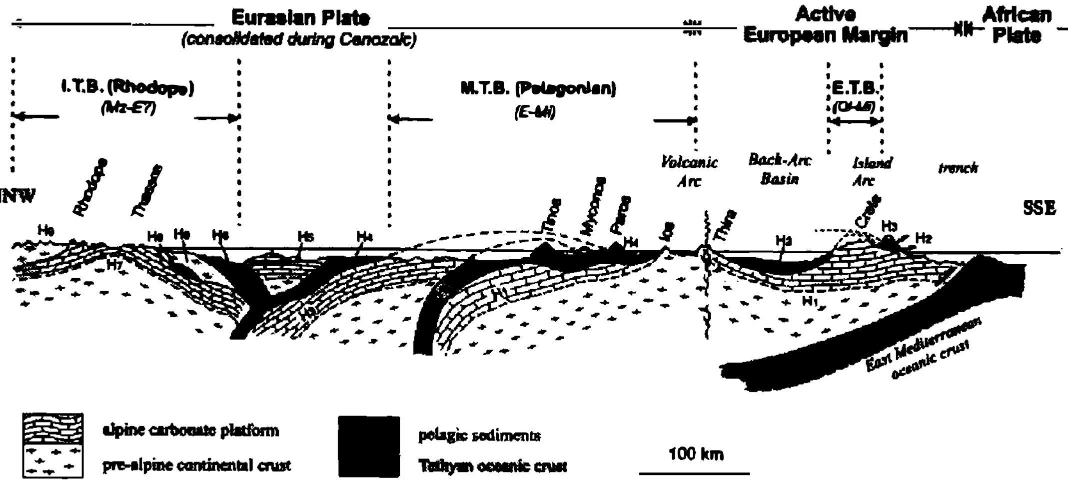

Fig.1

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MORPHOTECTONICS OF KOS ISLAND, DODEKANESE, GREECE.

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Morphotectonic analysis of Kos island focused on the distinction of planation surfaces (p.s.) in: a) depositional (constructive) p.s. and b) erosional (destructive) p.s. The erosional p.s. where further distinguished in horizontal and inclined p.s., the latter being characterised by an arrow towards the dip direction.

The existence of the p.s. is highly depended upon their geological basement and also upon the neotectonic movements. Thus, only very few horizontal errosional p.s. in high altitude (600-800 m.) are observed in Dikaios Mt., where the alpine basement crops out whereas numerous errosional and depositional p.s. at altitudes less than 100 m. are observed in the northern coastal zone between the cities of Kos and Mastichari.The existence of recent stratigraphic formations of Neogene and Quaternary age with alternating lithologies of hard sandstones and breccias with soft argillaceous and marly rocks control the development of the p.s., usually over the top of the most recent and hard formations. The most characteristic case is the volcanic breccia of Upper Pleistocene age, covering most of the central-western part of Kos island with a thickness of a few tens of m.

The neotectonic structure of Kos island comprises the following 4 major neotectonic blocks (figure 1):

a) The Kefalos block, which is a tectonic horst, where the alpine basement is observed below the Neogene s ediments and the Pleistocene volcanic breccia.
b) The Antimachia block, which is tectonic graben, where only Neogene and Quaternary sediments are observed bellow the widespread Upper Pleistocene volcanic breccia.
c) The Dikaios block, which is a tectonic horst, where only alpine rocks crop out, intruded by a Miocene monzonite.
d) The Zipari block, where alluvial sediments along the northern coast and Neogene sediments are cropping out, covering small outcrops of Alpine rocks.

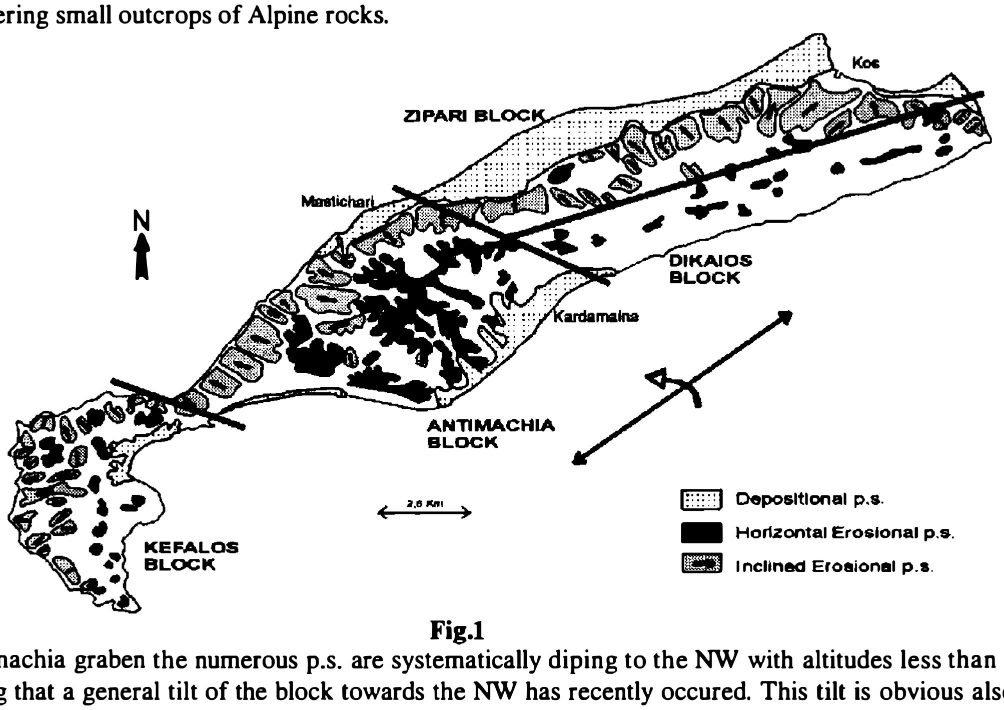

Fig.1

In the Antimachia graben the numerous p.s. are systematically diping to the NW with altitudes less than 100 m., implying that a general tilt of the block towards the NW has recently occured. This tilt is obvious also in the assymetry of the drainage network, of the downcuting or gully erosional zones and also in the outcrops of the Pliocene-Quaternary marine sediments which extent all along the southern coasts of Kardamena area. In the Kefalos neotectonic block the p.s. are diping to the W, except for its northern part where they dip towards the North. The average altitude is higher by about 50-100 metres than that of the Antimachia block. A systematic dip of the p.s. to the NNW is also observed in the Zipari block whereas only a few horizontal p.s. occur in the Dikaios Mt. Block. The general neotectonic movement of Kos island shows a tilt towards the NW with abrupt slopes in the southeastern coastal zone and smooth landscape in the northwestern.

HYDROGEN ISOTOPE GEOCHEMISTRY OF OH-BEARING MINERALS IN PEGMATITES RODNA MOUNTAINS (EAST CARPATHIANS, ROMANIA)

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This study report data on hydrogen isotopic composition of hydrous minerals (biotite, muscovite, tourmaline) of the pegmatitic rocks of the Rebra metamorphic series (SSW of Rodna Massif). They are considered in comparison with δD values displayed by other metamorphic rocks of the same series, and by other rocks and minerals of some Neogene magmatic structures out-cropping in the area (Mg. Arsente, Mg. CFR, Parva).

Routine isotopic analyses were carried out after removal of the adsorbed water by pre-heating the samples under vacuum at temperatures up to 120 °C. Generally, the amounts of the expelled water are rather smaller than the theoretical content because of the removal more or less complete of the interlayer water together with the adsorbed water. The synopsis of the distribution of the δD values shows that there is a strict delimitation between metamorphic and igneous rocks and minerals, in the wise of decreasing of these values in the last case. The scatter is as follow (δD ‰): pegmatitic minerals: -38,59 ÷ 0,26, mean value -21,28, standard deviation 11,96; metamorphic rocks and minerals: -44,68 ÷ 0,26, mean value -24,58, standard deviation 11,79; igneous rocks and minerals: -45.97 ÷ -97.65, mean value -66.76, standard deviation 17.59. Our study made evident that there are regularities in the deuterium distribution among different rock-forming minerals reflected in the systematic trends of the δD values. It can be establish the follow decreasing scale: *biotite, tourmaline, muscovite.* We also found that variations in chemistry of muscovite are less important that the occurrence location. Thus, muscovitic minerals with different chemical composition occurring in the same pegmatitic body are very similar in deuterium content. Contrary, muscovitic minerals with very similar chemistry coming from different pegmatitic body display distinct δD values.

Study of the hydrogen isotope fractionation in pegmatites was performed in temperature range of 350°C - 450°C. The considered systems were biotite - water and muscovite - water. For the system biotite - water there are no evidences for the attainment of isotopic equilibrium in the considered temperature range. In exchange, processed data of the muscovite - water systems suggest that for these systems probably the isotopic equilibrium reached at a temperature near the 450°C. At the same time, it appears that the aqueous-rich fluid phase that fractionated with studied muscovites, representing the fluid of the last major metamorphic event, evolved in an open system. The result is a decreasing of the deuterium content on the flow direction. The linear and the quadratic interpolation surfaces of the calculated δD values of water for the collecting zone of the muscovitic minerals, suggest that the flow direction was in a parallel direction with the cross-cutting, NW-SE oriented, fault system (probably Alpine in age). In touch with these considerations we credit the idea that the recorded metamorphic event is also Alpine.

APPLICATION OF COSMOGENIC RADIONUCLIDES IN GEOCHEMICAL DETECTION OF SOLAR NEUTRINO WITH 205-Tl

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Orebody Crven Dol, situated in the north-western part of Allchar deposit (Republic of Macedonia), is unique in the world by the quantity of thallium and number of thallium minerals. Among them, lorandite ($TlAsS_2$) has a special importance as a geochemical detector of solar neutrinos. The interest in solar neutrino detection is extraordinary because the Sun, as the powerful source of neutrinos, ought to confirm the most important aspects of the SSM (Standard Solar Model) theory which has a deep significance in the field of cosmology, nuclear physics, elementary particles physics, cosmoarcheology, geological sciences and other relevant fields. After almost two decades of research there is still no answer as to whether the lorandite from Allchar can be used as geochemical detector of solar neutrinos. One of the key problems in the realization of this experiment is the depth of mineralization. It determines the influence of the cosmic radiation on the final result of the solar neutrino flux for the period of the geological age.

The mineralization depth of Crven Dol orebody is in direct correlation with the determination of the erosion rate. The erosion rate was determined in the broader area of Allchar deposit (56 km2) applying the method of quantitative geomorphologic analysis, whereas exact determination was carried out at the location of Crven Dol orebody (6 km2). Two stages in the geomorphological history of the site were taken as the reconstruction limits of the broader Allchar area. The first one is for the Pliocene period, corresponding to approximately 5 My, and the other for the Pleistocene period, or about 1 My. The reconstructed reliefs for both evolution stages are represented with isohypses. It enabled a quantitative comparison of the reconstructed reliefs to the present relief in each of the investigated points of the site. In this way, the difference between the reconstructed and the present reliefs was the erosion rate, i.e., the mineralization depth, for the above mentioned time periods. The dependence of the erosion rate on time is linear for the given period. Average erosion rate for this location is 82.5 m per 1 My as the mean value of the maximum 175 m and minimum 155 m for the period of the geological age of Crven Dol orebody.

Pavićević and Amthauer (Pavićević & Amthauer 1992) have suggested long-life cosmogenic radionuclides (26Al, 53Mn) for determination of both the geological age and mineralization depth in Crven Dol orebody. They proposed the use of sulfide minerals: lorandite, realgar, orpiment and others. However, the application of quartz would be preferred to the proposed minerals because of its frequent occurrence in the geological environments, its stability during its geological age. Also, quartz enables determination of two nuclides (10Be and 26Al) which have favorable half-life in relation to the geological age of Crven Dol. These nuclides are produced during the nuclear reaction between stopped muons (m) and the isotopes of oxygen and silicon, according to the reaction:

16O (m,an) 10Be	T1/2=1,6.106 y
28Si (m,2n) 26Al	T1/2=0,72.106 y

Preliminary calculations have shown that 1kg of quartz would, for the period of the geological age of Crvon Dol (4,2 My), contain 3,5.1010 atoms of 26 Al at the deposit surface. This means that 100g of quartz would, after the correction for erosion (37m/My), contain 5,4.10-17 atoms of 26Al g-1 mol-1 in this deposit. At the depth of 25m this value would be 1,1,10-18 atoms of 26Al g-1mol-1. According to this estimate, the quantity of quartz at the deposit surface would be 0.5 kg, at 25m 1 kg and at 52 m 2-3kg. It needs to be taken into consideration that 26Al is also produced as the result of nuclear reactions which originate from 238U and 232Th and constitute background reactions.

The problem of the sampling of quartz from different depths could be solved by sampling it along the isohypses with different erosion rates. For determination of 26Al and 10Be in the range of 10-11 to 10-18 atoms g-1mol-1. AMS (Accelerator Mass Spectrometry), as single atom detection method, is only suitable for the time being.

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NEW IDEA OF TECTONICS AND OIL AND GAS-BEARING POTENTIAL OF THE FORELAND OF THE UKRAINIAN CARPATHIANS

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It is established, that foreland of the Ukrainian Carpathians was formed on the passive continental margin in Neogey and is represented by the edge system which comprises: Baltic-Dnister pericraton depression, Striy Jurassic depression, Lviv-Lublin Cretaceous depression and Carpathian Neogene foredeep. The greatest structure of edge system with the most thick sedimentary cover is the Baltic-Dnister pericraton. Four platform complexes: Baikalian, Caledonian, Hercynian and Alpine form the geological section of the foreland. They are subdivided into several formations. Foreland (Volyn-Podillia plate) is composed of monoclinal slope and Lviv depression. These tectonic units differ by their structure as well as by geodynamic development. Tectonics of the western part of the Lviv depression displays the resonance influence of the geodynamic processes which actively took place in the adjacent mobile Alpine-Mediterranean belt. Paleozoic deposits from the basement of the Carpathian foredeep extent as an approximately parallel strips form the North-West to the South-East. Their strata goes down step by step in the Carpathian direction. Deposits are intensively dislocated. Their characteristic feature is the wide development of thrust tectonics. Cross-faults divide Paleozoic basement of the Carpathian foredeep into several separated parts. The structure of each part has its own specific features.

The Baltic-Black Sea oil and gas-bearing belt is genetically connected with the foreland of the Ukrainian Carpathians. In it margins the Volyn-Podillia oil and gas-bearing province is located. The formation of this province was finished in after-Cretaceous time. Three oil and gas-bearing complexes: real oil and gas-bearing Carboneous-Devonian complex and prospective Silurian and Cambrian complexes are distinguished. The region of monoclinal slope is determined as a first order area for prospecting works in the Cambrian complex.

Two areas in the margins of the development of Paleozoic deposits beneath the Carpathian foredeep are also prospective. Prospects of the Silurian complex connect with the facies of organogenous limestones which form separated morphostructures - bioherms.

Another object for prospecting works at the Volyn-Podillia plate - deposits of the Polissia series of Upper Rhyphean (transitional complex of the ancient East-European platform).

Nannoplankton, isotopes and elemental markers from the Paleocene/Eocene boundary in the flysch from Goriška Brda (Western Slovenia)

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A continuous transition between Paleocene and Eocene was established on the ground of changes in nannoplankton association in flysch at Nozno in Goriška Brda, SW Slovenia. Nannoplankton in marls is rather abundant but poorly preserved. Owing to high degree of reworking of nannoliths for stratigraphy only species that appearing in Eocene could be used. Reliably Eocene is only the species *Rhomboaster bramlettei*, along with some others less important for boundary.

Across the boundary there are no sedimentation changes. In Paleocene taken place normal flysch deposition with carbonate turbidites that contain in base coarse grained breccia. Upwards follow sandstone and in the uppermost part grey marl (called opoka). In-between occurs fast interbedding of marl and sandstone. Eocene starts with carbonate turbidite about 20 metres thick. Therefore no samples for nannoplankton studies could be collected from this interval. Sampled was only the grey marl above turbidite

The discovery of Ir and other elemental abundance anomalies at the P/E boundary suggests a possible link between extraterrestrial impact(s) and global extinction of benthic foraminifera in the latest Paleocene, as well as associated transient climatic changes. However, the multiple Ir enrichment in marl layers 1.3, 1.5, 2.5 and 4 m below the boundary and other associated elemental anomalies which span a 2.7 m thick stratigraphic interval, as well as the lack of shocked quartz does not support a single impact scenario. Although the combination of different terrestrial sources and processes seems to have had the dominant role for the origin of the observed geochemical signatures in P/E boundary sequence, we cannot preclude an extraterrestrial impact(s) on the ocean as a possibility.

THE TERTIARY SUBLONGITUDINAL DYKE SWARMS (SOUTH BULGARIA) - IMPLICATION FROM NEW K-Ar AGE DETERMINATIONS

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Large volumes of Paleogene (37 -25 Ma - Lilov et al., 1987) orogenic, mainly intermediate and acid volcanics and subordinate plutons of dominating HKCA-, and SH- affinity, crop out on large territories of South Bulgaria. They are located in the Northern part of the Macedono-Rhodope-North Aegean Magmatic Zone (MRNAMZ), crossing from NW to SE the central and southern parts of the Balkan Peninsula.

Widespread magmato-tectonic structures of the MRNAMZ magmatics in the Eastern Rhodopes and in the eastern part of the Central Rhodopes are the sublongitudinal (80-125^0) linear dyke swarms ("dykes of the tensional zones" after Kostov, 1954). They cut the Pre-Paleogene basement of high-grade metamorphics and granitoids and the Paleogene volcanic, volcaniclastic and sedimentary rocks. The swarms consist of tens of dykes, frequently associated with stock-like bodies, small diatremas, etc. The length of the swarms is 3-30 km, the width varying from hundreds of meters up to 5-8 km. Some of the dykes, studied in detail, show a primary-fragmented monolateral and bilateral en-echelon organization, reflecting a formation in conditions of sublatitudinal (170-205°) tension axis. Most of the swarms are bimodal in composition, being built of acid (predominantly felsitic rhyolites) and intermediate (basaltic andesites, phenoandesites/?/, latites, trachytes) to rare basic dykes. In the Bulgarian literature the swarms are considered to be Late Oligocene and even - Miocene magmato-tectonic structures and their intrusion is referred to the latest stage of the Paleogene magmatic activity.

The results of new K-Ar age determinations of 14 dykes from four dyke swarms (Table 1) fall in the Early (to Middle) Rupelian age.

Table 1 New K-Ar ages of dykes from the Eastern and Central Rhodope sublongitudinal dyke swarms

	Dyke swarm	Rock types	Dated fraction	Age (Ma)
1.	Topolovo-Pilashevo	Latites, trachytes	w. r., biotite (3)	32.78±1.59 - 32.73±1.45
	(western part)	Rhyolites	w. r., sanidine (2)	32.82±1.27 - 30.68±1.3
2.	Zagrazhden	Phenoandesites	w. r. (1)	31.3±1.2
		Felsitic rhyolites	w. r. (1)	31.4±1.2
3.	Zvezdel	Rhyolites	w. r., biotite (3)	32.20±1.24 - 31.79±1.21
4.	Levocevo caldera E-	Latites	w. r. (3)	33.4±1.4 - 30.2±1.3
	W dyke swarm	Felsitic rhyolites	w. r. (1)	30.9±1.1

Remark: in brackets - the number of age determinations.

The ages obtained could be interpreted as follows:
1. Taking into account the existing Chattian literature age data on some dykes, they could be regarded: a) as an evidence, that the swarms were intruded in two separate periods, the first - Early-Middle Rupelian (about 33 - 30 Ma), coinciding with the period of the paroxysmal magmatic activity in the Bulgarian segment of MRNAMZ and the second - Chattian; b) as a call for a revision and re-evaluation of the present days concepts on the age of the Rhodope bimodal sublongitudinal dyke swarms.
2. The Early Rupelian intermediate dykes were the main feeding channels for the respective Eastern Rhodope extrusive rocks. This conclusion agrees with petrologic data, proving that the intermediate lava flows from the vicinity of the village of Bezvodno (Eastern Rhodopes) were supplied by some of the Zagrazhden swarm dykes.
3. The new K-Ar ages combined with the macro-, and meso-structural data on the sublongitudinal dyke swarms show that, during the Early - Middle Rupelian the geologic development of the Eastern - Central Rhodopes was controlled by a stable extensional regime with sublatitudinal main tension axis.

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TIMING OF THE NEOGENE SILICEOUS EXPLOSIVE VOLCANISM IN NORTHERN HUNGARY

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The stratigraphic position and chronologic conclusions of earlier K-Ar datings on the Miocene acidic pyroclastic rocks in Hungary have been summarised by Hámor et al. (1979). The aim of this paper is to discuss the space and time distribution of siliceous calc-alkaline volcanism of Northern Hungary (NH) on the basis of new geochronological, paleomagnetic, petrological and volcanological data. In the study area a large proportion of acidic volcanic rocks are not interbedded with fossiliferous sedimentary rocks. Due to this fact, a reliable correlation of temporal distribution of the different acidic volcanic episodes in NH is only possible using the radiometric and paleomagnetic dating.

K-Ar data indicate that siliceous explosive volcanism developed from Eggenburgian to Uppermost Sarmatian times (21.0-11.0 Ma). Within this interval, the evolution of acidic volcanism can be divided into three main magmatic episodes: Lower Tuff Complex (LTC), Middle Tuff Complex (MTC), and Upper Tuff Complex (UTC), respectively. They are well separated by paleomagnetic declinations of their volcanic products (80° 30° and 0° respectively). With the available radiometric, geochemical and petrological data it is possible to demonstrate that each of the three tuff complexes consist indeed of several eruptive pulses. However, it is impossible to determine the periods and intervals of quiescences between the episodes of activity, because of the overlapping of the analytical ages.

Occurrences of volcanic products belonging to the LTC are known in the Nógrád Basin, in the Mátra Mts. and in the Bükk Foreland. The most intense activity of Neogene acidic volcanism was the eruption of MTC, which is also the most widespread: it can be recognised in the Börzsöny-Dunazug Mts., in the Nógrád Basin, in the Cserhát and in the Mátra Mts., in the Borsod Basin and in the Bükk Foreland. The UTC started to erupt near the Sarmatian-Badenian boundary and ceased near the Pannonian-Sarmatian boundary. Sporadic spots can be found in the Cserhát and in the Mátra Mts. and in the Bükk Foreland, but the largest volume was erupted in the north-eastern Hungary.

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GEOCHEMICAL STUDY OF THE OILS AND THE SEDIMENTS FROM THE WEST AND THE CENTRAL BALKANIDY

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A lot of oil and gas showÿ are encountered in the West and the Central Balkanides. The subject of this study are the ones aged Late Jurassic-Early Cretaceous and their associated sediments.

The oils from Bely Izvor and Cherny Vrah areas and the organic matter (OM) within the Late Jurassic-Early Cretaceous rocks are investigated by standard organic geochemistry scheme.

The Bely Izvor" oil is characterized by the following features: mixed type of source biomase with prevalence of saproppel; marine restricted deposition environments; full maturity and presence of oleanane which is appeared to be an age marker. The oil doesn't display the "classic carbonate" characteristics, neither CPI nor Pr/Ph values are as low as in typical carbonate, may be assume to be aged Cretaceous or younger.

The "Cherny Vrah" oil is derived from sappropelic type organic matter deposited in a reducing environment. Maturity related parameters indicate fully mature source rocks. The oil display some of the classic carbonate characteristics (the low Pr/Ph ratio, low CPI , low waxiness).

The Late Jurassic-Early Cretaceous sediments, of carbonate type prevailingly, contain low to fair TOC abundance in the Central Balkanides. The genetic type of the organic matter is different reflecting the deposition environment variance. The source biomase was from prevalent algal to the prevalent higher plants, and deposition environment varied from the marine/reducing to the terrestrial/oxidizing. Slight reducing/shallow marine environments with little influx of terrestrial material prevailed. The rocks are within the oil window.

Regardless of the oil-prone prevalence and the maturity levels, the oil-generation potential of the Late Jurassic-Early Cretaceous sediments is not significance in the West and Central Balkanides.

Both oils are derived from sediments of different age and/or beyond the West and Central Balkanides. The presence of oleanane may be due to migration through the Cretaceous rocks to the reservoirs.

ANALYSIS OF THE SEDIMENTARY DISCONTINUITIES IN THE "GAS FORMATION" FROM TRANSYLVANIAN BASIN

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Geological and geophysical researches represented both by field geological and geophysical works as well as drilling - show that "gas formation" is represented by a molasselike monotonous succession which consists of both detrital-terrigenous and pelitic-psammitic deposits with thin intercalations of volcanic tuffs. This sequence consists of deposits of the Badenian, Sarmatian and Buglovian age. It covers salt deposits of the Badenian age . If to "gas formation" the salt deposits from its basal part as well as the Dej tuff from its upper one are added, it may be considers that this formation is delimited by two important stratigraphic unconformities: first is encountered at the basal part and corresponds to Uppermost Burdigalian during whom was not deposited sediment and second is situated at the upper one and it is the result of the uplift and erosion during Kersonian and Lowermost Meotian. These important unconformities are well known by the geologists that worked in Transylvanian Basin.

In this paper, the authors have demonstrated the presence of the others sedimentary discontinuities in the "gas formation". This results are based mainly by detailed analysis of the boreholes data in correlation with the geophysical informations (well logs and some seismic profiles). The best results have been obtained from the SP logs that have been filtered for the elimination of the random noises. These discontinuities have been identified in the southern and eastern part of the Transylvanian Basin at the boundaries of the Buglovian/Badenian and Sarmatian/Buglovian stages that compose the "gas formation". In the central part of the basin, the sedimentation could be continuum in overall Late Miocene. This part of the basin will be studied later.

In the different zones analyzed of the study area, the erosion was selective. During of the discontinuities development, the rock thickness that has been removed is very variable. The greater thickness was removed from the Badenian deposits. It exceptionally may to reach 400 m, but in average, the erosion removed only 100 – 200 m. Sedimentary discontinuities are marked by unconformities and their role in gaseous hydrocarbon yet are not well known. Thus, the "gas formation" consists of three sedimentation minicycles. In the gaseous hydrocarbon generation evaluations from the Transylvanian Basin must be well known these depositional discontinuities, because the temporary uplift have a certain influence on the thermal regime of the Latest Miocene sediments. Micropaleontological analysis of the Latest Miocene deposits may to confirm the conclusions of this paper. In addition, the stratigraphic traps formed by pinches out of the psammitic complexes are very important in accumulation of the gaseous hydrocarbons.

HYDROGEOCHEMICAL AND GENETICAL PARTICULARITIES OF GEOTHERMAL SYSTEMS IN THE STRUMA VALLEY (SW BULGARIA)

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The present complex investigations are aimed at defining the consequences of the influence of recent igneous phenomena on genetic processes acting in the „thermal water-gas-silicate rock" system (in its hydrogeochemical evolution) along the structural depression of the Struma River (Southwest Bulgaria). This influence is imposed on the hydrogeochemical behavior of an important number of trace elements (52 ones) and gases (together with all physico-chemical characteristics), present in deep high-temperature geothermal systems in the valley and these modifications appear with important indicator possibilities. The pre-dominating N_2-bearing thermal waters of deep circulation are related to tectonic fault zones and their deep reservoir is situated in the fissured Hercynian granites, introduced in the Proterosoic and Archaic metamorphic complexes. The most recent volcanic rocks (Miocene) constitute the extinct Kojouh volcano and the significant presence of CO_2 (up to 88% of the gaseous phase) is related to the igneous and thermometamorphic processes. The results obtained show that this enrichment in CO_2 (relative to the normal N_2-rich gas background in the valley) has an important „deformation" action on the overall fluid composition and during the evolution of the dynamic system: „rock⇒solution⇒suspension⇒deposit at the emergence" as follows:
1) The aggressive behaviour of CO_2, increasing in the thermal waters from north (pure N_2-rich hydrotherms) to the south (volcanic influence) superposes it important deforming action on the primary water and gas composition; the macrochemical character of the thermal waters significantly changes with closeness to the volcano. The lowest pH values correspond with the lowest resistivity R_x, highest Eh and PO_4^{3-} values; 2) Concomitantly with the relative increase of CO_2 content, near the volcano, the gases: N_2, Ar and spontaneous and dissolved He decrease and attain minimal values, as well as the He/Ar ratio, pointing to a shorter residence time for CO_2-thermal waters (from >7Ma for N_2 hydrotherms to 0,6 Ma for the CO_2-containing ones); 3) The CO_2 influence leads to a new trace elements distribution and behaviour in the thermal waters. The specific paragenesis of deep fluids in contact with crystalline rocks (Li, Rb, Cs; W, Ge, Ga, Mo; F, Be, V, Sr/Ba) and their typochemical ratios and correlations) are significantly affected. Be, B, As, Sb, also Au, Tl, Se, Ag and In have a typical increased content in thermal waters, „rejuvenated" by CO_2; they are indicative of the genetic deviations, linked with the post-volcanic action. The dissolved heavy metals and the REE are enriched here relative to the alkaline - N_2-waters, in which these elements are transported mostly in suspension; 4) The reactions in the „rock-water system are displaced to the right (with an inhibition of secondary sorption processes) by the elevated CO_2 content. The Na^+-HCO_3^- model leachates are enriched relative to the host rock in W, Ge, Mo and mostly Li, V, Sr and Sn, Ni, Pb, Ag; also in B, As, Bi, Cu and Zn - near the volcano. The sulphide and polysulphide trace elements species are replaced by bicarbonate and carbonate forms, and often - by their simple ionic form. The speciation of the specific trace elements, having a good mobility in the alkaline hydrotherms (with a negative asymmetric distribution) is selectively altered (simple cations together with typical anionogenic and complex species). The migration in the CO_2-rich waters is preferentially controlled by the minerals: chalcedony, barite, sepiolite, magnesite, etc., whereas for N_2-waters fluorite, aragonite, calcite, chalcedony and covellite are nearest equilibrium; 5) The experimental study of the „water-rock" interaction processes presents the genetic (primary and secondary) argument for all observed hydrogeochemical phenomena. The results of the modeling demonstrate the decisive role of the interaction on the formation of the primary („granitic") analogous composition of all thermal waters in the area. It is the secondary influence of CO_2, linked to the more recent volcanism, which modifies this primary composition and an in a larger sense one can treat it is a new system: „thermal water- CO_2-solid phase"; 6) Empirical chemical geothermometers indicate a T_{depth}< 90°C, whereas for the N_2-hydrothermes it is about 130°C; 7). The Tertiary and Quaternary deposits near the surface can play a secondary decisive negative role on water migration process: it mostly consists of geochemical migration barriers, „refreshing" the thermal water, but the elevated CO_2 content displaces the reactions in the „water-solide phase" system to the aqueous phase, with a significant inhibition of secondary sorption and precipitation processes.

The complex „deformation" of the composition of the „pure" type of N_2-bearing alkaline waters from deep granitic reservoirs in the very rich in hydrotherms Struma Valley can be considered as a reflection of the changes and the processes (both primary and secondary) acting on the thermal fluid at depth and during it ascent to the surface. This knowledge can facilitate the resolution of the inverse problem: to discover and reconstruct, by means of these new indicator criteria, all the genetic stages of the formation of the hydrothermal systems and their influencing factors and processes.

RECENT SEDIMENT IN THE IRON GATE I - ECOLOGICAL RISK ASSESSMENT

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Separation of suspended material from the water phase and deposition of sediments is a process which has led throughout geological evolution to creation of enormous spaces. This process has recently run along with deposition of new sediments of various characteristics. Composition of new sediments depends on numerous factors either natural or anthropogenous in origin. Formation of sediments in energetic water reservoirs with backwater effects represents a specific problem. The water reservoir of the hydroelectric power plant Djerdap I (Fig. 1.)is an example where have been studied phenomena of intensive deposition producing sediments of the finest structure with high content of organic material, then with effects of accumulation of the most variable kinds of detrimental and dangerous materials, potentially dealing as a chemical time bomb.

Here is particularly to be emphasized the efficiency of deposition of the fine allochtonous material with enormous separation of planktonic mass and with accompanying processes, among which degradation of the oxygen regime in the water reservoir is prominent, certainly representing, along with concentration of toxic materials, one of the key phenomena exhibiting in the recent day generation of deposits in the run-of-the river reservoir. By the newer screen analyses of suspensions in the downstream sector of the Djerdap I water reservoir have been yielded data on enormous effects, on high grade water purification with extraction of suspensions averaging 9 μm in size.

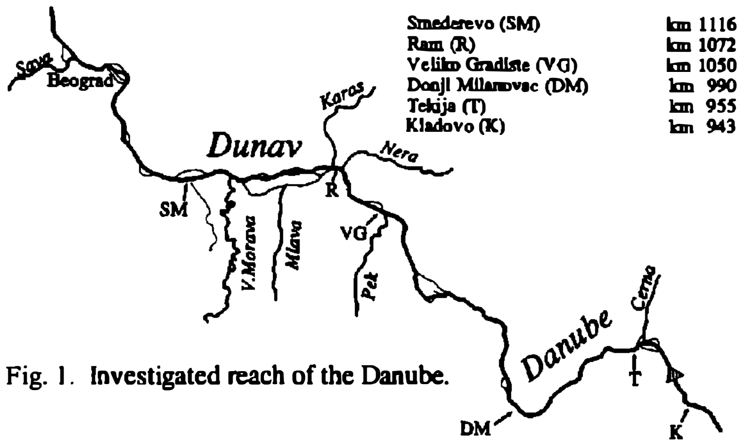

Fig. 1. **Investigated reach of the Danube.**

Data on macrocomposition of sediments, as well as the X-ray analysis give a more complete notion on the new sediment which essentially represents a material with non completed mineralization process, as a consequence of high organic background and decelerated anaerobic kinetics enrolling in the domain of a low redox potential, where as electron capture medium occurs the sulfate already in the subsurface layer at the depth of 20-50 cm. Analyses of sediments to the depth give data on moderate mineralization effects, of an order of magnitude 20% for the 50 cm layers, in the subsurface column up to the depth of 1.5 m.

Table 1. Composition of sediment near Donji Milanovac

Depth (m)	SiO_2 %	Al_2O_3 %	Fe.oks %	FeS %	MnO %	MgO %	CaO %	K_2O %	Na_2O %	HPK $ppmO_2$
0.3	49.60	16.55	7.32	1.13	0.14	2.71	6.55	2.12	0.79	87.500
1.4	48.10	18.10	5.21	2.83	0.13	2.90	7.24	2.47	0.74	78.000

The following mineral species have been identified by the X-ray measurements, according to degree of abundance: quartz, calcite, clay minerals, feldspars and dolomite. Quartz is predominant relative to other minerals, and clay minerals are, after the decreasing range: illite, chlorite and montmorillonite.

The results of mineralogical composition, beside notion about representativity of the catchment, give data on efficiency of the deposition process in the Djerdap water reservoir, but also records on numerous causes of these processes generated by high organic production at the top of the run-of-the-river, as well as by consequences of the whole process of the water purification in the Djerdap I lake, impacting to the ecosystems in Black Sea.

CORRELATION AND SEDIMENTARY HISTORY OF THE BADENIAN GYPSUM IN THE CARPATHIAN FOREDEEP (UKRAINE, POLAND, AND CZECH REPUBLIC)

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In the middle Miocene Badenian evaporite basin of the Carpathian foreland basin, broad zones of sulphate deposits occur in the marginal parts, and narrow zones of chloride sediments are restricted to the basin centre. The origin of these evaporites is related to the salinity crisis at the end of Middle Badenian. The time and facies relations of evaporites occurring in marginal and central parts of the Carpathian foreland basin are still unclear and different correlation have been proposed for particular parts of the basin (*e.g.* Petrichenko *et al.*, 1997). However, it is possible to correlate particular marker beds in both domains over a distance of hundreds of kilometres (*e.g.* Garlicki, 1994; Peryt *et al.*, 1994, 1997) suggesting common controls of evaporite deposition regardless of the geological setting.

In the lower part of the gypsum section in the peripheral part of the basin, a unit built of blocky crystalline intergrowths occurs. Towards the basin margins, its place is taken by unit of stromatolitic gypsum; the transitions between both units have been recorded in West Ukraine. Above, a characteristic, thin (10 – 40 cm) bed of microcrystalline ("alabastrine") gypsum occurs; in many places its occurrence is preceded by a few thinner beds of microcrystalline and/or stromatolitic gypsum intercalated with selenitic gypsum. Higher up, a unit of sabre gypsum occurs. This unit contains, in its upper part, a thin (usually 10 cm) intercalation of clastic gypsum. Towards the basin margins the stromatolitic gypsum is the facies equivalent of sabre gypsum, and possible counterpart of clastic gypsum intercalation is a lenticular layer/lamina of limestone occurring in some sections. This limestone has $d^{18}O$ and $d^{13}C$ values that are characteristic for contemporaneous marine limestones. The upper part of the gypsum sequence consists of interbedded laminated gypsum, gypsiferous claystones and gypsum breccias. The redeposition phenomena are common in that part of the gypsum section. In the central part of the basin, the place of gypsum is taken by anhydrite, the redeposition features abound throughout the entire sulphate section that is built of laminated anhydrite intercalated with anhydrite breccia.

The middle Miocene Badenian gypsum of Carpathian Foredeep was mostly deposited, in the lower part of the stratigraphic section, in a vast brine pan. This brine pan was characterised by a facies mosaic that reflects an interplay of concentrated brines from the central part of the evaporite basin and diluted brines, possibly due to the influx of continental meteoric waters (Peryt, 1996). Although individual depositional features and facies types in the Badenian may be explained by comparison with modern salinas (*e.g.* Orti Cabo *et al.*, 1984), lateral persistence of thin beds over large areas with only minor changes in thickness and facies indicates that they formed on broad, very low relief areas which could be affected by rapid transgressions. A similarity of evaporite facies through the Badenian basin seems to be related to an extrabasinal control that did not obscured important local and regional tectonics. Intrabasinal marker beds occurring in the evaporite sequences record distinct phases of brine body evolution (frequent refreshing episodes) or diagenesis related to subaerial exposure.

In the peripheral part of the basin, gypsum is overlain by marine limestone (Ratyn Limestone); the boundary between gypsum and limestone is the sequence boundary, and gypsum deposits prior to limestone accumulation underwent an important faulting phase and subsequent erosion.

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DRAFT COPY OF METALLOGENETIC MAP OF F.R. YUGOSLAVIA SCALE 1:2,000,000

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Model of metallogenetic development is in fact step forward of the concept of geotectonic evolution. By metallogenetic analysis model is chosen for establishing time and space of creation of ore and ore-bearing formations.

So far there is no accorded model of global geotectonic and metallogenetic development. Definitive solution is hinted through a variation of Mobilistic concept, most probably in Geodynamic model, based on physical phenomena: phase changes and rotation of Earth, conditioning, permanent continental drift, meaning, perpetual opening and closing of seas and oceans.

In SE Europe region and even wider, from the Alps to Himalayas, and further, towards the east and west, in the past there were relatively short shallow continental seas: Tethys and Palaeotethys. The coincidence of these aquatoriums and Tethyan-Palaeothethyan metallogenetic belt is definitely not occasional. The problem was to explain the mechanism of creation and disappearance of these seas and the connection with magmatism and metallogeny.

The continents in solid state move very slowly by spreading along systems of horizontal and micro- and macro-planes. On such style indicate geophysical investigations (several hundreds of planes of discontinuity were established) but also schistosity of metamorphic rocks in deeper and granulites in deepest parts of continental crust. By spreading depressions, seas and oceans are created. The feature of aquatoriums is reduced continental crust, fragmented periditotic zone (incorrectly designed as basalt oceanic crust) and thinned upper mantle. These are the areas of dilatation and parting of voluminous rock masses (several hundred millions up to tens of billions tons per square kilometer), in fact areas with distinct decrease of lithostatic pressure. Astenosphere relieved of pressure very easily undergoes phase transition into magma, expands its volume, forms domes and primary magma chambers, sources of basic magmatic complexes. Submarine facie is easily recognized, these are volcanogene-sedimentary formations and specific ore deposits: pyrite-chalcopyrite, polymetallic with and without barite, skarn magnetite, volcanogene-sedimentary iron and manganese and others. Easily is also identified commencing stage of geotectonic cycle. By the way, we divide cycle into two stages: commencing and terminating, meaning two metallogenetic epochs.

Once formed magmatic centers of basic magma are active for a length of time, for several hundreds million years. Evencrust, 30 or more kilometres thick. In the newly formed platform conditions secondary magmatic chambers are formed. Therewith continental crust is the screen to primary basic magma and its partial melting enables hybridization and a suite of magmatic rocks of volcanogene-intrusive granodiorite complex. Perpetual drift of lithosphere and difference in velocity of motion of surface lamellae in relation to the level of secondary chambers enables lateral zoning of thermal and magmatic fronts in time and space, actually regular interchange of mineral and geochemical parageneses. In the terminating stage of the cycle interesting ore deposits are created: porphyry, massive sulphide or vein of copper and gold, metasomatic or vein of polymetals, antimony, arsenic, volcanogene-sedimentary and vein of magnesite, chrysotil asbestos and others.

The basic unit for regional classification is province (space) which corresponds to geotectonic cycle (time). Higher order unit is polycyclic belt, while lower order unit structural-metallogenetic zone, actually epoch. Detailed metallogenetic classification includes: ore regions, ore fields, deposits and mineralizations.

The classification of regional metallogenetic units is shown together with the legend of ore formations for the map of Yugoslavia scale 1:2,000,000:

TETHYAN-PALAEOTETHYAN METALLOGENETIC BELT

Tethyan province (cycle)

Alpine structural-metallogenetic zone (epoch)

A_4 Marine and limnic sediments
A_3 Volcanics
A_2 Granodiorites
A_1 Terrigene-calcareous, flysch and coal-bearing formations
Mz Peridotites (Cold intrusions)

Kimmerian structural-metallogenetic zone (epoch)

Km_2 Volcanogene-sedimentary formations
Km_1 Terrigene-calcareous formations

Palaeotethyan province (cycle)

Hercynian structural-metallogenetic zone (epoch)

H_2 Granitoids
H_1 Terrigene-calcareous formations

Caledonian structural-metallogenetic zone (epoch)

C Volcanogene-sedimentary and terrigene formations

Proterozoic

Pr Metamorphic rocks

Analysis of space is performed by drawing formation maps. For regional metallogenetic maps satisfactory results are obtained by synthesis of data from geological maps scale 1:100,000, while for detailed ones a more academic approach is necessary, in addition to the results from field and laboratory investigations.

It is necessary that the metallogenetic map is as simple as possible, easily readable and understandable even to non-specialists. The degree of detailing depends on the scale of the map and the surface it represents. During the preparation of the Metallogenetic map of Yugoslavia scale 1:2,000,000 some restrictions were necessary. The favourable circumstance is that all significant Yugoslav deposits belong to Alpine epoch, structural-metallogenetic zone. This is the reason why we have shown it. Beside that we have also presented contours of endogene oreregions ring structures. The deposits of earlier epochs are either small and economically insignificant or insufficiently researched and investigated so that we have excluded them.

The basic aim of our researches was establishing of metallogenetic evolution on the territory of Yugoslavia, even wider, SE Europe. The method consisted of logical connecting of causes and consequences which resulted in a metallogenetic model which explains regularities of creation and disposition in time and space of ore deposits of the investigated region. **Geotectonic model is based on good old ideas of two prominent geologists, Stille and Wegener, from the brilliant group of European geological school.**

RECONSTRUCTION PETROLOGICAL RESEARCH OF THE BRONZ AGE STONE CULTURES SOURCE OF RAW MATERIALS

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Sánchegy, South-West of Budapest rises in the region of Százhalombatta-Ófalu, on the right side of the Danube. This flood-free bank is built of argillitic, sand and marl layers. The settlements of Nagyrév and Vatya culture from the Bronz Age have been excavated since 1963. The date back to 1800-1400 B.C. The aim of our research was to test the materials of these cultures stone implements establishing their original quarry. A lot of chipped and polished stone implements, grinding stones, weight stones, cast moulds, stone axes, sickles and other industrial and architectural stone objects were found in the material. We performed examinations which differ from the traditional methods (mineral- and rock analysis, main- and trace elements, X-ray, other special examinations).

We found Carboniferous granite from the Velence mountains (Velence Granite Formation), different types of Miocene andesites from the Visegrád mountains (Matra Andesite Formation) and different age (Permian, Oligocene, Miocene) sandstones and fine-grained conglomerates among the grinding stones. The most typical material of the stone axes was the above mentioned andesites, however, besides them we found various serpentinized dolerites (Budakeszi Picrite Formation and subordinately siliceous shale quartzites as well). A large amount of stone blades, sickles and scrapers were excavated and their materials are flintstone and hornstone which can be found in some of the formations of Buda Mountains and Gerecse. Among these tools (1-4cm in size) a small amount of jasper bar as well as bone- and shell fragments were also found.

The most exotic and unique groups from the rocks used for tool making are the serpentinized basalts. Their small porphyritic, microcrystal subophite texture indicates that they are dyke rocks. Their materials underwent various contaminations and hydrometasomatic effects near the surface, so their geochemical character is ultrabasic and basic, partly calc-alkaline partly alkaline. The transformation increased their toughness and polishability but did not decrease their stability significantly. We can see whimsically changing large Mg and Fe contents together with high concentration of heavy metals typical of ultrabasics. In the chrystal phase there appear smectite, illite, kaolinite, tremolite, albite, cummingtonite, chlorite, muscovite, maghemite, baumite and, in part, chrisotile as well as amorphous phase subordinately.

On the basis of the identified localities the most likely area of movement the tool makers was the Dunazug mountains and its environs. So it is a fan shaped area, with a radius of 50 km, however they may also have reached the territory of the Velence mountains and the Western side of the Balatonfelvidék.

ALLANITE – MONAZITE DICHOTOMY IN GRANITOID MAGMAS: THE ROLE OF WATER AND REE CONTENT

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Dichotomy of allanite and monazite, the main LREE minerals in granitoid magmas, is a long established fact (Vernadsky 1929). The main reason for this is usually sought in the Ca^{2+} activity (Lee and Silver, 1964): allanite forms in the rocks with higher CaO contents.

The detailed study of Variscan S- and I-type granitoids in the Western Carpathians revealed that while the former are characterised by the assemblage monazite ± ilmenite the latter is dominated by allanite + magnetite ± titanite. Albeit allanite is typical of I-type tonalites, a rare example of allanite in S-type granodiorite was found in the Tribeč Mts. (Broska, Petrík and Williams in prep.) Mainly on the basis of biotite composition Petrík and Broska (1994) characterised the I-type tonalite magma as relatively oxidised and water rich (up to wt. 5 % H_2O), and S-type granodiorite magma as reduced and water poor (3 wt. % H_2O) both magmas being vapour-absent. The association of allanite and monazite with rocks showing contrasting water and oxygen regimes offers a possibility of more complex interpretation of their dichotomy.

Numerous experiments with granitic melts at various water contents (e.g. Whitney 1975) showed that phase boundaries (crystallisation temperatures) of quartz and feldspars fall steeply with increasing water content. Monazite saturation temperatures also depend on water contents (Montel 1993) and in T-H_2O space show a slightly different pattern: while they drop steeply from 0 to 1 % H_2O, they decrease much slower at higher H_2O crossing all anhydrous phases boundaries.

In a low H_2O, S-type magma early crystallisation of plagioclase causes the drop of Ca^{2+} activity in melt. Because monazite saturation temperatures strongly depend on total REE contents, generally lower REE in S-type granitoids cause monazite to precipitate at a temperature lower than that of plagioclase. At ca. 3 % H_2O only very high total REE would enable a REE phase to precede plagioclase: this is the case of Tribeč S-type granodiorite with total REE = 259 ppm, where allanite is included within monazite. Here, the replacement of allanite by monazite is explained by the onset of plagioclase crystallisation.

A different situation is in a water rich I-type magma where plagioclase starts to crystallise at lower temperature. Although allanite saturation temperatures are not known, generally higher REE contents in Western Carpathian I-type tonalites suggest that allanite is stable at temperatures higher than those of plagioclase, in magma with still high Ca^{2+} activity.

Thus, as the crucial factors decisive for the granitoid magma to precipitate allanite *or* monazite are seen: (1) water content influencing Ca^{2+} activity *via* plagioclase crystallisation and (2) total REE content determining the saturation temperature of both REE phases. Relatively low water and REE contents favour monazite in S-type granitoids. By contrast, higher water and REE contents cause allanite to be typical of I-type tonalites.

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SAGENITIC TYPE ILMENITE INCLUSIONS IN INTERSTRATIFIED PHLOGOPITE-VERMICULITE FROM ICHTIMAN REGION

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Though the presence of "sagenite" in altered biotite and in chlorite formed by biotite altering is common, sagenite is identified only optically under a microscope. Studying sagenitic type titanite and rutile inclusions Shau et al mentioned the presence of ilmenite and apatite inclusions in biotite. Cardile and Slade, using Mossbauer spectroscopy to study vermiculites, suggest that the oriented growth of ilmenite in the vermiculite is quite a common phenomenon. The conclusion was made on the basis of Mossbauer spectrum analyses but optically visible inclusions were not observed.

Materials. Micas, interstratified mica-vermiculites and vermiculites from Ihtiman region were studied. The monomineral or almost monomineral fractions were extracted from the inclusions contained flakes.

Results and discussions. According to their morphological characteristics the inclusions can be divided into two groups: Lath-shaped inclusions forming a net of equilateral triangles; elongated and isometric inclusions of geometric or irregular shape. Some of the inclusions are not ilmenite but they are not a subject of this paper. The inclusions vary from 1 mm to 2 cm in length and from smaller than 0.1 mm to 70 (100) mm in width. Their thickness cannot be defined precisely, yet it is about 0.03 to 0.1 of the width.

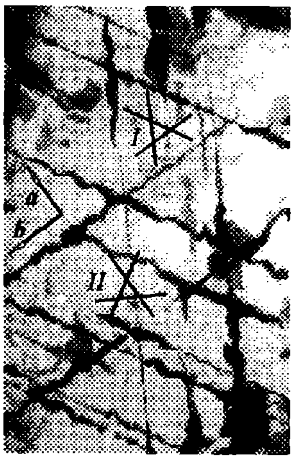
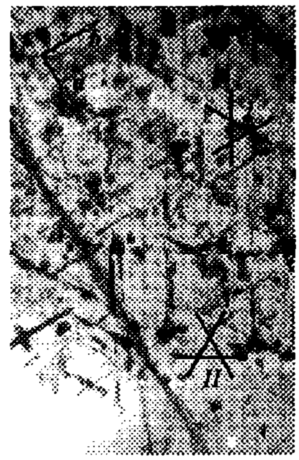
Fig. 1 

Fig. 2 

Ilmenite inclusions in interlayered phlogopite-vermiculite from Ihtiman region (x 100):

Fig 1 Specimen Bsch 4/89 from Boschourat deposit;

Fig 2 Specimen Bk 275 from Belyia kamak deposit;

I - Directions of net (I);
II - Directions of net (II);
a, b - Directions of crystallographic axes of the layer phlogopite-vermiculite

The equilateral triangles are formed by three sets of parallel lath-shaped inclusions. The nets are in the {001} plane of the interlayer silicate (Fig. 1). The first impression is that the lath-shaped inclusions are straight (Fig. 2). In fact their shape is much more complex - it is wavy or step-like (Fig. 1). The most of the inclusions do not intersect in the same plane but lie cross-wise in different, though very close planes parallel to {001} of interlayer silicate.

It was available to determined *a* and *b* crystallographic axes directions, using conoscopy. Then it becomes clear that a set of lines in net (I) is parallel to *b* in the layer silicate, while a set of lines in net (II) is perpendicular to *b* (Fig. 1). The inclusions with a regular shape are represented by hexagons or such extending in the direction of or perpendicular to one of the axes, either a_1 or a_2 or a_3. The shape of the inclusions is specific for the specimens from the different deposits.

The X-ray diffraction patterns obtained from textured and non-oriented preparations revealed that the plane {0112} is the best developed and is parallel to the X-ray preparation plane. On the basis of optical microscopy and the X-ray diffractometric study it may be concluded that one of the axes (a_1, a_2 or a_3) is perpendicular to *b* and the ilmenite crystals grow either parallel to an axes a_1 or a_2 or a_3 with preferably developed {0111} or {0112} perpendicular to an axis a_1 or a_2 or a_3 with preferably developed {1121} or, though very rarely, preferably developed some other forms {1431} (Fig. 1). Judging by the morphology of the inclusions one can suggest a well developed (0001).

The ilmenite crystals can grow in the direction of mechanical anisotropy in the structure of layer silicate, e.g. parallel to the cleavage and parting. As a result they grow in plane {001} and form bands dislocated in three sets of parallel lines intersecting at angles of 60° and one of the sets is parallel to *b* (along net I). The small ilmenite crystals have preferable orientation of growth at an angle of 30° to the band itself (along net II).

Though plenty of unweathered phlogopite crystals were studied as well as fully vermiculitized ones, no sagenite type inclusions were found there. On the grounds of all this one can conclude that the ilmenite inclusions develop in exogenic conditions and their orientation depends on the layer silicate structure. Their formation is closely connected to the structural and chemical changes during the process of weathering (phlogopite - interlayer phlogopite/vermiculite - vermiculite).

QUARTZ, PRIMARY FLUID INCLUSIONS, AND ORE DEPOSITIONAL PROCESS IN THE RHODOPES Pb-Zn DEPOSITS, SOUTHERN BULGARIA

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More than 40 Tertiary Pb-Zn deposits have been mined throughout the last decades in the Rhodope Mountains Southern Bulgaria. The deposits are widespread in two regions: 1/Central -Rhodopes with geological environment represented by gneisses and marbles (vein and methasomatic type); 2/Eastern-Rhodopes with a geological environment represented by thrahyandesites and rhyolites (vein type).

The main ore minerals of the deposits are galena, sphaleryte and piryte. The major gangue mineral is quartz (Qz) with a variety of massive structures. Druses of Qz, amethyst and chalcedony like Qz also occur. The predominant part of the Qz has formed relatively simultaneously with the ore minerals. The fluid inclusions in the ore associated Qz are two phases gas and liquid. The Thom is 290-270 and 270-250 °C respectively for the Central and Eastern Rhodopes. The salinity is low - 6-2 ecv. of NaCl for both regions.

The ore associated Qz has two important special features. One part of it is transparent and has a water-clear color. The other one is nontransparent and has a primary white color, being due to a great number of primary fluid inclusions. The latter have linear arrangement perpendicular to the rhombohedral faces of the quartz crystals.

The ore minerals occur exclusively together with the bulk of transparent Qz, and occasionally at the boundary between the transparent Qz and the white Qz. This successive mineral formation is reflected in the distinct zonality of the ore bodies and infers a rhythmic evolutionary development of the ore deposition process in isothermal conditions.

AGE AND METAMORPHIC EVOLUTION OF METAGRANITES FROM KESSEBIR REKA REGION, EASTERN RHODOPES - Rb-Sr ISOTOPE DATA

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Metamorphosed granites from the region of Kessebir reka in the Eastern Rhodopes of Bulgaria are investigated by the Rb-Sr isotope method. Previous petrological and geochemical research (*Ovtcharova, Sarov, 1995*) permited to characterize them as S-type (Kessebir equigranular and porphyroclastic metagranites) and I-type (Metaplagiogranites). Both types are deformed and locally mylonitic. Mesoscopic and microscopic characteristics of the deformation (shear-sense criteria) are well developed in the Kessebir metagranites and indicate top to the northeast sense of shear. The two types metagranitoids belong to different tectonic units - Kessebir metagranits to the lower one (the so called "Strazhetsko-Belorechka"), and the metaplagiogranites - to the upper one.

The opinions about the age and evolution of the granites differ largely. Long time these rocks were considered as Archaic (Kessebir metagranites) and Proterozoic (metaplagiogranites) migmatites and anatectites (*Kozhoukharov, 1987; etc.*). Accordingly to *Burg et al. (1996)* they belong to the Intermediate terrain of the Rhodope Massif and have Alpine age of emplacement and subsequent deformation.

Whole rock samples were investigated by the Rb-Sr method to determine the age of the granites. The data for the equigranular and porphyroclastic Kessebir metagranites allow us to calculate an isochrone, which slope determines an age T=328±25 Ma and $(^{87}Sr/^{86}Sr)_i$=0.7065±0.0006. (Fig 1, a.). It is parallel to the isochrone of the Bjala-reka-metagranites and this fact supports its unification in one tectonic unit - the lower one. Having in mind the numerous data (including isotope data) for the mainly Alpine activity of the Rhodope region (deformation, metamorphism, granite fonnation) it is suggested, that Hercynian crustal fragments are involved in the tectonic processes in Alpine time.

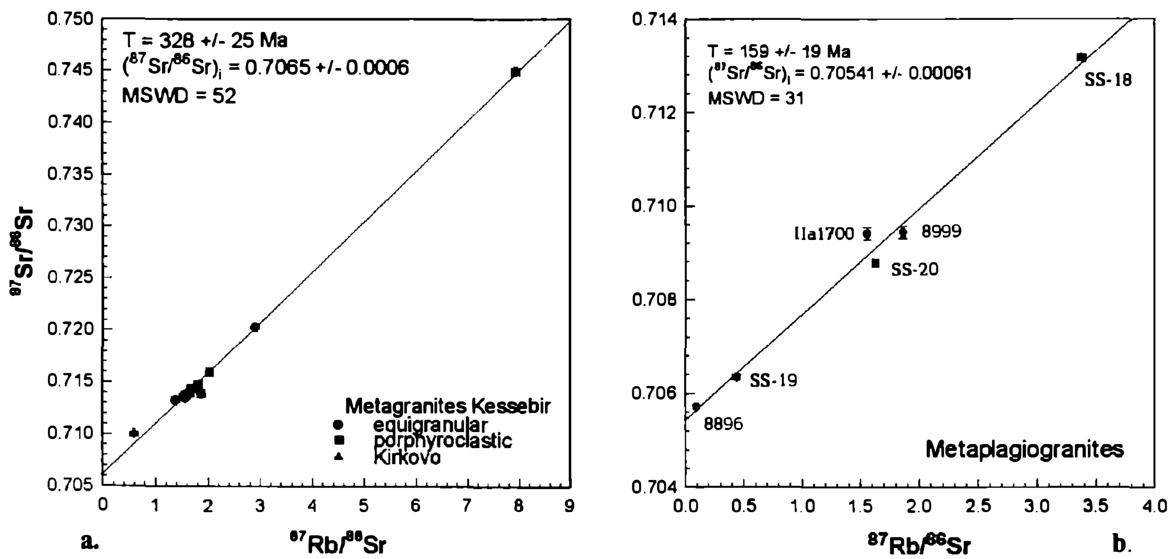

Fig.1 Rb-Sr plot for whole rock samples of metagranites from Kessebir reka region, Eastern Rhodopes

Not only the whole rock, but also the mineral Rb-Sr system of the metaplagiogranites was researched. Two minerals - biotite and plagioclase and the whole rock sample SS-18 determine an age T=34±5.3 Ma and typical crustal initial ratio $^{87}Sr/^{86}Sr_i$=0.71146±0.00015 for the metamorphism in the region. This age is interpreted as cooling age and the end of the metamorphic process.

The Rb-Sr isotope whole rock data of the metaplagiogranites determine an age T=159±19 Ma and initial Sr ratio $(^{87}Sr/^{86}Sr)_i$=0.70541±0.00061. (Fig.1, b.). We considere these data as the time of the emplacement of the granites, while the deformation and metamorphism carried out in or up to Late-Alpine time (proved by the mineral isochrone). The low initial strontium ratio is in agreement with the geochemical data and confirm the mixed mantle-crustal source of the magma. The same Sr-ratio is measured in the host metagabbro of the metaplagiogranites, so it can be suggested, that these rocks make a magmatic series, generated perhaps in an island arc or back arc basin.

KIMMERIDGIAN-NEOCOMIAN IN TAMARA REGION (NORTH ALBANIA)

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In the Tamara region (Albanian Alps zone, north-west Albania) thick carbonate platform deposits of the Triassic, Jurassic and Cretaceous are encountered. This well exposed section, in the upper part gradually passes into red and gray marls of Paleocene and over them Eocene flysch deposits occur (Selca village) [10,4,8,3].

The Kimmeridgian sequence, in the low part, is represented by intraformational limestone breccia. They pass into limestones of the wackstone-packstone facies, alternated here and there by diagenetic small chert lenses and nodules. Over them continue limestones of the coral-algal facies, sometimes dolomitised. *Kurnubia palestinensis*, *Protopeneroplis striata*, *Teutloporella socialis*, *Trocholina sp.*, *Frondicularia sp*, *Thaumatoporella parvovesiculifera*, *Heterodiceras commune*, *Heterodiceras sp.*, *Cladocoropsis mirabilis* are frequent in the above mentioned limestones [10,3]. The upper part of the Kimmeridgian sequence pass into limestones of the mudstone-packstone facies very rich in *Charophytes*, therefore they are often called as Charophytic limestones, which represent an episode of brackish and freshwater facies during upper Kimmeridgian [11]. The Kimmeridgian deposits are medium to thick bedded and reach a general thicknees of 260 meters. In a small erosional hiatus, bauxitic clays (5-14 m. in thicknees) lie over slightly karstified charophytic limestones The bauxitic clays are composed by multicolored oolites and pisolites, reaching a diameter about 10 mm. [2,9]. Other charophytic limestones, some meters thick, represent the base of the Tithonian deposits in many sectors. They lie over bauxitic clays or in their absence on Kimmeridgian limestones and belong to the brackish and freshwater facies. Over them are the limestones and dolomites of the facies with *Clypeina jurassica*, which is very typical one of the Tithonian in the Albanian Alps zone, reaching a maximum thicknes of 217 meters. This is accompanied by other fossils: *Salpingoporella annulata*, *Thaumatoporella parvovesiculifera*, *Cayeuxia sp.*, *Pfenderina sp. Trocholina alpina*. Besides, many nerineids tests are found in the Tithonian deposits: *Trochoptygmatis carpathica*, *Ptygmatis pseudobruntrutana*, *Nerinea defrancei var. posthuma*, *N. tuberculosa*, *N. jeanjani*, *N. hohenegeri*, *Itieria moreana* [10,4].

Neocomian deposits are build up by the limestones of the wackstone and packstone facies (20-34 m.) rich in *Campbelliella striata*, *Favreina salevensis*, *Clypeina jurassica*, *Trochominidae*, *Textularidae*, *Miliolidae* [1,4,5,12]. The limestones of the wackstone-packstone facies (270 m.thick) belong to the upper part of the Neocomian section. In these limestones *Salpingoporella annulata*, *Favreina salevensis*, *Trochaminidae*, *Textularidae*, *Miliolidae* are very frequent [10,4,6]. These limestones contain interbeds of brackish-freshwater facies [11]. To the Barremian-Aptian age belong to uppermost part of the section, starting with the mudstone-packstone facies with oncoids and alternated by dolomites strata (109-202 m.thick), which pass into the limestones very rich in algae *Salpingoporella dinarica aand Salpingoporella cemi*, *Salpingoporella melitae*, *Palaeodictioconus arabicus* and small *Nerineids* and *Requienides* of a thicknees between 24 m. up to 185 m.[4,7,8,11].

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PALEOGEOGRAPHICAL EVOLUTION OF THE SEDIMENTARY COVER ON THE OPHIOLITES IN THE MIRDITA ZONE

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The Mirdita zone occupy the eastern part of Albania with more than 4500 km2. It is build up by Paleozoic, Triassic, Jurassic, Cretaceous, Paleogene, Neogene, Quaternary deposits and ophiolites.

Ophiolites are very distributed in the Mirdita zone, being a part of the Mediterrannean ophiolitic belt. They evrywhere are tectonically setled over the Triassic-Middle Jurassic limestones with the reddish radiolarites and volcano sedimentary formation on the top. Fossils carried out from these limestones in the Krejlura section, indicate a Lias and Dogger age [2]. The study of radiolarians from the radiolarites, which are accepted as the first their sedimentary cover in the Mirdita zone, testify the age of the Bathonian-Callovian [1]. So it's much more possible that Albanian ophiolites are formed during the Late Lias-Early Dogger and not during the Upper Jurassic [9]. This also is in accordance with their absolute age 188 million years, meassured in flogopyt from the ultrabasic rocks [9]. After obduction of the ophiolites during the Middle Jurassic the Mirdita zone has rised and deformed and turned in a dryland, during the Late Callovian-Oxfordian, caused by the Kimmerian orogeny.

The first transgression came during the Early Kimmeridgian. Its deposits, saved only in the village of Polena (district of Korca, south Albania), lie over folded ophiolites and are represented by many blocks of conglomerates, thin bedded marly limestone, rose in color, with chert lenses and thin marls, very rich in particules and small pieces of efussives, chlorites and iron hydroxides, derived from the weathering of ophiolites [8,4,5,6]. These limestones are very reach in ammonites, and calpionellids, indicating the ammonitic zone of the Lower, Middle and Upper Kimmeridgian [3]. In these limestones many pelagic microfossils as *Sacoccoma* etc. are meet to [8,4,5]. In the upper part are meet many calpionellids [7,8,4,6] and ammoites of the Lower and Upper Tithonian and Berriasian [3]. Tithonian and Berriasian-Valanginian transgression was wider, represented by flysch and flyschoid deposits with many calpionellids [4] and weathering products [8,4,5,6]. During the Hauterivian a new deformation and rise has happened (Mirditean movements). Big rock masses of older formations were displaced in to the east-west direction (Kurbneshi overthrust nappe) in central Mirdita and south Albania. Paleomirdita has emerged and from weathering product originated the bauxites (Krejlura region)[7,8,4,6].

Barremian deposits (mostly Urgonian facies) lie in angular discordance over very folded basement (different ophiolitic rocks, Triassic-Jurassic or Neocomian deposits). At the boundary Lower-Upper Cretaceous middle and south regions of the zone subsided and changed the character of the sedimentation with more fine material (marls etc.)(Austrian phase). Thus is formed the Labinot-Dibra depression in the central Albanides. Cenomanian and Turonian are represented by the platform limestones with many rudists [7,8,4,5]. During the Late Turonian and Early Coniacian the central and southern part of the zone emerged (Mediterranean phase). Santonian-Early Campanian transgression (Gosau facies), lie with unconformity over ophiolites, Triassic-Jurassic or Barremian-Aptian limestones. During the emergence of the Late Senonian-Early Maastrichtian (Subhercinian movements) in the continental condition and warm and humid climate are formed the bauxitic bodies (Pogradec district, Mali Thate and Korca district). Marine regimen returned by Late Masstrichtian transgression. Their deposits have either pelagic character with Globotruncana or neritic ones with Orbitoides. The latest Maastrichtian and Early Paleocene are represented by the flysch deposits (Laramide phase). Other movements has acted in the Mirdita zone, which caused the emergence during the Middle Eocene (Illyrian movements) [8,4].

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THE CRETACEOUS-TERTIARY TRANSITION IN THE ALBANIAN ALPS ZONE

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Albanian Alps zone is placed in the Northern Albania. It's buid up by Permian, Triassic, Jurassic, Cretaceous and Paleogene deposits. On the base of the recent researches it is devided in two subzones [4, 1]: Malesia Madhe subzone, which during the Mesozoic time has been a carbonate platform with a pelagic and hemipelagic events during the Late Maastrichtia and Paleocene-Eocene time. Valbona subzone have had the same development during the Triassic, but begining from the Jurassic it subsided into a slope with pelagic facies up to the end of the Cretaceous. Having a intermediate position the Valbona slope has connected the Albanian Alps platform with Cukali basin [4, 1].
The C/T boundary is observed in Selca and Dubinja Mountains, which consists of the same formations.

SELCA FORMATION. Lower part, approximatively 470 m. thick, is represented by thick-bedded platform limestones with local biostromal and biohermal rudist deposits. Rudists and microfossil content testify the presence of Coniacian-Santonian age. The upper part of the formation, 80 m. thick, is represented by the massive and brecciated limestones with rudists, belonging to the Campanian-Lower Maastrichtian.

LIMESTONES WITH GLOBOTRUNCANA FORMATION. Present the uppermost deposits of the Cretaceous in the Albanian Alps zone, which form the basement for the Tertiary deposits. It is represented by thin-bedded gray to reddish limestones with different *Globotruncana* of the Upper Maastrichtian: *Rosita contusa* (CUSHMA.), *Gansserina ganseri* BOLLI, *Globotruncana stuarti* (DE LAPP.), *G. conica* White, *G.lapparenti* BROTZEN, *Racemiguembelina fructosa* (EEGER), *Rugoglobigerina* sp. and globigerinids
[2,1,5].

MREGU FORMATION, member 1 (M1). The lower part, M1 of the formation, lies directly over the limestones with *Globotruncana* and is represented by the scaled red marls, 8 m. thick. The marls are rich in *Globoconcha daubjergensis* (BRONNIMANN), *Parasubbotina pseudobulloides* (PLUMER), *Morozovella trinidadensis* (BOLLI), *Chiloguembelina* sp., testifying the presence of the Danian [2,1,3]. Although in these sections the uppermost zone with *G. mayorensis* of the Latest Maastrichtian and the lowermost zone with *Parvularugoglobigerina eugubina* are not documented, our opinion is that the sedimentation between the Maastrichtian and Paleocene was in continuation, without any interruption, on the basis of very clear superposition and observations. M2. In continuation from the M1, member 2 is build up by gray schistic and scaled marls, 17 meters thick, very rich in carbonatic material. In this marls are found *Morozovella aragonensis* NUTTAL, *M. velascoensis* (CUSHMANN), *Globorotalia* sp., tesifying the age of the Middle Paleocene-Lower Eocene. These marls are the latest Paleogene deposits exposed in the Selca section. In the Dubinja Mountain, over the Mregu formation continues the Dubinja Flysch Formation [2, 1, 3].

DUBINJA FLYSCH FORMATION. The deposits of this formation mark the latest deposits in the Albanian Alps zone. They are more than 300 m. thick and consist of argillites, aleurolites and sandstones alternated with rare thin layers of biomicritic and biogenic limestones. This deposits are poor in the fossils, but in the limestones are met small pieces and fragments of rudists and orbitoids. Besides, there are found rideposited microfossils as *Lepidorbitoides* sp. and *Siderolites calcitrapoides* as well. The opinion of the geologist is that flysch deposits belong to the Lower-Middle Eocene [2, 1, 3].

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Biostratigraphy of the Jurassic carbonate deposits and stratigraphic position of bauxitic clays of Tamara-Kastrat region (Albanian Alps tectonic zone, Malesi e Madhe subzone)

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Key words: Upper Jurassic, Biostratigraphy, Benthic foraminifers, Algae, Shallow water sediments, Bauxitic clays, Albanian Alps tectonic zone, Albania.

Biostratigraphy of the Upper Jurassic sediments of Tamara-Kastrat region (Albanian Alps tectonic zone, Malesi e Madhe subzone) has been carried out (1989-1990) to precise the stratigraphic position of bauxitic clays occured within them. Some detailed sections were carried out, mainly at the sectors where the bauxitic clays horizon occur. Rich fossil content has enable to apply the detailed microbiostratigraphy.

This region (Tamara-Kastrat), during the Jurassic and Cretaceous was represented a sector of the Albanian Alps ridge with shallow water carbonate sediments of neritic and reef facies, sometimes of lagoonal waters with any episode of the coming of terrigene material, associated with the formation during the Upper Jurassic (Kimmeridgian-Tithonian boundary) of bauxitic clays (Tamara), of clays throughout the Tamara-Kastrat region as well as with the formation of some thin clay layers rich in carbonate clastic matter during the Lower Cretaceous.

The investigated region consists structurally of a monocline divided in some horsts and grabens, also separated in blocks with SSW, W and NW dipping.

Some litho and biostratigraphic units are distinguished in Kimmeridgian, Tithonian and Berriasian-Valanginian deposits of this region.

Three clay horizons occur in Tamara-Kastrat region.

The most important and spread bauxitic clay horizon is that of the top of Kimmeridgian deposits, occured throughout the region.

TECTONIC AND THERMAL EVOLUTION OF THE WESTERN CARPATHIAN OROGENIC WEDGE: INFERENCES FOR THE PALEO-ALPINE CRUSTAL EVOLUTION

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Accumulation of lithospheric material in collisional orogenic zones commonly causes great thermal perturbations that may diminish with a considerable time delay with respect to the collisional event. This especially applies for continental collisions with cold lithospheric roots that avoided the slab breakoff due to effective velding of the oceanic and continental part of the downgoing plate. In that case the surface uplift of overthickened lithosphere is blocked by the subcrustal load exerted by the persisting slab-pull beneath the orogenic zone. The collision zone can remain for several tens of Ma in this incubation state, without significant mountain building. When the temperature relaxation is achieved, the buried crustal material softens. The orogenic system starts to progress again and a new, cold crustal material is indenting the weakened wedge from the foreland. This process could account for an exhumation of metamorphic core complexes in contractional tectonic regimes in internal parts of rapidly growing orogenic wedges. Upper-crustal extension and unroofing of metamorphic domes is then orogen-parallel and domes are cut by transpressional and/or transtensional belts which exhume extremely soft material extruded from the crustal root. Advective dissipation of thermal energy leads to work hardening and deformation ceases within the wedge. Provided that the slab is still attached to the lithospheric root, the contraction zone relocates towards the foreland.

The Cretaceous growth of the West Carpathian orogenic wedge shows progradation from the Meliatic suture and an episodic accretion of crustal material from its northern foreland. The first latest Jurassic - earliest Cretaceous episode directly followed closure of the Meliatic ocean. It was associated with an exhumation of the Meliatic blueschists and a deep burial of the Veporic domain below the accretion/collision stack. The second episode is mid-Cretaceous underplating of the Veporic wedge by the buoyant Tatric-Fatric crust that triggered the vertical extrusion of thermally softened material in the rear of the wedge. The inferred P-T-D-t path of the Veporic metamorphic core complex, which is based on detailed petrological and structural studies, indicates its exhumation from lower crustal levels (peak metamorphic conditions: T about 600°C, P in excess of 10 kbar) to the near-surface during ca 30 Ma (the time span between Ar/Ar cooling ages of amphiboles and biotites). The path remained in the stability field of kyanite, therefore heating from the mantle can be excluded. Large parts of the stiff and buoyant Tatric crust avoided substantial thickening and were overridden by only thin blankets of the Fatric and Hronic cover nappe systems. During the latest Cretaceous, the rear of the orogenic wedge cooled and contraction prograded to the zones at the northern Tatric (continental) and Vahic (oceanic) interface. However, only indistinct crustal thickening is indicate here and the northern Tatric edge became to act as the rear buttress of the developing Outer Carpathian accretionary wedge during the Paleogene.

NEOGENE DELTA SYSTEMS WITHIN THE PANNONIAN BASIN

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The Pannonian Basin is a unique study area for geologists as it became gradually isolated from the sea, its size was not too big, several hundreds of kilometres in diameter and high rate of sediment input exceeded the thermal subsidence. Therefore progradation and infilling of the basin was rather fast, causing characteristic patterns in sedimentologic records and a good sequence resolution in seismic. Relatively thick and rather continuous sandy littoral sequence were deposited above the basinal sediments. They were formed mostly in deltaic environments, being the rivers that carried the huge amount of siliciclastic sediments towards the basin and as the preservation potential of deltaic sediments are much higher than that of other shoreline facies.

Sequence stratigraphic analysis of reflection seismic and borehole data allowed the identification of sequence architecture in the late Neogene sedimentary fill and reconstruction of delta progradation. The results of paleomagnetic measurements carried out on samples from continuously cored test holes by the Hungarian Geological Institute, were related to composite seismic profiles. The paleomagnetic polarity zones were correlated with the geomagnetic polarity time scale and radiometric K/Ar age data to determine the chronostratigraphic position of seismic stratigraphic time markers.

As continuous seismic horizons are considered to correspond to isochronous surfaces, numerical datum levels could be drawn across the basin. Seismic datum levels permitted crosschecking of discrete age (radiometric, magnetostratigraphic and biostratigraphic) data and their correlation to other parts of the basin, thus dating evolutionary events. Unconformities belonging to deltas which prograded towards the basin depocenters from at least three main directions can be shown to be out of phase by 0,5 million years if followed on seismic reflection profiles through the central part of the basin.

Mapping of numerical datum levels revealed a general dip towards the interior of the basin and a general southward shift of the different depositional environments according to delta progradation from the NW and NE, between 12 and 5.2 My. Based on seismic data a map series were compiled demonstrating the infilling and shrinking of the Pannonian lake.

Correlation of results from magnetostratigraphic and seismic reflection studies in conjunction with radiometric age dating indicates that the flanks of the Pannonian basin subsided at highly different rates. Varying subsidence rates together with varying sediment supply rates controlled the sedimentary pattern revealed on seismic and well records.

Sedimentological studies were carried out on the basis of core samples and well log interpretation. The whole sedimentary succession of the basin is interpreted to be a second order cycle. More than 6 km of lacustrine sediments were deposited in the deepest parts of the basin. The major lithofacies associations show a gradual shallowing upward trend during Pannonian s.l. and Pliocene time, from hemipelagic basinal marls of a starving basin (Endrod Formation) and deep water sandy turbidites with associated facies (Szolnok Formation) in the deepest and central parts, through muddy slope sediments (Algyo Formation) to littoral facies (Ujfalu, formal Tortel Formation). This latter is represented mostly by sediments settled in a deltaic environment, with fine-grained Gilbert type deltas, steep slope and thick delta front multi-storey mouth-bar sequences. In the uppermost part of the succession alluvial sediments (Zagyva Formation) can be found in a varying thickness. The different lithofacies units, corresponding here to the lithostratigraphic units as well, can be detected over long distances and well mappable. Mapping was carried out in the Hungarian Plain, showing their thickness and distribution in the basin.

Based on comparing and combining the chronostratigraphic and lithofacies map series, a more detailed reconstruction of the subsidence, accumulation and facies distribution in space and time was carried out. The infilling of the Pannonian Lake and the rate of delta progradation was not uniform. It was interrupted by backstepping of the prograding shoreline in certain periods due to relative lake level changes.

A STUDY OF PREHNITE FROM RUDNA GLAVA (EAST SERBIA, YUGOSLAVIA)

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First occurrence of biotite-prehnite association with garnet in granitoide of Gornjane massif, was reported by Radukić (1989). Second occurrence in Rudna Glava is studied in detail in this paper.

Rudna Glava is located in the northern part of the contact aureole of the Gornjane granitoid massif. The central part of the massif is composed of granite-monconite, while its margins have been highly altered. Prehnite was found in diabase rocks of the stream Radovica, nearby Rudna Glava.

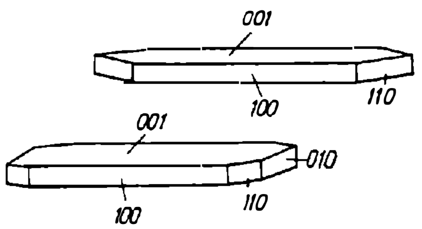

Fig. 1. Crystal forms of prehnite (Rudna Glava)

Prehnite occurs on the surface of the rock in rounded groups of tabular crystals with a crystalline surfaces, showing characteristically pale green color and vitreous luster. Colorless, translucent crystals (Fig. 1) up to 1 mm in diameter, are filling up fissures of the host rock.

Intensive prenitisation process penetrates entire rock. Diabase, as it is observed microscopically, have slightly altered pyroxene filling the intersticies of former tabular plagioclase crystals which are completely replaced with prehnite.

Chemical analysis	
SiO_2	41.91
TiO_2	0.28
Al_2O_3	21.05
Fe_2O_3	5.31
MnO	0.03
MgO	0.52
CaO	26.09
Na_2O	0.10
K_2O	0.05
H_2O (110°)	0.48
H_2O (1000°)	4.13
Total	99.95

Results of detail study of prehnite are as follows:

$(Ca_{3.95}\ Na_{0.03}\ K_{0.01})_{3.99}\ (Al_{3.41}\ Fe^{3+}_{0.56}\ Mg_{0.11}\ Ti_{0.02})_{4.10}\ (Si_{5.91}\ Al_{0.09})_{6.00}\ O_{20}\ (OH)_{3.89}$.

Chemical analysis pointed out rather small substitution of Al for Si, but appreciable content of iron substituting Al. Cell dimensions (Å): a_o= 4.638(3), b_o= 5.492(2), c_o= 18.515(6) and V = 471.6(3) $Å^3$.

Optical properties: $n(\alpha) = 1.616$; $n(\beta) = 1.624$; $n(\gamma) = 1.650$. Density is 2.96 g/cm^3.

Positions and intensities of observed bands in the IR spectra are characteristic for prehnite, according to Moenke (1962).

Prehnite obviously occurs as a mineral of secondary origin in diabase, mainly as a result of plagioclase alteration.

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PROPYLITES: HISTORY OF THEIR SYSTEMATIZATION AND GENETICS (HUNGARIAN SCHOOL OF PETROGRAPHTY, 19TH CENTURY)

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ABSTRACT

In the Carpathian Arch the Neogene magmatism plays an important role, because of its petrographical, magma genetical, tectonical and economic aspects (associated noble and non-ferrous ore deposits). This was the reason why the geology and petrography of these mountains was intensively studied by Hungarian and foreign geologists in the second half of the 19th century.

József Szabó (1822-1894) was one of the most prominent scientists who paid great attention to the systematization of the volcanics then called "trachytes" and created their system (1870). Into his system beside the orthovolcanites, the modified rock types were also included, revealing also their real genesis. The modifications were connected with the rich ore bearing zones, so they were of particular importance for the practical field work of geologists (see **Béla Inkey**'s mining geological works).

Accordingly, the propylites, as secondarily transformed varieties of different "trachytes" (later andesites and dacites) were described. It was an important discovery, since e.g. **F. von Richthofen**, one of the most prominent petrologists of the period, considered the propylites as an independent rock type. This systematization was accepted by **F. Zirkel**, as well (1876).

József szabó presented his system to the international community only at the **World Exhibition of Vienna** (1873). In his publication he stated beyond doubt that propylite is not an independent rock type but "modification by sulfurous and water exhalations of various trachyte type".

Probably, due to this study **H. Rosenbusch** separated the propylite-dacite and propylite-andesite, respectively, in his system of magmatic rocks published in 1877.

C. Doelter also revised his former statements in the publication of Transylvanian volcanics, describing the propylites found there, as andesites.

In the United States in 1875 **G.F. Becker** published his views concerning the genesis of propylites of the Comstock Lode ore deposits, which exactly coincide with the assumption of **József Szabó**.

IDENTIFYING AND DISTINGUISHING BETWEEN THE ACIDIC EXPLOSIVE SEQUENCES OF THE BÜKK FORELAND (PANNONIAN BASIN, HUNGARY) USING PETROGRAPHIC AND PETROCHEMICAL CRITERIA

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The Miocene acidic explosive volcanic sequences of the Bükk Foreland area represent the most complete surface occurrence of the "Lower-" and "Middle Rhyolite Tuff" horizons of stratigraphic significance in the Pannonian Basin. The "Upper Rhyolite Tuff" is found as well in two little occurrences.

Our study proves that the three tuff complexes can be distinguished from one another on the basis of their characteristic rock types, juvenile mafic minerals, major and trace element distribution, in addition to K-Ar ages and paleomagnetic features.

The Lower Tuff Complex has high-K calc-alkaline rhyolitic composition. It consists of fallout pumice lapilli, welded and non-welded ignimbrites and phreatomagmatic tuffs, containing rhyolitic, dacitic, and andesitic lithoclasts. Juvenile mafic rock-forming minerals are tipically the **biotites** (FeO 23-25 %, MgO 8-9 %).

The Middle Tuff Complex has normal to high-K calc-alkaline chemical character. The apparent (rhyo)dacitic composition of most of its rocks resulted from the mixture of two components (andesitic and rhyolitic). Ash flow deposits with mixed pumice-scoria, non-welded to strongly welded ignimbites, phreatomagmatic deposits with accretionary lapilli are the main lithologies, containing andesitic, dacitic and rhyolitic lithoclasts. The juvenile mafic rock-forming minerals are mainly the **hyperstenes** (FeO 21.4-26.5 %) and biotites (FeO 27.5-29.0 %, MgO 6.6-6.8%).

The Upper Tuff Complex is high-K calc-alkali rhyolitic in character. Non-welded or slightly welded ignimbrites, crystal tuffs with rhyolitic, dacitic lithoclasts are the main rock types. Juvenile mafic rock-forming minerals are tipically the **biotites** (FeO 22.-23 %, or 29 % respectively, MgO 8-9%, or 5% resp.).

The REE and incompatible element distribution of the Miocene Tuff Complexes shows similarities to the granitoids of the Velence Mts. (Pannonian Basin), but differs from the granulite xenolits from Pliocene basalts (representing the lower crust of the Pannonian Basin). The values of the **HREE** in all of normalization are higher in the case of the Middle Tuff Complex and its lithoclasts of andesitic composition comperatively to the Lower and Upper Tuf Complexes. According to the normalization to granitoids all of the positive and negative **anomalies of incompatible elements are only in one order of magnitude**, according to the genetical relations to granitoids.

The petrographic and petrochemical character of the examined tuff complexes may support the hypothesis that their **magma derived from the melting of an acidic crustal component** of granitic (or acidic metasediment) composition. **In the genesis of the Middle Tuff Complex, mixing of a crustal acidic magma and a subduction-related andesitic magma has to be taken into account**.

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KARST OF THE WEST OF UKRAINE: THE PECULIARITIES OF IST SHOW AND THE PROBLEMS OF STUDYING

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THE GEODYNAMIC PROCESSES IN BANAT (ROMANIA)

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The paper intends to explain the geodynamic processes and the crustal seismicity (Ms=5.3; h=25 km) in the Banat area, starting from the correlation of this seismicity with the 10 km deep structure, the hypocentral level of the majority of normal earthquakes, with the crystalline basement fractures and finally with the neotectonic structure.

The Banat region represents the southeastern border of the Pannonian Depression, which leans upon the Carpathian Orogene. From the geodynamic point of view it corresponds to two distinct lithospheric blocks of the Intra-Carpathian Microplate: the Pannonian Block, represented in depth by the metamorphic units of the Biharia Nappe and by the Transylvanides units (Apuseni Mts.) and the Geto-Danubian Block, composed of mesometamorphic and sedimentary Mesozoic units proper to these domains of the Southern Carpathians.

The analysis of the focal mechanism solutions of 25 recent earthquakes (1988-1994), by an inversion method, allowed us to establish the type of faulting, dominantly reverse (48%) and transcurrent (48%),as well as the stress field, characterized by the four stress parameters (σ_1, σ_2, σ_3 and R ratio). In the Pannonian Block a NW-SE compression is dominant, while in the Geto-Danubian one it is ESE-WNW. A distinct SW-NE direction of the stress tensor, characteristic for the southern compartment, determined the separation of the third block, the Banloc Block.

Between the litospheric blocks there is a compression, more abvious at their contact, the Lucareţ reverse fault. Along this fault, the more western compartments, the Pannonian (σ_1 - 157^0 / 0.5^0) and the Banloc (σ_1- 49^0 / 39^0) Blocks sink under the Geto-Danubian one (σ_1 - 288^0 / 28^0).

The seismic activity in South Banat area is related to the compressive stresses, concentrated on the triple jonction of these blocks, with different geodynamic behaviour.

THE GEODYNAMIC COMPARTMENTS AND PRESENT-DAY STRESS STATE ON THE ROMANIAN TERRITORY

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The paper presents a geodynamic model of the active compartments configuration on the Romanian territory, which takes into account present-day processes, as revealed by seismicity, stress distribution and recent crustal movements. The accurate delimitation of the compartments was done on a specially elaborated structural map, at 10 km depth (the hypocentral level of the majority of crustal earthquakes) and on the comparative geological and geophysical data. The new model gives the real limits of the compartments at depth, limits which are covered at the surface by the Carpathian overthrusting and sedimentary covers.

The model reveals present-day relatively stable compartments like the Moldavian Block from the European Plate and the Central Moesian Block of the Moesian Microplate, characterized by a low intensity of the recent crustal movements and by a low seismicity, as well as active compartments, like the Black Sea Block and the South Pannonian Block, characterized by significant recent crustal mouvements and an intense seismic activity. The most interesting block, from the geodynamic point of view, is the Black Sea Block, which concentrates the Vrancea crustal seismicity, and probably, has a great influence in the generation of the intermediate one. This block is characterized by a prevailing senestral strike-slip movement, along the two marginal transcurrent fractures.

Since the fault plane solutions of the crustal earthquakes are expressions of the present regional stress, we applied the inversion method to a set of 48 focal mechanism solutions, obtained on the basis of P-wave first motion, to constrain the tectonic stress field and allow implications on geodynamic processes.The present-day stress state, is characterized by a NW-SE compressive stress, with specific variations for each block, in the Intra-Carpathian Microplate, by a SE-NW compressive stress in the Black Sea Block and by a SW-NE secondary stress in the southern part of the Pannonian Block.

This stress pattern could be considered as the result of the present-day E-SE translation in the Pannonian Domain, under the influence of the last roll-back phase and break-off of the subducted lithosphere in Vrancea area, on one hand and of the W, NW relative movement with 3 cm/year of the Arabian Plate towards the Moesian Microplate, on the other hand.

MODEL OF GEOLOGICAL STRUCTURE OF THE UKRAINE SOUTH AND SEA AQUATORIES FROM THE POINT OF VIEW OF PLATE TECTONICS

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Till lately most investigators developed the opinion of M.V.Muratov (1955) on the geological structure of the South and the sea aquatories of Ukraine, who distinguished the sea aquatories of heterogenic (Paleozoic - Early Mesozoic) folding-Scythian plate between the southern margin of ancient East-European platform and Alpine orogenes of Carpathians, Balkans, Crimea, Caucasus and Kopet-Dag. But a number of questions concerning its boundaries, age of the basement in some regions, deep structure and others remain questionable till today. In this connection since recently the competence of distinguishing Scythian plate is given in doubt. The ground for this were the facts ascertained by deep drilling that the various by age, character of forming and tectonical nature structural-formational complexes are distinguished in its basement. The question of boundaries of the plate, especially in the zone of its joining with East-European platform is still debatable. On some tectonical schemes the plate is marked as a very narrow strip. This makes doubtful attributing this lot of the earth crust to the category of young platform.

Having analyzed the available materials of geophysical and drilling works and also manuscrips we suggest such tectonical elements:

1. East - European Precambrian platform
    - 1.1 Moldova monocline.
    - 1.2 Pre-Black-Sea-Area monocline.
    - 1.3 Pre - Azov monocline.
2. Moesian - Scythian tectonical belt
    - 2.1 Pre-Black-Sea-Area - Azov system of deeps.
    - 2.2 Dobrogean - Crimean zone of uplifts, probably of nappe - thrust structure.
    - 2.3 Zone of deeps formed thanks forming folded structures of Mount Crimea and Caucasus.
3. Cimmerian - Hercynian folded construction of North Dobrogea.
4. Cimmerian - Alpine folded structure of Mount Crimea.
5. The Black Sea deep-water depression.

During the history of their development structural zones except East-European platform suffered repeated rebuilding tectonical plans, heredity laying on the structures and inversional movements. This stipulated for complicated structure of sedimentary cover and non - coincidence of contours of different structural elements by different formational complexes.

NON-CONVENTIONAL GAS IN TIGHT RESERVOIRS OF THE UKRAINIAN FOLDED CARPATHIANS.

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One of the most characteristic and definitive features of non-conventional gas accumulations in the sequence of the tight rocks of the late catagenesis (R_0>0,9) is their inverse position concerning the reservoir water. Gas accumulation is not underlain by the reservoir water, but is sealed from above by the low porosity water saturated rocks. These accumulations, which are characterised by the significant height of gas saturation, are revealed by the wells 1, 2 Borynia, 1 - Bitlia, 1 - Gryniava in Paleogene deposits of the axis zone (Krosno) of the Folded Carpathians.

Krosno zone is made up of Paleogene and Cretaceous flysch, folded into asymmetric folds, which are thrust over each other. From the south the Uzhokska, Duklanska and Chornogorsko-Shypotska zones anticline, made up of highly faulted and lithified cretaceous rocks, is thrust over them. Northeastward Krosno zone is thrust over the Skiba zone anticline, which is also made up of folded , more lithifield Cretaceous rocks. In Skiba zone, according to drilling data of the wells 1-Synievydne, 1-Lugi, 1-Shevchenkovo the non-conventional gas accumulations can occur at depths 7 km are more. The rocks of the Uzhokska, Duklianska and Chornogorsko-Shypotska zones anticline have a very low porosity characteristics, are degased and can not contain the non-conventional gas accumulations.

Deposits of Krosno zone had experienced less uplift (up to 2,5-3,0 km) comparing to the surrounding anticlines, they keep the overpressure and the lower zone of gas accumulation is spread in them. At the Borynia area the sequence of the late catagenesis rocks, begins since depth of 3200 m. In the depth interval of 2860-5230 m, according to well-log data, 63 - gas-saturated layers with the total thickness of 874 m, and also 9 layers (75 m) partly water-saturated (from 26 to 50%) were distinguished. The initial gas flow rate from the oligocene rocks of the first reservoir (4995-5160 m) of the 2-Borynia well was around 400 thousand m^3/day, but it quickly decreased to 4,2 thousand m^3/day. Together with gas, the technogenic water with flow rate of 26 m^3/day was periodically produced. From 9 other reservoirs of this well from the total interval 3145-4886 m the dry gas with the flow rate of several thousand m^3/day or gas with small quantity (up to 4 m^3/day) of technogenic water was produced. The prospectivity of the north-western part of the Krosno zone for north-conventional gas is shown by the results of the 1-Bitlia well, where from the interval 1865-1933 m during drilling, gas was produced. Currently the well is suspended.

Towards the central part of the Krosno zone the depth of the Paleogene depression decreases and in the area of the Smozke high, at the north-eastern limb of which the well 1-Tukholka was drilled, the Upper Cretaceous rocks are outcropping. They are transformed to the stage of methagenesis, their filtration - porosity properties are very low, reservoir pressures are lower than the hydrostatic ones (abnormality factor 0,9), the rocks are degased. That's why here mainly small production of the methane-carbon dioxide gas with flow rate of 60-2500 m^3/day were obtained.

At the south-east the Krosno zone is covered by the Chornogora nappe there the well 1-Gryniava was drilled. From the Oligocene deposits of the first three reservoirs, occurring in the depth interval 4420-4602 m the gas condensate with the flow rate 12,4 - 14,2 thousand m^3/day was obtained. The abnormality factor of the reservoir pressures was 1,5. Small gas flow rates (near 0,9thousand m^3/day) were obtained from the Menilite deposits, which occur below the Krosno deposits, during testing of the well 2-Kosmach-Pokutsky.

Porosity of the sandstones from the productive horizons doesn't exceed 5%. Low filtration properties of the rocks cause difficulties to build up the pressure. The most exact determination of the reservoir pressure can be obtained as a mean value between the curves of pressure build up at draw-down and repression.

Great height of gas saturation in the lower zone of gas accumulation leads to great repressions on the reservoir in the lower part of the penetrated gas saturated sequence of rocks by the drilling mud and technical water penetrate into fractured rocks. For detailed determination of volumes relationship of drilling mud filtrate, technical and reservoir water in production obtained as a result of development, if is necessary to elaborate and to apply the indicator of the drilling mud filtrate and technical water.

Analysis of the represented materials: allows to state, that according to the complex of features, characteristic to deposits of the tight gas of different gas bearing basins of the world, in the axis zone of the Ukrainian Carpathians the non-conventional gas accumulations exist. These features are: 1) the catagenetic maturity of the rocks; 2) overpressure of the reservoir fluids; 3) existence of reservoir water above the gas accumulation; 4) well production free of water, or with a small quantity of water; 5) quick decrease of the initial gas flow rates with their further stabilization at low levels; 6) low reservoir properties of the reservoir rocks, caused by their transformation to the stage of late catagenesis and even metagenesis.

BIOSTRATIGRAFY OF THE LOWER CRETACEOUS FORAMINIFERS FROM THE PIENINY TECTONIC UNIT (UKRAINIAN CARPATHIANS)

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Introduction. The Lower Cretaceous deposits of the Pieniny tectonic unit are characterized by extensive distribution of calcareous benthic and planktonic foraminifers and have been a subject of numerous studies with respect to their biozonation (Ponomaryova, 1995). The present study is concentrated on the modification of the existing biozonal scheme and complement by new data.

Materials. Biostratigraphycal analysis is based on the retrospective materials and new collection from about 140 samples from fore outcrops.

Biostratigraphy. Ukrainian part of the Pieniny Klippen Belt (Pieniny tectonic unit) traces as a narrow stripe, separating the Flysch Carpathians from the Transcarpathians foredeep and is characterized by complex tectonic development. Lower Cretaceous deposits can be observed in this area as the separate fragments of the sections at the basins of the Uzh, Latorytsa, Borzhava and Luzhanka rivers. These are represented by Svalyava (Tithonian-Berriassian) and Tissalo (Aptian-Cenomanian) Suites. The first of them consists of light coloured limestones with cherts and seldom thin black and green shales interbeds. Foraminifera occurrences are known at the vicinity of the vill. Pryborzhavskie and the Svalyavka river. These are very seldom found and represented by bad preserved *Spirillina, Trocholina, Patellina,Coscinoconus, Lenticulina, Praedorothia,* which can indicate the Berriasin-Valanginian strata. Tissalo Suite is represented by dark, grey, green and red marls with limestone intercalations, which contain numerous calcareous benthic and planktonic foraminifers, especially in the upper part of sequence. A local modified biozonal scheme is proposed for the studied area and correlated with biozonal subdivisions of the Slovakian (Salay, Samuel, 1984) and Polish (Bąk K., Bąk M., Gasiński, Jamiński, 1995) Carpathians. Six zones were recognized from the Aptian-Albian deposits of the Tissalo Suite, as follows:

Globigerinelloides ferreolensis (Interval Zone). Lower boundary: first occurence (FO) of *Globigerinelloides ferreolensis* and *Hedbergella aptica.* Corresponds to the Early Aptian.
Discorbis wassoewiczi (Interval Zone). Lower boundary: FO of *D.Wassoewiczi.* Corresponds to the Late Aptian.
Ticinella roberti (Interval Zone). Lower boundary: FO of *T.roberti.* Represents the Early Albian.
Ticinella gaultina - Thalmanninella subticinensis (Interval Zone). Lower boundary: FO of index species. Corresponds to the Middle and Late Albian.
Thalmanninella ticinensis (Interval Zone). Lower boundary: FO of *Th. ticinensis.* Corresponds to the Late Albian.
Rotalipora appenninica (Interval Zone). Lower boundary: FO of *R. appenninica.* Represents the Late Albian.

Conclusions. This work made it possible to correlate more precisely the Aptian-Albian deposits of the Tissalo Suite with analogous formationsof the Pieniny Klippen Belt.

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BIOEVENTS AND BIOZONES OF TITHONIAN TO HAUTERIVIAN PRAECALPIONELLIDS AND CALPIONELLIDS

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The high-resolution biochronologic potential of the Tethyan planktonic micro-organisms grouped into Chitinoidellidae TREJO, Semichitinoidellidae NOWAK and Calpionellidae BONET is here materialized in the joined model including several successive biozones. They are: (1) Chitinoidella Zone with Dobeni and boneti subzones defined by the FO of L. dobeni and Ch. boneti; (2) Praetintinnopsella Zone marked by the FO of P. andrusovi; (3) Crassicollaria Zone including the Parvula, Intermedia and Colomi subzones given by the FO of Calpionellidae, large C. alpina and Cr. colomi; (4) Calpionella Zone comprising the Alpina, Ferasini, Elliptica and Longa subzones delimited by the sudden proliferation of small- to medium-sized C. alpina (= provisionally Tithonian-Berriasian and Jurassic-Cretaceous boundaries) and the FO of R. ferasini, C. elliptica and typical T. longa; (5) Calpionellopsis Zone with the Simplex, Oblonga and Murgeanui subzones defined by the FO of Cs. simplex, Cs. oblonga and Pc. murgeanui; (6) Calpionellites Zone including the Darderi and Major subzones given by the FO of Ct. darderi (corresponding to a possible lower boundary of Valanginian) and Ct. major; (7) Tintinnopsella Zone tentatively divided into Cadischiana and Carpathica subzones by the LO of Calpionellites, R. cadischiana and T. carpathica (upper zonal boundary). All the zones and subzones are defined by their lower boundaries. Practically, the above biozones may be identified by their relatively unitary assemblages.

Many other bioevents are already remarked, which prove that the biochronologic potential of these micro-organisms is not exhausted and that it may be improved using fuirther new data.

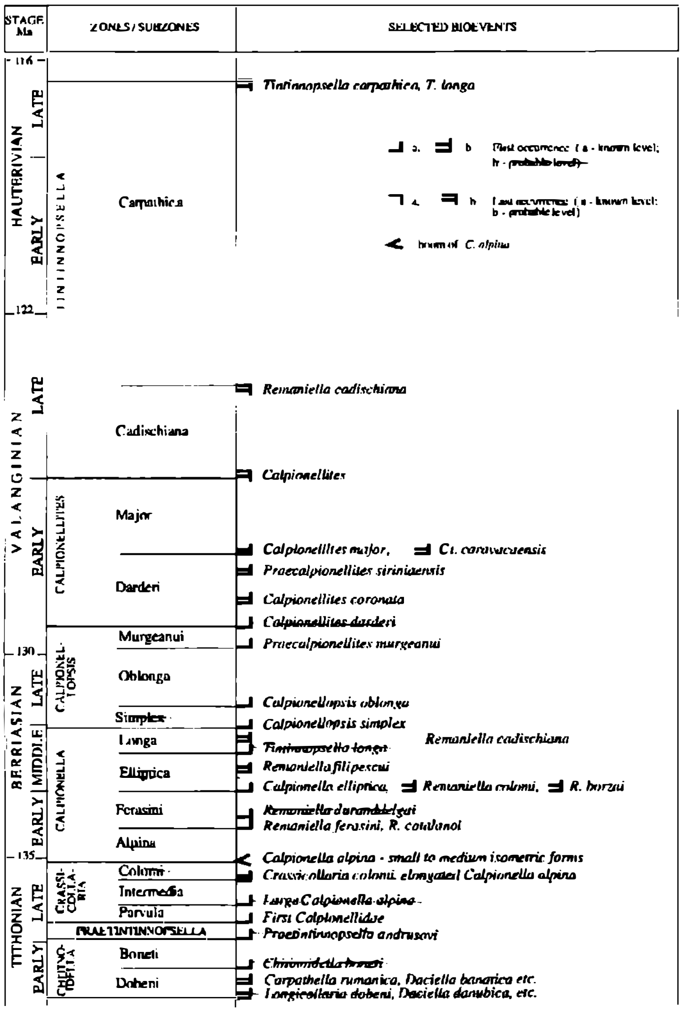

Fig. 1 Biostratigraphical model based on the evolutionary events of praecalpionellids and calpionellids.

RELATIONSHIPS BETWEEN LITHOLOGY AND CHEMICAL COMPOSITION OF GROUNDWATER FROM IASSY DISTRICT(ROMANIA)

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The main purpose of this paper is to make a succint synthesis of the natural geological conditions in which are situated the accumulations of waters, according to the lithological structures which determine the way of the waters accumulate and their chemical character.

From a geomorphological point of view, the Iassy country is part of the Moldavian Plateau, characterized by: a)the absence of the metamorphic and magmatic formations, of the post-volcanic manifestations and post-tectonic depressions(basins); b) the high value of the relief energy; c)the relatively high index of dryness; d) the prevalent occurence of the neritic-litoral and fluvial-lacustine facieses; e) well-developed terraces, also hydrogeologically important; f) groundwaters with a high degre of mineralisation.

The 43 hydrostructures of the Iassy district are of the following types: a) divide-dischrging type; b)belonging to the alluvial fans, on the right side of the river Siret; c) terrace groundwaters, of alluvial type; d) alluvial, of the main riverbeds; e) discharging, of the oolithic sandstone type; f) profound. All hydrostructures receive their supply of water from rainfall and from the superficial drainage system.

Depending on the lithologic status and of the thermo-dynamic conditions, the meteoric waters pass through a process of enrichment in the chemical component parts, therefore from a hydrogeochemical point of view, one can tell: 1)bicarbonatic waters, rich in chlorine and sodium; 2) alkaline waters; 3) terrous-alkaline waters; 4)sulphatate waters; 5) strongly sulphurous waters, also rich in chlorine, bicarbonate, sodium,iodine

Their chemistry reflects several genetic parametres, the most important being: 1)the lithological environment; 2) the geochemical particularities of the environment during weathering of the rocks. The correlation coefficients and the regression lines curvefit were used in order to check the existence of a connection between different ions so, the chemical composition of the waters has been found correlate with the spatial distribution of the sedimentary rocks types and also with the vegetation. The over 200 water samples analysed by the APM-Iassy, lead us to the following conclusions: 1) the meteoric waters are largely enriched in CO_2 at the soil level (on the account of the vegetation), becoming relatively aggressive against the component parts of the rocks; 2) some constituents of the water derive from dissolving and then taking the pre-existent soluble salts from the rocks along the tract of the groundwaters; 3) other component parts derive from the ion-exchange reaction. In fact, researches show that the clays of the Moldavian Plateau, have a great cation-exchange capacity. It seems that in the geological past these have absorbed Na^+ and now they free it, absorbing Ca^{2+}; 4) finally, a part of the constituents comes from the weathering of the basic minerals of the feldspathic type,such as in the following reaction: plagioclase = kaolinit.

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MARINE MIDDLE MIOCENE STRATIGRAPHY OF CENTRAL PARATETHYS (ROMANIAN AREA)

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Marine Middle Miocene of the Romanian territory extends between a continental or continental lacustrine facies (in the base) and a brackish marine facies (at its upper part). Two main sedimentary areas have been distinguished: one occurring in the western Romanian territory representing, paleogeographicaly, the eastern border of the Pannonian realm and, the second one, the Carpathian realm. In south Dobrogea, these deposits belong chronostratigraphicaly to the Upper Kossovian and paleogeographicaly are assigned to East Paratethys.

The most important outcrops occur in north, west and southern Transylvania Depression, in the "gulfs" from eastern border of the Pannonian realm, in Subcarpathians and the Getic Depression. Some isolated outcrops also occur in western Oltenia and northern Moldavia. Some data have been obtained from wells.

Although there are evidences demonstrating the large connections between the two main realms, important litho- and biostratigraphic differences occur. Thus, lithological sequences common in all Carpathian area (Evaporite, Radiolarian Shales and Spirialis Marls formations) cannot be recognized in the Pannonian.

BIOSTRATIGRAPHIC UNITS	CHRONOSTRATIGRAPHIC UNITS			BIOSTRATIGRAPHIC UNITS (this work)
		E.PANNONIAN REALM	CARPATHIAN REALM	
dividens	SARMATIAN			dividens
VELAPERTINA (Bulimina-Bolivina Z.)	BADENIAN	KOSSOVIAN	KONKIAN / KOSSOVIAN	(Borelis rotella) V. luczkowskae VELAPERTINA (bellicostata/styriaca) V. indigena
druryi/grilli (Spiroplectammina Z.)	BADENIAN	WIELICIAN	LANGHIAN	druryi/grilli (minuta/orbignyana) (transsylvanica)
universa/bykovae (Lagenids Zone) ULZ LLZ	BADENIAN	MORAVIAN	LANGHIAN	(ariminensis) universa/bykovae (dentata)
glomerosa	BADENIAN	MORAVIAN	LANGHIAN	glomerosa/bisphaerica
triloba	BURDIGALIAN			triloba

Fig. 1. Bio- and chronostratigraphic correlation of marine Middle Miocene
Legend: ULZ = Upper Lagenids Zone
LLZ = Lower Lagenids Zone

In the discussed stratigraphical interval, two homeomorphic evolutive lineage have been identified: *Candorbulina* (=*Praeorbulina*) lineage (in the Langhian = Lower and Middle Badenian) and *Velapertina* lineage in Kossovian. The two lineages constitute the base of the Carpathian biostratigraphy. Beside planktonic foraminifera zonation, the benthonic ones have served for carrying out a detalied regional and local biostratigraphy.

THE RANGE OF THE CRYSTALLIZATION OF MINERAL PARAGENESYS OF GOLD SAULIAK DEPOSIT (RACHIV REGION)

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The range of crystallization of minerals, their assoctiations and complexes were distiungished on the base of detailed mineralogical -paragenetic analysis of ores and thermabarogeochemical investigations of the inclusions within minerals of different age generations. The previous scheme of the range of mineral paragenesys in Sauliak deposit includes:

I. Pyrrotite - quartz complex.

1.Pyrrotite - quartz association

II. Pyrite - quartz complex.

2.Chlorite - quartz association

3.Pyrite - quartz association

4.Pyrite - carbonate (early) association

III. Gold - polimetall complex.

5.Quartz - pyrite - sphalerite with gold association

6.Sphalerite - galenite with gold association

7.Gold - chalcopyrite

8.Quartz - carbonate association with gold

IV. Quartz - carbonate complex.

9.Quartz - carbonate association

10.Pyrit - carbonate (late) association

Gold was taken from one (productive) fluid portion; together with productive mineral association it fills that cross all early pre productive mineral associations and complexes. There were elaborated thermobarogeochemical criteria of prediction of them and on this base prognostic resourese were assessed.

DISTRIBUTION OF PRECIOUS METALS IN CENRAL PART OF SERBIA
(Yugoslavia)
by

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A part of Serbia, as a subject of this work, is characterized by numerous lead-zinc and subordinated copper ore occurrences and deposits, in association with precious metals.

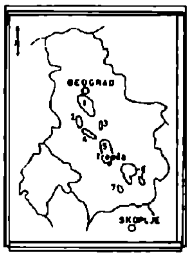

Fig. 1 Simplified map of distribution precious metals in central Serbia.
1. Area of Sumadija (Avala, Babe on the Kosmaj, Rudnik, Kotlenik), 2. Stanča, Tolišnica, 3. Goč, 4. Čemerno and Željin (Rastište, Odmenje, Međurečje), 5. Kopaonik without deposits of Trepča (Sastavci, Kiževak, Plavkovo etc.) 6. Radan massif (deposits of Lece, Dražnja, Tulare and Sijarinska Banja) and 7. Area of Novo Brdo.

According to date informations gold and silver occur at Avala in dacite-andesite and listwaenites. Gold content is about 0,5 g/t and silver over 50 g/t.On the Kosmaj (Babe locality) lead and zinc deposit, the silver content is more than 500 g/t, but there are no data on gold grades. Similar situation is in the "Rudnik" mine, where the highest gold concentrations are likely to be related to arsenopyrite, exhibiting gold contents of 8 g/t and silver 850 g/t. Otherwise the silver contents for the deposit as a whole is more than 150 g/t, offering opportunity of economical survival even in the most critical times of this mine.

Precious metals in Tolišnica and Sranča are associated with copper deposits in diabases. Gold concentrations vary from 0,5 g/t to 1,0 g/t and silver up to 20 g/t.

Differing from them, on the Goč mountain are registered, beside gold, metals of the PGE as well. The content has not been reliably determined, but platinum flakes are found in river drifts. According to an unreliable record in the arsenopyrite mineralization 3 g/t platinum, 21 g/t gold and 15 g/t silver was found. In this area occur listwaenites mineralized by copper and arsenic sulfides, but quartz veins are also present in serpentinites and in green schists. One quartz-chalcopyrite vein in chlorite schists on the northern slopes of the Goč mountain, 1,5 m in thickness, bears 0,69 g/t gold and 10 g/t silver. In the Međurečje also occur listwaenites with the auriferous arsenopyrite mineralization., with contents of gold varying from traces up to 80 g/t and silver ranging to 5o g/t, with platinum and palladium contents 0,6 g/t and o,77 g/t respectively. In the Kiževak, Sastavci and Plavkovo localities the auriferous mineraliztion occur in andesite volcanites. In them the gold contents generally vary from 0,14 g/t to 6 g/t and silver from 0,6 g/t to 85 g/t.

In the district of the Radan dacite-andesite massif, in the "Lece" mine, the lead and zinc ore shows gold contents of about 4 g/t and silver of around 17 g/t. At the other Pb, Zn and Cu occurrences the gold contents vary from 0,1 g/t to 9 g/t, sporadically to 20 g/t as well. In Sijarinska Banja, where the gold occurs in dacite-andesite volcfanites, but also in chalcopyrite and quartz veins, gold contents range from traces up to 8 g/t, then silver up to 380 g/t, platinum to 0,5 g/t and palladium to 0,6 g/t.

Novo Brdo was known in medieval age as a silver mine, where coins were ment. The silver contents range in the ore from 5 g/t to 700 g/t and gold ranges from traces to maximum 4 g/t.

ALBANIDE OPHIOLITES EXPRESSING THE FORMATION OF MIDOQEANIC RIDGE (MORB) AND ISLE ARCHS (IAT)

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Albanide ophiolites as part of Alpine Mediterranean Belt are confined from Dinarides in the North and from Helenides in the South. Albanide ophiolites construct Mirdita tectonic zone, which is represented in Dynarides by Serbian zone, and in Helenides by Subpelagonian zone. (fig 1.2)

In Albania ophiolites exist in the form of two belts named Eastern and Western Belts, which lay in concordance with other structures of Albanides. (fig 3)

In the beginning, they were given conventional names of Eastern and Western Belts, but later, with evolution of plates theory explaining the formation of different ophiolitic types by other mechanisms including petrographic and geochemic ones, those names were really expressing an essential features of different condition of formation.

Numerous studies made by albanian and foreign geologists have given evidence about different geochemical, petrographical, mineralogical, metalogenical, structural and tectonic features between these two belts.

In general, the ophiolites of Mirdita region, occupy a territory nearly 4500 km^2 from 28000 km^2 of the whole Albania.

They represent a great resource for the country, both in petrologic and metalogenic aspects for minerals such as chromite, copper sulphures, polymetals, nickel-iron, nickel sulfides, platinium group etc.

That is why, in the years before, the ophiolites were studied in details from the cartographic, structural, mealogenic, geochemical, petrological, petrochemical and mineralogical aspects with data collected both from the surface and depth.

It were many investigations and discovery works as galleries, deep wells (until 1000-1500m) and also exceptional erosional sections that made possible the study of the continuity sequences in the magmatic profile of two belts.

The division in two ophiolitic belts is evident in Albania and represents a distinctive feature in a small zone where complete sections of mantle sequences and cumulitic ones are met. The magmatic section is nearly perfect with ophiolites of the Eastern Belt formed in environments similar to isle arch (IAT) in the presence of suprasubduction and those of the Western Belt formed during the spreading of mid-ocean ridges belonging to a lherzolitic primar mantle of MORB affinity (fig. 4).

From geological and tectonic point of view which refers to Shkoder-Peja fault and supposed line fault Vlore-Lushnje-Elbasan-Peshkopi, ophiolites of Mirdita zone (with the two belts) may be called as ophiolites of north and south Mirdita, which have common features as well as different ones concerning the geodynamic environment and facial and lithological distinctions.

Detailed data from different massifs or within the same belt as well as from volcanites of Mirdita show that beside the homogeneity, differences are evident, demonstrating their suprasubduction. This is the reason why some massifs of Western Belt (Gomsiqe, Krrabi etc.) are explained as diapiric lifts linked with transverse faults and representing parts of lherzolitic primar mantle (fig.4).

INTERPRETATION OF 2D SEISMIC LINE FROM THE SE PART OF THE POLISH CARPATHIANS.

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In the Polish Carpathians, the complex geological structure has not allowed for proper projection of its deep structure using seismic methods. This situation can be explained by many factors however, the main factor influencing the quality of interpretation is a poor knowledge of the velocity field. This is caused by a low number of velocity measurements, or even a lack of them, unequal distribution and very often a long distance between wells with measurements of average velocities. On the poster there is presented a solution that makes is possible to forecast the velocity field, in line with geological structure of a particular area.

We begin the methology of solving the geological task with construction of interval velocity maps. We used measurements of average velocities from 24 wells situated within the area of about 1,300 km^2 We begin calculations with preparation of the distribution of continuous Rc, i.e, delimitating a map hauhg a window, of measurement points grid significantly smaller than the distribution of well points. In our example, we used gravimetric data which was the base for separating a geological trend. Next, the map of the trend was transferred into the distribution of well points for given velocity data and as a result we ended up with Rco maps. Then maps were calculated on the grounds of well data Rot. Later, similarity conditions of two pictures Rco and Rot, consecutive interval velocities, were checked. If the similarity conditions are fulfilled, we can transform the Rc distribution into Rk distribution of the final map, according to the equation:

$$Rk = f(Rc,Rco,Rot)$$

Then we set velocity distribution along a particular seismic profile basing on slices of Rk interval velocities maps. Set distributions of interval velocity were used in depth migration before the folding, gaining proper detph models on seismic profiles.

Conclusions

The calculated velocity distribution correlates with current assumed geological model. Significant concordance of interpreted distribution is present in those elements where geological structure results from detailed knowledge of surface observations and well data. Discrepancies are due to the fact that author of the geological profile makes his own interpretation of the deep structure of the Carpathians. Next argument for correctness of set distribution results from its comparison with different velocity madels in depth migration before the folding.

Assumed velocity distribution was verified by introducing geophysical logs on seismic profiles in the depth version.

Significance of Fluid Chemistry for the Origin of Siderite Mineralization in the Greywacke Zone of the Eastern Alps

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The rock series of the Greywacke Zone range from the Ordovician to the Carboniferous and comprise carbonates, metapelites and metamorphosed quartz porphyries. The siderite mineralizations are bound to the tectonically highest segment of the Greywacke Zone and to the basis of the Northern Calcareous Alps. A set of siderite mineralizations from Ordovician to Permomesozoic age was investigated:

Siderite veins in Ordovician quartz porphyries: The structure of this type of mineralization is that of a typical vein type deposit with siderite-quartz veins crosscutting Ordovician quartz porphyries.

Metasomatic siderite bodies in Devonian limestones: The most prominent example of this type of siderite mineralizations is the Erzberg in the province of Styria. Metasomatic-epigenentic structures are dominant, and usually coarse grained siderite ore exhibits crosscutting contacts to the unmineralized limestones.

Vein type mineralizations in Permoskythian hostrocks: Different mineralizations of this type were investigated within the course of this work (Gollrad, Grillenberg, Sohlenalm). The usual structure is that of siderite veins crosscutting Permoskythian sandstones and conglomerates.

Because of the incompatible behaviour of Br changes in the molar ratios of Na/Br and Cl/Br are very sensitive for fluids being affected by evaporitic processes (and ultrafiltration processes) or for fluids acquiering their salinities by dissolution of halite during migration through the crust. In the first case Br is enriched with respect to Na and Cl with prograding evaporation or filtration of formation water being expelled during diagenesis. The molar compositons of the fluids plot along the „evaporation trend" (fig.1). The inclusion fluids of the Erzberg siderite province fit well within this trend.

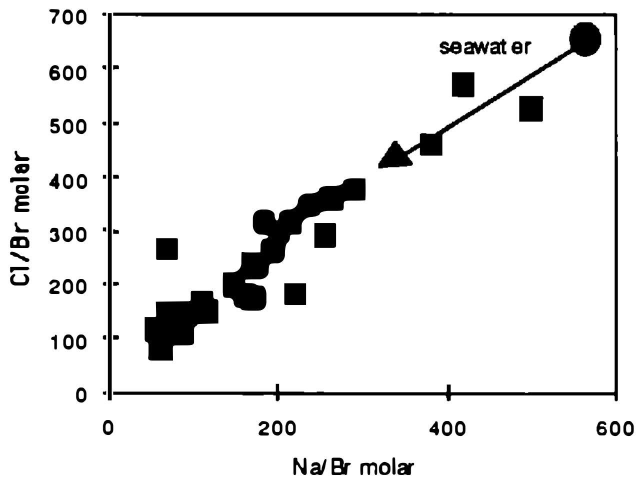

Fig. 1: Na/Br-Cl/Br molar ratios of the inclusion fluids of the Erzberg siderite province

In summary the siderite mineralizations from the Erzberg siderite province evidently exhibit epigenetic features. They were formed in an initial stage of the Alpine tectono-metamorphic event and can be correlated with extensional phases in the Permoskythian. The overall high Br-content may be indicative of this type of mineralizations. A fluid origin from Permo-mesozoic, halite- fracionated seawater is suggested.

This study was made possible by a grant of the Austrian National Bank project no. 5868.

FORMATION OF EPIGENETIC DJERDAP GORGE

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Volcanism in the Timok region commenced at the end of Cretaceous, continuing to the Middle Tertiary. But, the volcanism was preceded, as it is known, by the stage of initial magmatism, accompanied by remarkable uplift of the terrain. It means that in the Djerdap district (Fig. 1) uplift of the terrain and formation of larger ruptures began as far back as to the end of Cretaceous, in the time when Tethys included the later differentiated Panonian and Wallachian-Pontian basins. One could suppose that afterwards had existed Danube in the continental stage, and that this water course was in the Djerdap district controlled to the certain degree by larger ruptures. The Danube river periodically served as communication between Panonian and Wallachian-Pontian sea (in intervals between volcanic stages) and the river route initially was out of so called "Dunavski kljuc", meaning that from Donji Milanovac the Danube river had flown nearly rectilinear toward Prahovo (as it is traced, first of all, by the flow of Rumanian little river Cerna, left-hand tributary of Danube).

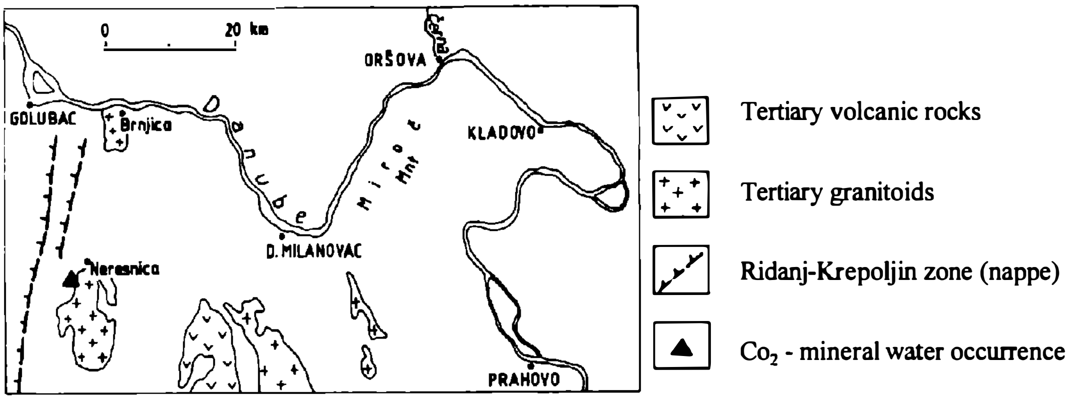

Fig. 1. The Djerdap district, with some geological features

The gorge cutting began, accordingly, during the initial stage of Tertiary volcanism and was closed in the final volcanic stage, when came to the regional uplift of the terrain and maximum raising of Southern Carpathians. Uplift of the terrain caused deformation of the Danube riverbed contours, the river route being accommodated to the weakened rupture zones respectively. Parallel to the terrain raising advancement the linear river erosion had been intensified, resulting in more and more deep cutting of the gorge. The large intrusive mass (during the final volcanic phase) in the Veliki Greben and Miroc district, prevented the rectilinear Danube flow in the direction from Donji Milanovac to Prahovo, the watercourse being turned to the north.

The Neresnica and Brnjica granitoid masses are, with regard to numerous indications, Tertiary in age (although the isotope analyses suggest the Paleozoic emplacement), thus representing plutons of the final stage of the Timok volcanism. As an important evidence of their Tertiary age are acid CO_2-mineral waters near Neresnica, as well as the thermal springs (now submerged) along the gorge. Mineral water is identical to occurrences of these waters at margins of the Bukulja and other (as proved) Tertiary intrusive masses in Serbia, which formerly also were considered as Paleozoic in age. If the Neresnica and Brnjica plutons would really be Hercynian, it could have meant that in this district already existed a pre-Neogene resistant mountain ridge, which later couldn't be cut by Danube. The elongate shaped intrusives parallel to the Ridanj-Krepoljin zone clearly indicate that the intrusive granitoid masses were emplaced after or synchronous with formation of the mentioned zone (nappe), meaning exactly in the period of the great volcanic activity in the Timok area (in the Serbian-Macedonian mass as well). The new and more exact investigation of absolute age of granites are necessary.

In the model of formation of the Djerdap gorge have been, accordingly, partially reflected the former hypotheses of numerous investigators considering fault systems, paleogeographic communications between Panonian and Wallachian-Pontian basins, the terrain uplift, but not the piracy hypothesis.

PETROLOGY AND GEOCHEMISTRY OF ULTRAMAFIC ROCKS IN THE EASTERN ALPS

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Ultramafic rocks are frequent in orogenic belts. Their early history may be obscured by deformation and metamorphism, which accounts for the uncertainty and controversy about their origin. They either represent fragments of upper oceanic or subcontinental mantle, cumulates of basaltic magmas or are products of ultramafic magmas. The ultramafic rocks of the Eastern Alps, commonly referred as to serpentinites, belong to different tectonic units and show different magmatic and metamorphic evolution histories. These units include the series of the Penninic domain which where overthrust during Alpine orogeny by the basement nappes of the Austroalpine domain.

Samples from ten different localities were selected for a comparative study of Eastern Alpine ultramafic rocks. The Precambrian to early Paleozoic rocks of the Schwarze Wand Ultramafic Complex, the Stubachtal Complex, the Felbertal serpentinite occurrence (all Salzburg) and the Ochsner-Rotkopf Complex (Tyrol) belong to the Prealpine Penninic unit. The Reckner Complex within the Lower Austroalpine Zone and the ultramafic rocks of Blauspitze, Ködnitztal (all Tyrol) and Wurmtaler Joch (S-Tyrol) within the Matrei Zone, comprising Pennine and Lower Austroalpine elements, are of Mesozoic age. The occurrences of Hochgrössen, Kraubath and Pernegg (Styria) are part of the early Palaeozoic Speik Complex of the Middle Austroalpine Basement units. Primary igneous structures, especially layers with pyroxene, are recognizable in the Ochsner, Stubachtal and Speik Complex.

Metamorphic ultramafic rocks show a wide range in composition, which is controlled mainly by the absence or presence of normative clinopyroxene. Within the ultramafic rocks of the Speik Complex the dominant rock types are dunites and harzburgites with an Al_2O_3-content of less 1 wt.%. In Kraubath and Pernegg dunite is more frequent and represents the residue after extraction of basaltic magma. Dikes of olivin-orthopyroxenites crosscutting the peridotite are also present in Kraubath and Pernegg. Some rocks of the Stubachtal and Ochsner massifs are notably different in containing normative clinopyroxene and can be distinguished of the general depleted harzburgites of the Schwarze Wand Complex and Felbertal. Such layers of olivin-websterites and wehrlites may represent ultramafic cumulates formed during magmatic differentiation. These cumulates are characterized by moderate Al_2O_3-contents of ca. 2.8 wt.% and high CaO reaching 18 wt.%, which corresponds to 67% normative diopside. Comparison of bulk chemistry of the analyzed lherzolites of the Reckner and Blauspitze with the other peridotites demonstrates a clear distinction. The lherzolites have significant high amounts of the magmaphile elements Al and Ti. The high Al_2O_3- (2.6-4.6 wt.%) and TiO_2-contents (0.9-0.22 wt.%) are comparable with values of a Primitive Upper Mantle, reflecting low degrees of depletion. REE pattern of Reckner und Blauspitze ultramafics display similar shapes. The samples are slightly LREE depleted (0.1 times chondrites) and represent a relatively undifferentiated, fertile upper mantle. The highly tectonized Wurmtal serpentinites, have in contrast to samples of the Reckner and Blauspitze, lower Al_2O_3- (1.2-3.2 wt.%) and TiO_2-contents (0.02-0.11 wt.%). Most of the investigated ultrabasic rocks have been completely serpentinized. The products of metamorphism are chiefly serpentine minerals acompanied by various combinations of diopside, olivine, tremolite, chlorite, talc, brucite and magnetite. In the lherzolitic samples of Reckner and Blauspitze relict clinopyroxene may exceed an Al_2O_3-content of 7 wt.% and a Na_2O-concentration of 1.5-2.0 wt.%. Magmatic olivine is restricted to samples of the Speik Complex. Compared with the metamorphic olivine (x_{Mg}>96), these have low x_{Mg}-values of 0.85-0.90 and higher NiO-contents of 0.25-0.40 wt.%. Orthopyroxene occurs in Kraubath and Pernegg with a composition varying from 6-10 mol% of ferrosilite solid solution. Chromite in the metamorphic ultramafics is extremly variable in composition. Spinels of the Reckner show intermediate Cr-values of 40-50, typical for lherzolite subtype, whereas chromites from the Speik Complex are predominantly rich in Cr with Cr# 0.73-0.95. However, the Kraubath and Pernegg spinels are characterized by lower Mg-values of Mg# 20-50 than those of Hochgrössen.

SOME PROBLEMS OF TRITIUM WASTE DISPOSAL IN CLAYEY ROCKS

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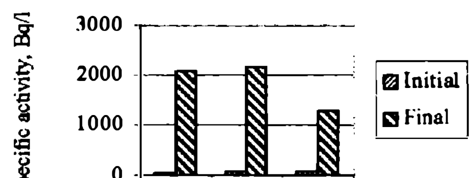
The radioactive waste repositories sites are probable source of radioactive contamination of the environment. The geological environment's response to technogenic tritium contamination was the subject of our investigation. We studied tritium accumulation in the underlying clayey rocks of the radioactive waste repositories site.

The main rock-forming minerals of containing rocks are quartz, feldspar and montmorillonite. To find out the structural position of tritium thermal analysis of the main rock-forming minerals was performed. Moisture losses resulting from heating of clayey rocks are caused by dehydration and dehydroxylation of montmorillonite. The water extracts distilled off clayey rocks according the data of the differential thermic analysis: in the temperatures intervals 16-120^{0}C (free water); 120-240^{0}C (interlayer molecular water); 240-450^{0}C (water of hydrogetite) and 450-700^{0}C (the structural water constitutional hydroxyls. Drawing below). Tritium activity in extracts increased in two order upon interaction of the samples with heavy tritium water having activity 4000 Bq/l for 180 days.

Tritium entry in the montmorillonite structure hydroxyls is possible as a result of the isotopic exchange. The structural peculiarities of the montmorillonite and radiochemical properties of tritium create the auspicious conditions for such exchange

Consequently, in situ and laboratory tests evidence that clay can be effective geologic-geochemical barrier to tritium contamination.

Tritium activity in water extracts, distilled in 450-700 C



	Sampl	Sampl	Sampl
Initial	58,33	83,33	82,19
Final	2098	2167	1274

Samples of the soil formed rocks

MORPHOGENETICAL STRUCTURO-RECONSTRUCTION IN A SW MODEL AREA OF THE BÜKK MOUNTAINS

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The above mentioned research was performed on the steep SW slope of the Bükk Mountains, which is made of pelagic Jurassic shales (84 %), interbedded laminated siliceous limestones (15.5 %) and thin interbedded radiolarite - siliceous shale lenses (0.5 %). The researched area is situated at 410-660 meters above sea-level, its extension is about 2.8 square kilometres. The basis of reconstruction was detailed geological-structurogeological mapping (scale of 1:5000), associated laboratory research and synthesised morphogenetic interpretation.

The thickness of the researched series is over 1 km, the original microfacies of the Jurassic series indicates the II-III Wilson-type facies-zone.

The main pitch of the series is nearly northernly with a dip of 30-50° In the centre of the series there is a similarly oriented anticline-pericline structure with an amplitude of nearly 100 meters (Imó-kő - Feketelen), the eastern limb of which is detached. The prepared surface of siliceous limestone, interbedding into the plastic shale mass, demonstrates a harmonic fold, in the central thickest part of which there are disharmonic phenomena detached by micro-faults and with small westerly curved parts.

The interpretation of the structures indicate the imbricational development of the area with NNW trend during the Cainozoic, and a folding with E-W trend. During the detachmental development of the Mesozoic mass of the Bükk Mountains, against the more rigid Triassic carbonate-system forming the Bükk-highland, the mainly plastic Jurassic shale series foliated trasversely forming back-curved layers, which are similar to an overthrust fold with S vergence. The main movements have NNW trend, whereas the compression movement toward NE must have been subordinate. There is a close connection between the movement of the Bükk Mountains and the main trends of Cainozoic development in the eastern part of the Carpathian Basin.

FORMATION OF HYPERGENE BENTONITE DEPOSITS IN THE BORSOD BASIN (NE-HUNGARY)

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The hilly region situated in the NE foreland of the Bükk mountains is formed by Miocene clastic sediment series. There were repeated transgressions of shallow, relatively warm Miocene seas into the tectonically dissected area characterized by oscillative movements. The actual intensity of geodynamic processes determinened the dissection of the area, the changing grain-size distribution of sediment series, its intraformational discordances and interdigitation with terrestrial series.

The sediment accumulation periodically (e.g. Badenian, Sarmatian) associated with an acidic volcanism forming the differentiated sheet tuffs and with neutral magmatism, which forms extrusive basic andesitic masses from the earliest Ottnangian to the Pannonian. The tuffs, tuff-lavas and tuffites of volcanic-volcanoclastic series partly resedimented, partly accumulated in autochthonous position and frequently bentonitised according to the sedimentational and paleohydrological conditions.

The largest bentonite deposite of the area was found, and mapped, between Miskolc and Sajóbábony by the authors. The deposit, which forms the ridge of an elevated hill, is exposed by erosional cuts. Besides the samples of three shallow depth drillings were collected for thorough analyses, (major and trace element composition, X-ray, DTA, grain -size analysis, micropaleontology etc). The deposit, the thickness of which may be more than 20 meters locally, was accumulated in neritic-sublithoral environments of the transgressive period of a Pannonian near-shore-fluvial sediment series. Its base and overlying beds were formed by fluvial and abrasional gravels and coarse sands. At the base of the deposit there are ten-million-year old andesitic volcanic block, tuff-lava outcrops and hypersthene placer beaches. The coarse sands and hypersthene placer beaches are even laterally interdigitated with the deposit.

According to our analyses the material of the deposit is mainly resedimented. Its lower two-thirds are andesitogenic, whereas the upper part shows mixed or rhyiolitic-dacitic tuffogene character Its main mineralogical composition is Fe-montmorillonite and crystobalite. Genetically it is one of the cleared resedimented deposit of the Carpathian Basin. The measured amount of montmorillonite in the 16 samples of 15-meter-thick section in Rock-valley is 20-65%, while the amount of illite is 5-30%, that of kaolinite 1-5%. In the other exposures of the deposit we could collect samples with 60-80% montmorillonite, some feldspars, carbonates and amorphous phase. The total amount of potassium seems to be 1,2-4,5%, that of sodium 1-1,5%.

INDICATIVE ROLE OF PLACERS, DRIED SURFACES AND HIATUSES IN THE RECONSTRUCTION OF THE MIOCENE PALEOENVIRONMENTS OF THE BÜKK-UPPONY MOUNTAINS AND THEIR SURROUNDING

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Based on the complex geological research of correlative sediment series accumulated on the foreland of the elevating central mass, we could demonstrate that the sedimentation of the NNE-E foreland of the Bükk Mountains was determined by oscillative surface-movements, by facies changes caused by these movements and by intraformational discordances, which indicate the syngenetic denudation and resedimentation of the non-consolidated young sediments.

The post-Eocene sediment series of the Bükk foreland indicate continuous structural development, the polyphasic imbricational overthrusting movements of the central mass with NNW trend, which were only slightly disturbed by geodynamic stresses with NE trend.

The Eggenburgian and Sarmatian series are especially capricious, but the Carpathian and Badenian series are also varied and meaningfully denuded by the simultaneous mosaically oriented erosional processes. Somewhere the Sarmatian sediments are nearly absolutely absent and it is usually quite difficult to separate the Sarmatian series from the similarly shallow-marine - fluvial - terrestrial type Pannonian series. The Sarmatian-Pannonian series is outcropped by the concomitant andesitic magmatism.

The sharp facies changes are determined by the nearly continuously active structural movements of the area and by the spatial position and acivity of the volcanic centres, nevertheless they are strongly correlated with intensity-changes of erosion as well.

The rock composition of the coarse sediments indicate local denudational surfaces, while the hypersthene-placers, sedimentat-cycles, padual and tuffogenic argillitic facies became associated with intensive oscillation movements of the area demonstrating rapid and mosaic-like burial and denudational processes.

EXHUMATION MODES OF AUSTROALPINE ECLOGITE-BEARING COMPLEXES IN THE VICINITY OF PENNINIC WINDOWS, EASTERN ALPS

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The investigated areas represent extremely shortened Alpidic domains with the buried crustal sheets, exhumed in the distinctive tectonic regimes. The applied methodological approach is based on field-mapping (Austrian GBA project 1991-1997) and some complementary structural-petrological and geochronological studies.

The Sieggraben eclogites and Grt amphibolites at the eastern austroalpine (AA) margin indicate burial conditions (DR1) at 730 °C and 14-15 kbar. The exhumation started at arised temperatures up to 770 °C and the breakdown of Om (39% of Jd) into Di+Pl symplectites. Other recrystallization minerals: Tch-Hbl, Ilm, Ttn, Bt formed at decreasing T and P The exhumation process was controlled by dynamic strain softening in Om and Zo, then Fsp, Am, Qtz, and Qtz and Cal. Textural (U-stage and X-ray) CPO patterns document micromechanism of dislocation flow during top-to-the SSE extensional shearing (DR2). A later stage of exhumation (DR3) was enhanced with top-to-the WSW extensional shearing, especially within the underlying (lower AA) Grobgneis and Wechsel units. U-Pb lower discordia intercept 103±14 Ma (MSWD=1.1) from Zr, Mnz and Ap of the granitic orthogneiss cutting the Sieggraben metabasite-marble complex, is almost identical with the same intercept obtained from Zr of the lower AA Wiesmath orthogneiss (109±18, MSWD=1.7), both proving a Cretaceous syn-metamorphic exhumation event. A model of collision-driven structural unroofing and exhumation is fitting for this AA domain.

The central part of the Kreuzeck Massif AA basement at the southeastern margin of the Tauern Window is divided by a large WNW-ESE trending dextral transpresion shear zone representing an exhumation suture of the Polinik and Strieden Complexes. The Polinik Complex consists of HP/HT-MT eclogites, Grt amphibolites, metaultramafics, gneisses and granitic-migmatitic orthogneisses. The micaschist-gneisses of the Strieden Complex contain Ky-St-Grt-WhM assemblage, which does not bear any features of a newer overprint. Mesoscopical and CPO fabrics asymmetries confirm dextral, or top-to-the WNW simple shear. Brittle-ductile period of transpression is marked by Early Tertiary undeformed NNW to ENE oriented dikes.

Extension-driven exhumation along a normal detachment fault can be documented within the austroalpine-pennine boundary at the eastern margin of the Tauern Window. The deformation of Cal tectonites during the uplift comprises mechanical twinning that transformed into dynamic recrystallization, and at last to cataclasis along the newly localized extensional shear bands. Together with asymmetric Qtz CPO patterns, both indicate top-to-the E extensional simple shear.

The outlined AA eclogite-bearing complexes appear to have been subducted within a thinned continental margin of the penninic realm and then exhumed within the AA structural complex during a long-term collision-transpression-extension events in Cretaceous to Early Tertiary.

CONTACT EFFECTS OF THE PIENINY ANDESITES ON THE SURROUNDING SEDIMENTARY ROCKS

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Intrusions of andesites near Szczawnica in the Pieniny Mts. (Poland) caused contact metamorphism of the surrounding sedimentary rocks. Shales in the contact zone are harder, more homogenous, and darker. Sandstones are more friable. The extent of contact metamorphism differs in relation to the lithology of sedimentary rock. Andesites are strongly altered close to the contact and exhibit chilled margins. Although several geological descriptions of andesites and their contact zones have been presented, the occurrence of mineral assemblages typical of contact metamorphism has not been noted previously from the study area. Mineralogical analysis of metamorphosed rocks is the aim this study

Marginal zones of andesites from Wżar and Malinowa near Szczawnica and sedimentary rocks (shales, sandstones) in contact with andesites were studied. It was possible to distinguished high-temperature contact metamorphism and low-temperature hydrothermal processes.

Contact metamorphism. Contact metamorphic mineral assemblages (which comprise garnets and pyroxene) have been determined in calcite cemented sandstoncs and shales from Wżar and Malinowa. Pyroxene occurs as clusters of several crystals or as discretc prismatic grains in the carbonate-rich cement of sandstone. The amount of pyroxene increases in the vicinity of contact with andesite. Garnet forms euhedral or subhedral grains. Atoll-like crystals are present also. Pyroxene and garnet is below 0.1 mm in size. Small amount of pyroxenes were determined also in shales from Wżar and Malinowa.
Electron microprobe results indicate that both pyroxenes and garnets are of calcium-rich varieties. The composition of pyroxenes is uniform and exhibits domination of diopside end-member (>91 mol%). The composition of garnets seems to be related to the distance from the contact. Garnets from the sample collected at 5 cm distance from the contact contain more grossular end-member (71-81 mol%) than garnets from the sample from 1 m distance (55-67 mol % of grossular).

Relativly narrow zones of contact metamorphism are related to small sizes of intrusions and the shallow depth of emplacement. Because of the limited period of thermal effect, mineral assemblages in thermally metamorphosed rocks are far from being in equilibrium.

Hydrothermal processes. Hydrothermal processes (carbonatization and argilization) operating at contact zones influenced both andesites and sedimentary rocks. Calcite replaces both phenocrysts and matrix in andesites. Partial replacement of framework grains in sandstones by calcite can be related to the carbonatization which occurs close to the contact and also to diagenetic processes. Argilization occurs in andesites and sedimentary rocks. It comprises chloritization (in andesites and sedimentary rocks from Malinowa) and the development of smectites (in andesites and sedimentary rocks from Malinowa and Wżar). The occurrence of chloritization in Malinowa suggests a higher temperature of argillization in this locality in comparison with Wżar, where smectite dominates.

Multi-element approach for the Variscan orogen within the Rhodopen Massif (Bulgaria)

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The Rhodope Massif cover a significant part of the Balkan peninsula. Metamorphic rocks metagranites, metabasites and metasediments, are outcropped in the eastern part. Several metagranites belong to the Variscan orogen (Peycheva et al., 1992). The pre-Variscan/Variscan basement was intruded by granites (Cretaceous-Paleogenic) and covered by Oligocenic sediments and volcanics.

This work presents studies, in which the duration of Variscan basement, in relation to plutonism and magma source, has been investigated by means of precise U-Pb zircon dating and Sr-Nd-Pb analyses. The purpose of these studies is to obtain a better understanding of the Variscan phenomena in the Rhodope massif.

The nature of the Variscan orogenic phase has been a matter of debate for many years; does it represent a phase of compression or is it a period of transtensional tectonics? Is it a typical example for an orogenic collapse? Geochemical and geochronological data: what is the age of the high-pressure/ high-temperature events? How can we explain the observation within the European Hercynides and Central Alpine basement with the data set for the East Rhodopen? There is considerable evidence that continental collision or crustal stacking was the motor for many phenomena for the Early Variscan evolution whereas lithospheric extension was the dominat part for the Late Variscan evolution. We know very little about the position of timing of the Variscan collision and extension: was it a contineous process during 40-50 million years or was it composed of several short-lived events?

U-Pb zircon investigations on metagranites from the East Rhodopes define an age range for the intrusion between 300 – 320 Ma (von Quadt & Peytcheva, 1995).

The ε-Nd_{T-320} values of the metagranites define a range of - 0.64 to - 5.8; the metagranodiorites show lower values of - 3.9 to - 5.3. The metagranites of the Kessibir Reka region are similar (ε-Nd_{T-320} - 4 - -5) to those from the East Rhodopes. Preliminary analyses from metagranites of the West Rhodopes show ε-Nd values up to - 7.7. The basic rocks (eclogites, gabbros) within the East Rhodopes point with ε-Nd_{T-320} values of + 4.5 - + 7 to an enriched source material.

Pb-Pb investigation on mafic and acid rocks show μ-values of 9.66 for the mafic and μ-values of 10.2 for the acid rocks. The U/Th ratios of the mafic rocks are different (0.47-0.84) from those of the acid rcoks (0.45-5.6). Model age calculation (Kober, 1985) reflect to an old lead component (2.2 – 2.7 Ga) and the high μ-values of all metagranites and metagranodiorites point to an old crust source which is involved within the Variscan evolution.

Conclusion:

- the obtained U-Pb zircon ages prefer an active Variscan plutonism in the East Rhodope Massif; the incorporated lead components prefer the existence of an old crust (Gondwana?)
- the Nd and Pb isotope data set demonstrate the participitation of a mantle component that a crustal stacking model was not the motor for the Variscan orogen; a collision model with subduction erosion seem to be possible to explain the obtained data set.
- Preliminary Nd isotope data from the West Rhodopen Massif reflect the incorporation of old crustal material during the Variscan orogen

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Fan delta conglomerates from the western margin of the southern Vienna Basin (Lindabrunn Conglomerate Formation, Upper Badenian, Miocene, Austria)

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During the Badenian stage of the Miocene, the Vienna basin formed a part of the western Paratethys Sea. Basin development was tectonically controlled by a pull-apart regime between the Eastern Alps and the Western Carpathians. At the western basin margin, to the south of Vienna, two facies were deposited: a conglomerate facies and to a minor extent a Corallinacea limestone facies (Leithakalk). The different types of conglomerate facies are known as „Gainfarner Breccie“, „Vöslauer (Badener) Konglomerat“ and „Lindabrunner Konglomerat“ The Lindabrunn Conglomerate Formation, belonging stratigraphically to the Rotalia zone (uppermost Badenian), is the only conglomerate which is still actively mined for building blocks and sculptural material in a large quarry. The conglomerates are composed predominantly of clasts derived from the Northern Calcareous Alps. This quarry allows insights in the sequences and internal organisation of this conglomerate facies.

The exposure has nearly an east (basinward) - west (landward) extent of about 200 meters. A distinct erosional surface, dipping at 4° towards the northeast, subdivides the conglomerates into two sequences. The lower sequence, of about 4 to 6 m thickness, consists mainly of massive conglomerate beds. Thin sandstone lenses occur within the conglomerates. The upper part of these lower conglomerates was deposited in erosional channels. A stacking pattern of channels can be observed. Thin reddish pelitic layers between low-angle bedded channel-fill conglomerates are indicative of inactive channel periods. The major erosional surface truncates the channel-fill deposits. The conglomerates above this surface were also mainly deposited in channels. Towards the east, in an old quarry, now out of operation, a coarsening-up sequence of sandstones to massive conglomerate beds, instead of these channel-fill conglomerates, occurs above such a distinct erosional surface. The sandstones and massive conglomerates of the Lindabrunn Conglomerate Formation are interpreted as sub-aqueous fan delta sediments, whereas the channelized conglomerates seem to be indicative for the fluvial part of this gravelly delta. The massive conglomerates show no distinct preferred clast orientation. Bioturbation is frequently observed in the sandstones. Rare information about marine (echinids, forams), as well as brackish to limnic faunas (ostracods) are available. In general, in the conglomerate sequences, both below and above the erosional surface, a coarsening-upward trend due to fan delta progradation has been established.

The Lindabrunn Conglomerate Formation, with its progradational trend, can be stratigraphically correlated with the Upper Badenian deposits of the central Vienna Basin, which are interpreted as a highstand system tract of the whole Badenian Sequence. In the terminology of sequence stratigraphy, the quarry exposes two parasequences, separated by a marine flooding surface, both belonging to the Upper Badenian highstand system tract.

MIXED AND MINGLED LAVAS AT OLIGOCENE MADJAROVO VOLCANO, EASTERN RHODOPES (BULGARIA)

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Magma mixing has probably played an important role in the genesis of the Tertiary extensional volcanism in the Rhodope Massif, Bulgaria. This report describes mixing processes in the Oligocene (32±1 Ma) Madjarovo volcano. Madjarovo paleovolcano is a shield volcano composed of high-K calc-alkaline and shoshonitic basic to intermediate lava flows with latites being the most voluminous rock type. The volcanic activity terminated with the most silicic lava flow of quartzlatite-quartztrachyte composition. The overall silica contents range from 51 up to 66-68 wt.% SiO_2 with noticeable increase of K during volcano evolution.

The volcanic activity produced two series of mixed basaltic andesite and shoshonitic lavas enclosed by latites (SiO_2=59-60 wt.%) and high-Al high-K and shoshonitic basalts (51-52 wt.%). The lower mixed series consists of 4-6 thin lava flows, showing all stages of mixing - from mingled hybrids to homogeneous hybrid rocks (blended mixes). The upper mixed series includes 2 or 3 lava flows of exclusively homogeneous hybrid rocks.

Mingling in the lower mixed series is well seen in thin sections as an alternation of dark, white and pink-brown compositionally different flow bands and lenses varying in size from a few mm to 1-2 cm. The light and black bands consist of similar phenocryst assemblages of olivine (Fo_{71-69}), clinopyroxene(Mg# 79-71), plagioclase (An_{80-88}), titanomagnetite, and groundmass composition (SiO_2=59-60 wt.%) which show that the black bands represent quench zones of the basic magma at the contact with the cooler more acid magma. The pink-brown bands and lenses (SiO_2=64.7 wt.%) consist of normally zoned plagioclase (An_{77-60}), biotite, clinopyroxene and titanomagnetite. Biotite crystals are strongly resorbed as a result of heating by the basic host.

Homogeneous hybrid rocks (blended mixes) have optically uniform groundmasses but evidence for magma mixing can be recognised from various disequilibrium features of the phenocrysts assemblages. These lavas contain two or more plagioclase populations: an euhedral, normally zoned with cores An_{77-71} and oscillatory outer zone (An_{63-50}), which is typical for the non-mixed latite lavas, and another reversely zoned with sodic core An_{45-60}, corroded by sieved high An intermediate zone (An_{63-84}) and sometimes followed by normally zoned outer rim (An_{53-49}). Similarly, the clinopyroxene shows a population of augite with Mg# 71-77, very often reversely zoned, sometimes containing biotite inclusions, whereas higher magnesium clinopyroxene of Mg# 87-81 occurs in crystal clots with olivine. Orthopyroxene phenocrysts have almost constant composition (Mg# 72.5-68.0). In a single lava flow coarse-grained overgrowths of clinopyroxene and olivine on orthopyroxene phenocryst indicate that the orthopyroxene phenocryst crystallisation was followed by renewed crystallisation within the olivine stability field.

Taken together, petrographic, chemical and isotopic (Marchev et al. unpubl. data) provide a simplified model for the magmatic plumbing system of the Madjarovo volcano. They suggest the existence of long-lived latite magma chambers at a depth of 10-12 km, periodically (at least twice) replenished by deep-seated basaltic magmas with increasing K content. This resulted in repetitive volcanic eruptions, and caused continuous change in magma composition in the upper chamber, which erupted as lavas with discrete compositions.

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EOCENE RADIOLARIA IN THE SKOLE UNIT (POLISH CARPATHIANS): PRELIMINARY DATA.

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Rich radiolarian assemblages were observed in the Variegated Shale Fm from the Eocene deposits in the Skole Unit (Rajchel, 1990, Bąk et al., 1997). The changes in radiolarian microfauna on the Paleocene/Eocene boundary and between the Variegated Shale Fm and the Hieroglyphic Fm are the most interesting problem. The first boundary is a global one, the second applies to paleoenvironmental trophic changes in the Skole basin only. The Variegated Shale Fm sediments formed beneath CCD, in slow depositions as far as the lower part of the bathyal zone. Their thickness in the axial part of the Skole basin varies from 190 - 130 m. The Variegated Shale Fm is petrographically diversified, mainly composed of red and variegated clayey and muddy shales. Its stratigraphical position has been determined from radiolarian investigations as Upper Paleocene - the lower part of Middle Eocene.

In the Paleocene part of the Variegated Shale Fm, a correlation horizon of the Bircza Lithothamnium Limestone Bed occurs. There are also lens-like lithosomes of: the Babica Clay - clayey and muddy cohesive flows; fine grained sandstones and mudstones of the Boguszówka and Kosztowa Sandstone. All these sediments belong to the foraminiferal Zone *Rzehakina epigona fissistomata.*

The Eocene part of the Variegated Shale Fm contains the Trójca Red Shale Mbr, cinnabar-red in colour, with clinoptillolite and rich in Radiolaria. In the western part of the Skole Unit there occurs the Chmielnik Striped Sandstone Mbr - polimictic, varigrained, turbidite siliceous sandstones abound with glauconite. This part of the Variegated Shale Fm belongs to the foraminiferal Zone *Saccaminoides carpathicus* and *Reticulophragmium amplectens.*

Preliminary investigations of Radiolaria from the Variegated Shale Fm have been conducted. The profiles studied were located in the southern part of the Jawornik-Dubiecko anticline on the central part of the Skole Basin, east of Rzeszów. On the basis of about 50 radiolarian species, four respective zones have been recognized: *Becoma bidartensis, Buriella clinata, Phormocyrthis striata striata* and *Theocotyle cryptocephala cryptocephala.* These radiolarian zones are currently defined from low latitudes of the world oceans (Sanfilippo et al. 1985). Comparison of these four zones with similar ones from the Caucasus and northern Russia will be possible. Among the Radiolaria described there are found many species not known previously in Poland: *Eusyringium lagena* (Ehrenberg), *Lamptonium sanfilippoae* Foreman, *L. fabaeforme* (Krashennikow), *Lithochytris cf. cheopsis* Clark & Campbell, *Lychnocanium bellum* Clark & Campbell, *L. conicum* Clark & Campbell, *Phormocyrthis striata striata* Brandt, *Sethocyrtis principi* Clark & Campbell, *Spongotrochus echinodiscus* Clark & Campbell, *Spongurus bilobatus* Clark & Campbell, *Theocorys anaclasta* Riedel & Sanfilippo, *Theocotylissa fimbria* Foreman, *Thyrsocyrthis cf. hirsuta* (Krashennikov).

Reconstruction of paleoceanographical conditions within the Carpathian branch of the northern part of Western Tethys are based both on the sedimentological and paleoecological investigations of Paleogene deposits and radiolarian fauna of the Skole Unit. Upwelling type of circulation probably took place during Paleogene in northernmost parts of the basin. The mass occurrence of radiolarian fauna within the Variegated Shale Fm indicates high primary organic productivity, most likely due to increased supply of nutrients carried by cold currents from deeper parts of the basin. Changes of Foraminifera/Radiolaria ratio during Paleogene presumably reflect fluctuations of the intensity of upwelling. Additionally, abundant glauconite grains within siliciclastic turbidite deposits are the evidence of their mass occurrence in a source area.

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REMARKS ON SULPHUROUS WATERS OF THE CARPATHIANS AND THE CARPATHIAN FOREDEEP

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Mineral and therapeutic waters (as well as peloids and medicinal gases) are the main assets of the Polish Carpathians. Representing carbonated, chloride (brines), thermal or sulphurous waters, they occur on the surface as natural springs or are made available with boreholes.

Sulphurous waters contain >l g/dm^3 sulphur (iodometrically determined) which is a therapeutic element. Ubiquitous in all tectonic units of the Carpathians, they represent mineral or therapeutic waters or acratopegae with low discharge. Associated with dislocation zones, these waters form through intensive migration that increases their mineralization. Specifically, sulphate ions originate from oxidation of pyrite, or may be formed by dissolution of small aggregates and coatings of gypsum disseminated in rocks or present on the fault surfaces. Hydrogen sulphide in groundwater is also linked to sulphates: their reduction takes place under anoxic conditions in the presence of either organic compounds of carbon or hydrogen molecules and is controlled by reducing bacteria. The presence of organic substances is necessary for the process to proceed as they are nourishment for the bacteria. In the Carpathians, substantial amounts of organic matter are contained in black or brown shales, also as natural oil and gas. It is easy to distinguish springs of sulphurous waters in the field: they emanate characteristic odour of hydrogen sulphide and reveal on their bottoms and along water outlets white coatings or festoons, formed by sulphuric bacteria. The content of hydrogen sulphide in Carpathian springs is from 2 to 220 mg/dm^3, except for a spring in Nowy S¹cz, where it is 60 mg/dm^3 (the spring is associated with Miocene rocks). Sulphurous springs occur in the Carpathians either individually, as it is e.g. in Barcice, Pora¿, Zagórze, or in groups, e.g. in Nieborów, Grybów, Lipnica in Orawa.

In the Carpathian Foredeep there occur chloride, sulphate and sulphurous waters. The latter two usually co-exist and their presence is linked to meteoric water that becomes mineralized during its flow through Miocene strata. The sulphurous water is genetically associated with reduction of sulphates. Carstic hollows and fractures, gypsum- and sulphur-bearing Miocene horizons as well as their carsted basement, built of marls and limestones, represent reservoir rocks of the sulphurous water. Empty rock spaces of any kind facilitate not only accumulation but also mixing of waters of various types and origin. The content of hydrogen sulphide in the water of the Carpathian Foredeep is from 2 to 220 mg/dm^3, except for the boreholes We³nin 1 and We³nin 2 near Solec where it is 875 mg/dm^3. The waters of Cracow, Krzeszowice, Busko Zdrój, Solec and Horyniec have been used in balneotherapy for years.

Cracow is a single town in Europe with vast reserves of variegated mineral waters of the artesian type. The sulphurous water of its Mateczny deposit, tapped with three boreholes, is unique among Polish waters. Similar waters have been boasted by health resorts in Karlove Vary (the Czech Republic) and *Borzhomi* (Georgia). The Mateczny water, with the TDS of 3.5 mg/dm^3, contains Mg, Ca, Sr, Br, B, Li, Mn, Cd, F, I and Se. Besides its use in balneotherapy, it is marketed as drinking water under the trade name „*Krakowianka*" The age of the water of Mateczny has been established by isotope methods as 10,000 years and linked to the final stage of the last glacial period.

In Swoszowice (one of Cracow's boroughs) the sulphurous water has been used for medicinal purposes since 15th century. From the Miocene gypsum-salt series there flow out two springs, „*G³ówne*" and „*Napoleon*" The „*G³ówne*" spring is a dug artesian well with a depth of 10.2 m, while the „*Napoleon*" spring discharges water from the old outlet of a collapsed adit. The water is of a sulphate-bicarbonate-calcium-magnesium, sulphurous type, with the hydrogen sulphide content of 61 g/dm^3 and TDS of 2.7 mg/dm^3 The sulphurous water of Swoszowice is comparable with the water from the Slovak spa Pistøany.

Springs of sulphurous water are a valuable natural asset, some of them being particularly predestined for protection as nature reserves. However, the current rate of their devastation is frightening and a concerted action of scientists is needed to rescue at least part of springs vanishing under our eyes.

THE QUATERNARY SEDIMENTS OF THE SOUTHERN PARTS OF PANNONIAN BASIN AND THEIR MARGINS

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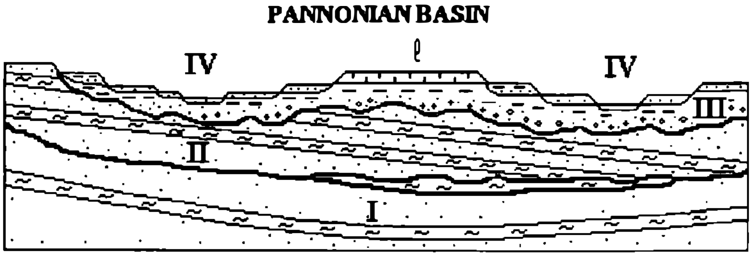
There are three leading opinions about problem of lower boundary of Quaternary in southern parts of Pannonian basin. According to the first, Upper Pliocene lake also existed very long time in Quaternary, and that is the reason for using "transition beds" to help boundary underlining between two periods, or conditional acception that, for the same lake environment, Quaternary starts with "beds with *Vivipara böchi"* Another opinion based on the ostracods supposes that lower boundary of limnic Pleistocene is located close over Pontian, what means that lower Palludina beds (Middle Pliocene due to their facial established position in Serbia) belongs to Eo-Pleistocene. Third opinion, belonging to authors of this paper, is based on proved successive paleogeografic changes, during Pliocene and Quaternary, which were manifested with change of four different lithogenetic complexes wirh clearly defined boundaries.

THE LITHOGENETIC COMLEXES IN THE SOUTHERN PART OF THE PANNONIAN BASIN



KEY:

I - $Pl_1 + Pl_2$ Marine sediments
II - $Pl_3^{1,2}$ Lake sediments
III - Q_1^{1+2} Polycyclic river sediments
IV - Q_{1+2} River sediments
ℓ - Q_{1+2} Loess

In brief description, in the oldest marine cycle were deposited caspibrackish sediments. In their youngest parts are presented scarce marine fauna and extremely rich freshwater fauna. The younger, Upper Pliocene lithogenetic complex has undoubtly limnic character and lies discordantly over Pontian and lower Palludina beds. In next episode, after flowing of lake at the end of Upper Pliocene, Pannonian area transforms into the composit alluvial plain in constrative dynamic stadium. In this complex flow aquatorium in initial fluvial phase were deposited so-called "fluvial-limnic" or " polycyclic fluvial sediments" (Rakić, 1977). At the same time in valleys of marginal parts are formed river terraces of perstrative type with monocyclic river sediments and, where they are not present, polygenetic cover (built of prolluvial and delluvial deposits) occurs instead of mentioned ones. Finaly, in the youngest phase (after Mindel), differentiation of Pannonian rivers valleys were happened, on which sides are presented: two Pliocene, older Holocene and recent (inundational) terraces. The same valley system is established for the other rivers of Danube river basin.

Parallel with deposition of the youngest alluvial paragenetic row were deposited aeolian and delluvial sediments which lies over Eo-Pleistocene and younger deposits of different genesis and stratigraphic determination.

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RISK MANAGEMENT OF NATURAL DISASTERS AND ECOLOGICAL CATASTROPHES - A BOOK FOR DISTANT EDUCATION

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Bulgaria is one of the most vulnerable countries from different natural disasters or man-made ecological catastrophes. More than 60 different geodynamic processes such as earthquakes, landslides, floods, forest fires. tsunamis, hails, icing, frogs, erosion, active faulting, loess subsidence, etc., are often observed on the territory of the country. Usually the big events of such type produced many economical loses and human deaths.

There are also many man-made catastrophes connected with the industrial, biological or radioactive wastes and polluters. Mining activity, industry, NPP, developed chemical and biological facilities equipped by old and not protected equipment are the main sources of the environmental pollution. Many accidents in the mines. oil and gas industry, chemical and biological productive facilities, very often bring human deaths or health decease.

During the last 5-6 years the statistics of such accidents show more than 5 000 deaths and injured.
To avoid this negative tendency, which became more clear some measures have been taken on the governmental, regional or local administrative levels. The execution of some tasks connected with the protection and the prevention of the population, show relatively low knowledge of the administrative officers to treat the appearing problems.

This create an idea to develop an educational program, to increase the knowledge of the physical processes, the possible negative consequences and the protective and prevention measures applied by the decision makers to the population.

As a result of this activity many different tasks have been developed and some of them executed. Following the international experience and national specific conditions a general scheme of the risk management in the case of the extreme events has been created.

In the frame of IDNDR many activities for the people education have been performed in Bulgaria. Several educational TV movies (on earthquakes, volcanoes, floods, forest fires, landslides, etc.) have been created and emitted by the national TV channels in the special organized thematic program called "Cataclysms" A program for the protection of the young generation of the negative consequences created by the ecological catastrophes has been developed and partially executed. Due to the very big economical difficulties in Bulgaria, large support by different international organizations has been provided.

A map of the geological hazards of Bulgaria in scale 1:500 000 has been created and on it can be seen the large influence of the natural disasters as well the man-made negative activities to the land and people vulnerability Following the idea that good education can decrease the direct and indirect losses by the increasing of the knowledge on the physical processes, negative consequences and right people's behavior before. during and after the disaster, a special book entitled "Risk management of natural disasters and ecological catastrophes" has been edited for the distant education of different target groups. Decision makers. Civil Defense officers, journalists, insurance agents, etc., can increase their knowledge on the described topics. The book is largely illustrated by tables, graphics, photos and provides a self-educating opportunities. The book is easily adaptable to the wider auditory in dependence of its educational level.

For the most interested students special items for scientific research have been provided including specialized topics of research as: scenarios for different catastrophic situations, research of the local hazards where the students live or work, data collection for statistical investigations, people protection measures in a case of catastrophe, etc.

KRESNA SEISMIC ZONE A UNIQUE OPPORTUNITY FOR EARTHQUAKE PROCESS RESEARCH

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The Kresna seismic zone (SW Bulgaria) is famous with the two strong earthquakes occurred on 4-th April 1904. Both shocks (M=7.2 and 7.8) generated big destructions of the buildings , many secondary effects such as landslides, rockfalls, mud and sand volcanoes, surface ruptures and many, many deaths and injured. The shocks have been followed by a long and strong aftershock series, due to the source depth (30-40 km.) and other specific peculiarities of the origin. The zone has been chosen because of the very interesting behaviour of the seismic process as well as the most active zone on the territory of Bulgaria and its location on the boundary of Bulgaria, Greece and Macedonia. It is surrounded by other separate zones with their own life and regime, placed in the near vicinity. The interactions between them is also a very interesting scientific and practical problem.

The first shock with the estimated magnitude of 7.2 appears as a foreshock of the second one 20 minutes later. It produced an epicentral intensity of IX degree MSK. The second shock have an epicentral intensity of X degree MSK and estimated magnitude of 7.8, checked as well by the records of some world seismic stations established before the origin time (for example Potsdam, Athens, etc.). The zone is still the most active on the territory of Bulgaria.

For the purposes of the seismogenic potential assessment a hard job of data collection has been done. Two main directions have been developed:
- Collection of macroseismic data
- Catalogue

The collection, transfonnation and creation of the macroseismic maps helped us to edit "A Set of the Macroseismic maps for the Kresna seismic zone" It covers the rectangular area with coordinates: 41,5-42,5E; 22,5-23,9N.

From the beginning of the century to the present days more than 80 macroseismic maps have been adapted in compatible form. Some of them consist of isoseismals only, some with the points of observed intensities, another with both combinations. To preserve the original shape, we avoid till now any changes, but put on the disposal all references, from which the originals can be extracted. [A Set..., 1998]. Some of the bigger maps have different interpretations of the primary macroseismic data and their isolines have been preserved as well.

The unified catalogue creation needs more efforts, because of the different ways of the data. The catalogue consists of more than 4 500 events from the oldest times to the present days. It is clear that these data are inconsistent in the time, space and magnitudes.

The magnitude-frequency relationship show usual distribution with some peculiarities. Near the big values some constant behavior for the quakes with the magnitude greater than 6.0 - 2 -3 events exists. For the magnitudes smaller than 2.5 can be recognized that the registration time is still not enough to cover the normal shape of the frequency-magnitude relationship.

The interesting behavior of the seismic process and the well investigated geological and tectonic environment
suggests that the choice of this zone as a test site for the seismic potential research is good.

The above mentioned peculiarities and the rich data collected provide the unique possibility to investigate the seismogenic potential of this zone with the new and sophisticated methods.

This work has been supported by the ASPELEA Project with EU (ERBIC15CT970200)

GIS-SUPPORTED MODELING OF STREAM-SEDIMENT GEOCHEMISTRY: HANDLING OF FUZZY DATA IN GEOCHEMICAL APPLICATIONS

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Uncertainty is a fundamental property of geological data (e.g. Mann, 1993). In this contribution, stochasticity, which is inherent in geochemical data of stream-sediments, is expressed by means of fuzzy sets. The complex system which produces the geochemical data in the sediment is reduced to a conceptual model consisting of the components lithology-erosion-transport-accumulation. This system is investigated using the geochemical data base of Austrian stream-sediments (Thalmann et al., 1989) within the "Nockgebiet" of Carinthia and applying multivariate statistical techniques in combination with a geographical information system (GIS).

In a first approach the lithological induced background concentrations inherent in geochemical data are used to construct a lithological map of the study area. The comparison of different techniques (multivariate regression, Bayes modeling, fuzzy modeling) demonstrates a relationship between the classification quality and the geochemical contrast of distinct lithotypes. Using only geochemical data of stream-sediments the relationship between lithology and geochemical signature in the sediment is seen from the relationship between observed and predicted lithology within a training area.

Geochemical anomalies modifying the background concentrations are identified and quantified by applying limited fuzzy clustering (Kramar, 1995). They are seperated from the geochemical background by the assessment of cluster assignment errors, which can be interpreted as concentrations exceeding the lithological induced concentrations. In the study area there is no spatial relationship between mineral deposits and geochemical anomalies.

In this study it is demonstrated that modeling of uncertainty which is inherent in geological data is a way to come to better geological predictions.

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LATE OROGENIC DISPERSION OF FOLDS IN SILESIAN NAPPE, WESTERN OUTER CARPATHIANS (POLAND).

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The Polish segment of the Outer Carpathians represents a north-verging fold-and-thrust belt composed mostly of the Lower Cretaceous through Lower Miocene flysch. The belt is comprised of several nappes. One of these nappes, the Silesian nappe extends along the whole belt. A part of this nappe, located in the Dunajec River valley has been the locus of this study. The folded rocks, within the study area are cut by numerous thrusts striking generally W-E and cross-fold faults. According to current opinions, the rocks within the Silesian nappe were folded only once, during Late Oligocene through Early Miocene times. The studied part of the Silesian nappe was folded before the Late Badenian (14 Ma).

The study area has been chosen for two reasons. First, the Silesian nappe was formed into bend convex towards the NNE and the study area lies within inflexion zone. Second, the regional fold axes within the Silesian nappe change their orientation in the study area. East from this area, these fold axes trend NW-SE, whereas towards the west they strike W-E.

This paper is focused on the distribution of the regional fold axes. The study area has been subdivided into 17 domains, bounded by tectonic contacts. Strata orientations have been measured separately for particular domains, at least 40 measurements for each domain. The total number of measurements is 1667

Bedding dips generally up to 45°, to the south. Overturned beds occur very rarely. The stereoplots have been made separately for each domain. Bedding orientations form generally single girdles, occasionally ellipsoids. Ellipsoidal projections occur when all measurements come from a single fold limb (the surveyed beds dipping normally). Both kind of the stereoplots show that the folds are cylindrical inside domains. Two domains reveal less coherent fabric. The folds are sub-cylindrical inside those domains. Moreover, all reconstructed fold axes plunge shallowly, generally less than 10° (max. 15°). The orientation of the fold axes differs distinctly between particular domains from N-S to NW-SE, to W-E (predominant), to WSW-ENE.

Such variable orientation of fold axes between particular domains could have been caused either by refolding or by rotations of domains. The refolding is not likely because the stereoplots show generally coherent fabric. Also, the orientation of fold axes does not reveal two predominant directions as a result of two folding events. In such case, the rotations, in turn, are more possible as a cause of the fold axes dispersion. These rotations have dispersed a original single fold set. Therefore the rotations were later, than the folding, which took place before the Late Badenian (14 Ma). The rotations could be related to the bending of the Silesian nappe. The bending involved extension probably caused breaking of the bend into blocks (domains) associated with individual rotations of these blocks.

SEDIMENTOLOGY AND GEOCHEMISTRY OF BAJOCIAN DEEP-WATER MARL/LIMESTONE DEPOSITS FROM THE MECSEK MOUNTAINS, SOUTHERN HUNGARY

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In the Mecsek Mountains (Tisza Terrane, Southern Hungary) an Aalenian-Bajocian rhythmic limestone-marlstone alternation crops out. To explain the origin of characteristic bedding phenomenon of Komló Calcareous Marl Formation sedimentology, clay mineralogical composition, major, trace element and stable isotope geochemistry were examined. Samples were collected from one section representing the lower part of the Bajocian stage.

According to the results of thin section analysis, hemipelagic processes without any erosive redeposition seem to be the main control on sedimentation. Nepheloid plume activity, however, as special sediment transport effect may not be excluded.

In the Bajocian hemipelagic/pelagic sediments, the clay fraction is dominated by illite and illite/smectite mixed-layer phases. Kaolinite is rarely found. Mixed-layer illite/smectite is characterized by 40-70 percent illite proportion and mostly random or 1/4-type ordered interstratification . These facts reflect preferential replacement of smectite by illite during burial diagenesis. This group of clay minerals attests erosion of smectite-rich soils developed under warm and seasonally humid climate and indicates 100-130°C maximum heating temperature during burial. Discrete illite is abundant, it seems not to be altered by burial diagenesis. Besides illite, the sparse occurrence of kaolinite, chlorite and abundant mixed-layer phases suggest a relatively distant source area during deposition. The abundance of the clay mineral types does not correlate with the lithologies suggesting that processes forming the alternation of carbonate-rich/carbonate-poor semicouplets could not affect directly the formation of clay minerals.

Stable isotope values of samples show higher $\delta^{18}O$ and $\delta^{13}C$ values in carbonate-rich beds relative to carbonate-poor beds. The stable isotope signal suggests the following:

1) Diagenetic carbonate dissolution and reprecipitation seem to be inefficient in producing rhythmic layering. Some diagenetic overprint on the stable isotope signal cannot be excluded. 2) Carbonate-rich semicouplets had formed during the periods characterized by enhanced bioproductivity. Their carbonate content precipitated from surface seawater controlled by relatively „arid" and/or „cool" climate periods. 3) Carbonate-poor semicouplets had formed during periods characterized by enhanced dilution from continental terrigenous sources. Carbonate content of carbonate-poor semicouplets were precipitated from surface seawater controlled by relatively „wet" and/or „hot" climatic conditions.

Carbonate-rich semicouplets are characterized by good oxygenation as expressed by the Mn* parameter, as well as the low Cu and Zn values. High Si/Al, P/Ti, Sr/Ti ratios and low Ti values indicate enhanced bioproductivity and low terrigenous supply during their deposition. The carbonate-poor semicouplets are, on the contrary, characterized by moderately oxic (dysoxic?) conditions (because of the Mn* parameter, higher Cu, Zn and V values) in spite of their bioturbated character and very low organic matter content. The low Si/Al ratio and very high Ti values indicate that marlstones received a substantial contribution from a terrigenous source. Bioproductivity seems to be moderate during deposition of marly semicouplets according to the low P/Ti, Sr/Ti ratios.

The sedimentation of Komló Formation was controlled by changing conditions. These alternating conditions are 1) efficient mixing, highly fertile surface and near-surface waters as well as and well-oxygenated seafloor, 2) enhanced runoff or decreased evaporation, or both, and weakly oxygenated bottom waters. The changes in sedimentation-controlling conditions may be attributed to alternating estuarine/anti-estuarine circulation of the basin.

INTEGRATED PLANKTON STRATIGRAPHY OF LOWER CRETACEOUS PELAGIC CARBONATE SEQUENCES IN WESTERN CARPATHIANS

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Phyletic evolution of planktonic microorganisms studied includes a number of events very favourable for detailed interregional and intercontinental corrclation of the carbonate deposits of pelagic origin, mainly in regions such as Western Carpathians are, where cephalopod remains (ammonites, belemnite rostra, aptychi) are very rare. Late Tithonian to Early Albian sedimentary record represented by regularly bedded white to grey cherty pelagic limestone sequences in contact with the underlying Ammonitico Rosso (or with more basinal marly limestones and marlstones). The biostratigraphic framework is based on calpionellid distribution supplemented by calcareous nannofossil, planktonic foraminifer, radiolarian and calcareous dinoflagellate zonations. The results obtained by common study of different fossil groups clearly reveal the advantages of this approach for establishment of accurate, fine and reliable biostratigraphic standards of the Tethyan Lower Cretaceous stages.

Detailed and integrated data on the vertical distribution of planktonic associations above mentioned are obtainable by co-sampling of same levels at same sections: to select characteristic bioevents, mainly first and last occurence data, within the parallel successions of these microfossil groups; to evaluate the biostratigraphic potencial of the selected bioevents for refining and enhancing the resolution of Lower Cretaceous zonal schemes, as well as to investigate changes in evolution and distribution of calcareous microplankton components in interaction with the changes of the paleoceanographic and paleoclimatic regime.

Integration of different para – biostratigraphic scales use to be hampered by diferences in paleobiogeographic and facies distribution, different diagenetic preservation, different development of knowledge of microfossil groups, and, sometimes, also by lack of cooperation between individual specialists.

The bioevents recorded in calpionellid-, calcareous nannofossil-, planktonic foraminifer-, radiolarian- and calcareous dinocyst evolution do not coincide. Thus, the accumulated number of successive, non - coinciding bioevents enhances potential for the high-resolution microbiostratigraphy. Evolution of these groups of calcareous microplankton reflected global climatic changes influencing directly the salinity and water temperature. Several stagnation and radiation phases have been identified during the process of their quantification. It seems that these phases coincide with movements of the sea level. Thus, they can serve as one of useful indicators of the sea level fluctuation.

OUTCROP GAMMA-RAY LOGGING OF DEVONIAN SHALLOW MARINE DEPOSITS: EXAMPLES FROM THE GRAZ PALEOZOIC (AUSTRIA).

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Recent geological investigations focused on the Upper Nappe System of the Graz Paleozoic (Upper Silurian to Upper Carboniferous) include the recording of outcrop gamma-ray logs in addition to standard methods yielding "conventional" lithological parameters.

Individual formations (lithostratigraphic units) differ considerably with respect to their gamma-ray signatures, showing a distinct relationship with their lithological characteristics. Outstanding fluctuations of gamma-log data (measured in profiles predominantly built-up of carbonate rocks) are correlated with lithological changes (e.g. limestone-marl alternations, intercalation of tuffite-layer, lydite, phosphorite-nodules horizon etc.).

Striking features of some gamma-ray logs are outstanding values (minima or maxima) that cannot be attributed to such lithological criteria at the basis of field observations.

The "Barrandeikalk"-Formation (a sequence of fossiliferous limestones interbeded with marls) was selected to explore the geological reasons for such unexplained "odd" gamma-values. The gamma-values observed in this section are significantly correlated with the quantity of insoluble residue (as expected) but some data suggest the existance of additional control mechanisms. This can be demonstrated by rocktype-specifc analysis of data: some of the marls yield lower gamma-ray values than the limestones within the same profile.

The relationship between gamma-ray values and

- insoluble residue
- microfacies type ("energy dependence")
- calcite / dolomite - ratio
- content of S, C-org
- trace elements

was subject of our investigation. The correlations of the parameters listed will be demonstrated.

BRITTLE - DUCTILE TECTONICS IN A SHARE ZONE - BETWEEN THE GETIC AND SUPRAGETIC UNITS

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Basement rocks of the South Carpathians are currently assigned to three major Alpine nappe systems : the Danubian with granitoids and metamorphic sequences , the Getic and Supragetic .They consist mainly in medium - grade sequences . Low - grade domains were previously interpreted either as prograde Variscan metasedimentary series or as domains of Variscan regional retrogression on the Precambrian crust , the importance of the Alpine events being neglected . We interpret the low - grade sequence at the boundary between the Getic and the Supragetic units - known as the " Sibisel series " - to be an Alpine lithotectonic assemblage developed on the Getic crust within a retrogressive shear zone .The shear zone with with about 1 km wide greenschist association can be followed in the right bank of the Olt river and further in the north of the Sebes Mountains Contacts with adjacent medium - grade crust are gradational The lithological content chows retrograde assamblges and also relicts reflecting both histories of the Getic realm (augengneises , staurolite - almandin micaschists , blastomylonitic - biotitic schists) and early stages of the Sibisel shear zone (igneus acid - basic rocks which are following the shear zone trent and are occasionaly slightly deformed and rotated to paralelism to the main schistosity) . Subhorizontal liniations are set in a generally steeply eastward deeping foliation Two sets of stretching liniations and an triaxial strain ellipsoid , are showing an L - S tectonite . Tails in pressure shadows , formed in the softening reaction of rigid grains in the mylonitization process and also by dynamic recristallization Shear - band geometry indicates and S - C mylonite in an ductile shear zone . Fractured and sheared grains produced by cataclasis are sometimes sealed by ductile recristallization structures themselves fractured Syntetectonically overgrowth of minerals as amphibole tend to grow in the local dilation strike . Ductile deformed amphiboles ask relatively high temperatures which could be locally achieved through the shear heat . Chloritoid post - tectonic growth occures epitaxially on the host structure . The microstructures indicate a change in the flow pattern from more continuous and distributed ductile deformation to a more localized discontinuous deformation involving fracturing and sliding . We propose the following evolution for the studied tectonites cataclasis I ------- dilation ------- increase of rock permeability ------- hidration I ------- blastesis ------- water consuming ------ cataclasis decrease ——— ductile behavior ——— uplift ——— cataclasis II ------- post - tectonic hidration ------- blastesis .Generally accepted as a compressional deformation zone , all the fabrics and structures are pointing out an extention domain with dominant brittle - ductile structures and possible polyphase activity The Sibisel assamblage is the exhumed brittle - ductile transition of the Middle - Cretaceous transcrustal shear zone sealed by the Late - Cretaceous sedimentary cover . Recent Ar / Ar data in the South Carpathians suggest Variscan age for the medium - grade tectonothermal event and Early to Middle Cretaceous ages for the low - grade ones . The " Sibesel shear zone " may represent either a dextral strike - slip zone which cut across the local trend of the Carpathian Orogen or the zone at the sole of the " Supragetic nappe system " , reoriented in an east dipping lateral ramp (listric fault system) .

SOME ASPECTS REGARDING MORPHOLOGICAL VARIATIONS OF ZIRCON CRYSTALS FROM MUNTELE MIC, SOUTH CARPATHIANS, ROMANIA

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Muntele Mic is included in the old granitoids of the Southern Carpathians. It is intruded in the Precambrian medium-grade crystalline formations of the Lower Danubian Unit (Bodu Series) and Upper Danubian Units (Zeicani, Godenele, Magura - Marga and Barnita Series).

It is composed of granitoids rocks, as granites and granodioritea and sometimes, diorites. A specific characteristic of the massif is the small quantites of mafic minerals, as hornblende or/and biotite, the majority of the identified petrotypes being leucocrate ones. As an exception, must be mentioned diorites, that due to a high proportion of biotite, have a stronger mafic character.

Zircon crystals identified using a specific methodology for heavy mineral is usually associated with common accessory mineral species for granitoid rocks, as apatite, garnet, magnetite.

Zircons are characterized by a long prismatic habit, determined by the large development of the prism faces. It is evident a predominance of the (110) prism faces, comparatively with (100) ones. The pyramid (101) faces are much better development, then (211) ones. These growth differences determined two morphological types:

- simple crystals, with simple terminations, determined by well-development of (110) and/or (100) prism faces associated with (211);
- complicated crystals, with complicated terminations, that have well-developed, (110) and/or (100) prism ones combined with (201) and (101) pyramid ones.

The typological study (according to Pupin, 1980) has emphasized morphological types, crystallized from melts with deep source, pointing out the possibility for some crustal contamination.

Sometimes zircons crystals are overgrowth, zoned and contain opaque and/or transparent (zircon, apatite) minerals

MG-PHYLLOSILICATES FROM LOTRU MOUNTAINS SOUTH CARPATHIANS, ROMANIA

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This study deals with Mg-phyllosilicates in ultramafic rocks of Lotru Mountains, as Păscoaia's ones. It has been mentioned in the Getic crystalline formation (Savu et al., 1982), beloginning to the Upper Precambrian.

Metasomatic processes determined, generally, by the main metamorphic phases, have produced some significant exchanges in physico-chimical equilibrium of the initial ultramafic rocks, determining some changes in their mineralogical context, and finally, the total and partial substitutions of some initial mineral phases and the crystallization of new ones.

Some Mg - philosilicates, as chlorites, serpentine minerals, talc, black micas have been studied for determining their chemico-structural characteristics, using chemical methods (dry powder method) and physical analytical ones (IR, RX, DTA).

C h l o r i t e s have a few spreading in the mineral assemblages emphasized by the Poniasca ultramafic body of the Paring Mountains. The investigations pointed out a Mg-chlorite, **clinoclore** type, with very interesting exchanges between cations, on the tetrahedral or octahedral levels. So, it is obvious some substitutions as Si $\rightarrow$ Al, or Mg $\rightarrow$ Fe^{2}, Mn, Fe^{3+}, Al, in both levels. All these substitutions do not modify their tri-trioctahedral character.

T a l c met as (1) well-individualized colourless lamellae, or (2) small grains very tight associated, has a low Al-character, and Ca is includes in its rethicular structure. The Al- lack determined a configuration of tetrahedral level, as follows: Si - Al - Fe^{3+} Its octahedral level is compound by Mg, Fe^{2+}, Fe^{3+}, Mn, Ni, Co.

S e r p e n t i n e m i n e r a l s, are represented by three structural types: *lizardite, crysotile and antigorite*. The high sensibility of serpentines at the chemico-structural exchanges of the geological context, has determined, frequently, some important structural exchanges at their lattice level, so that they are very intimate associated. It is remarked a low aluminous character, that determined a Si - Al - Fe^{3+} configuration for tetrahedral level. At the octahedral level, substitutions as Mg $\rightarrow$ Fe^{2+}, Mn, Fe^{3+}, Cr. Ni, are very frequently, but unsignificantly. (under 1 sfu). The investigations of serpentines using physical methods (IR, DTA) emphasized two main serpentine associations: (1) main antigorite, and (2) chrysotil-lizardite one.

THE TECTONOMETAMORPHIC EVOLUTION OF THE BRENNER AREA (TIROL, AUSTRIA): NEW Ar/Ar- AND Rb/Sr-DATA

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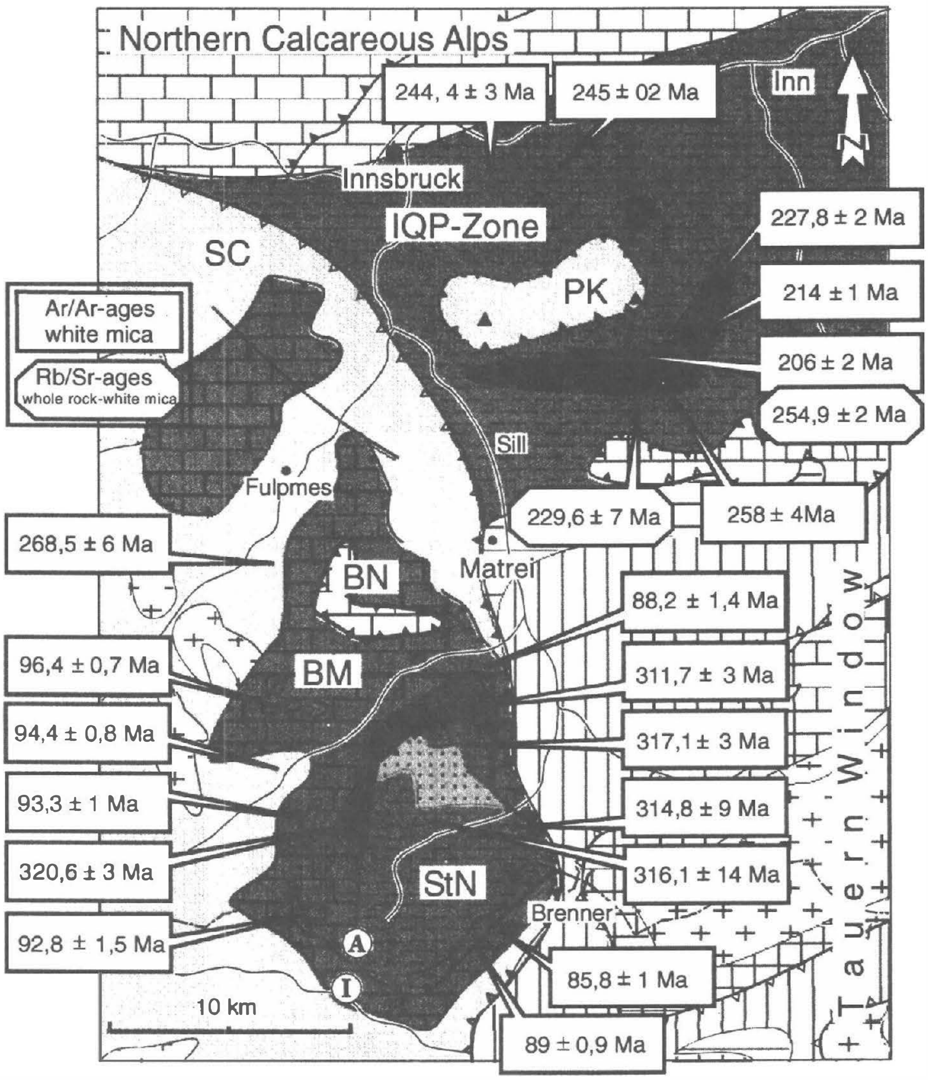

Interpretation of the geochronological data:

Stubai Crystalline (SC), Brenner Mesozoic (BM), Steinach Nappe (StN), Blaser Nappe (BN):
SC: 94 Ma is interpreted as cooling age of the Eoalpine metamorphism; 269 Ma - can be interpreted as late Herzynian cooling age or as a partly rejuvenated (by Alpine event) Herzynian age. Both analyzed samples show well defined Ar/Ar plateaus. **BM:** These well defined Ar/Ar plateau ages between 86 Ma and 96 Ma reflect the regional cooling after the Eoalpine metamorphism. **StN:** Platau ages between 311 Ma and 317 Ma are interpreted as Herzynian cooling ages.

Innsbrucker Quartzphyllite (IQP), Patscherkofel Crystalline (PK):
In the IQP-zone, the Ar/Ar ages range between 206 Ma and 258 Ma. All these ages show well defined Ar/Ar plateaus. A possible interpretation of these ages is by cooling processes in Permian and later times due to crustal extension and heat conduction.

STRATIFORM MINERALIZATION HOSTED IN THE PALEOZOIC SEDIMENTS OF THE WESTERN CARPATHIANS, SLOVAKIA

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The Early Palaeozoic sediments hosting stratiform pyrite, manganese and iron mineralization were object of this study. Pyrite mineralization occurs in the metamorphosed black shale associated with volcanic rocks. Occurrences of stratiform manganese ore are bound to the metamorphosed black shale and lydite accompanied by volcanic rocks in the Slovenské rudohorie Mts. Recent dominantly silica character of manganese ore was formed by metamorphism of silicates and carbonates of manganese. Association of rhodonite, rhodochrosite, spessartite, pyrophanite, pyroxmangite and tephroite suggests epidote-amphibolite zone of metamorphism of higher temperature than dominantly chlorite zone of regional metamorphism probably due to contact metamorphism of Gemeric granite. Occurrence of magnetite in the same area accompanied by biotite, albite and epidote reflects the same event. Oxide stratiform iron ores represented by thin layers of magnetite and hematite are bound mostly to quartzite or sericite-chlorite phyllite and they are related to the volcanism.

The Late Palaeozoic sediments are host of iron, copper and uranium mineralization. The Permian iron ore on the contrary to the Early Palaeozoic ore is represented exclusively by hematite mostly in the cement of the Permian sediments. The most important is uranium mineralization occurring in the sandstone with abundant organic matter and in volcanoclastic rocks. The dominant ore minerals in mineralized horizons are uraninite and molybdenite accompanied by U-Ti oxides and pyrite. Mineralization was formed at the temperatures from 90 to 150 °C corresponding to catagenetic stage of coal, homogenization temperature of fluid inclusions and illite crystalinity. Concentration of fluids corresponds from 27.1 to 33.wt. % eqv. NaCl. The isotopic composition of $\delta^{34}S$ varies from -32.7 to +2.7 and $\delta^{13}C$ from -27.1 to -0.5 ‰. U-Pb isotope dating gave from 240 to 270 Ma. The distribution of uranium indicate its mobilization and accumulation in aquiferous horizons by reduction and adsorption processes during peat or brown coal stage. Copper mineralization was found in the Permian grey sandstone with plant remnants associated with red coloured sediments. Accumulation of chalcopyrite, tennantite, chalcocite, bornite, digenite, pyrite and uraninite was formed due to the reduction barrier in permeable horizon of sandstone.

The metamorphosed black shale and volcanic rocks are considered as a potential source of metals, accumulated under favourable tectonic and metallogenic conditions due to metamorphic and hydrothermal processes into ore deposits. Stratiform mineralization in the early Palaeozoic rocks underwent the metamorphism of greenschist up to amphibolite facies. Higher grade metamorphism in some places reflects contact with the Hercynian granitoids. The Permian mineralization underwent only anchimetamorphism. Previous stratiform mineralization was remobilized during the Hercynian as well as the Alpine orogeny into vein or stockwork mineralization.

THE CONTRIBUTION TO METHODOLOGY OF GEOLOGICAL - OECOLOGICAL INVESTIGATIONS AS REGARDS THE PLANNING, DESIGN AND CONTRUCTION OF ROAD - TRANSPORT FACILITIIES

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Within the framework of general methodology of geotechnical investigations meant for planning, design and construction of road-transport facilities, the geological - oecological investigations play an important role since on tentative areas of road routes in Yugoslavia one may find the most attractive environment resources. In order to establish harmony between the conservation of geologic milieu and rational design, geological - oecological map must indicate onto the availability of resources, which is their present condition and which changes may ensue in the natural ambience at the phase of construction of transport facilities. Therefor, modern trends in planning, design and contruction of advanced transport facilities set very high standards as regards the definition of conditions and limitations for their construction and considerations for very strict criteriae over rational environmental utilization and protection.

Road planning and design process, as well as the process regarding the analysis of environment, in accordance with general decisions, must be two comparative processes mutually harmonized at all levels of design documentation elaboration, with distinct hierarchical structure. This paper is presenting a proposal of methodology as regards geological - oecological investigations and the content of geological - oecological map, which as "zero state" should serve to planners to establish present potentials of geological milieu and to appraise road environmental impact. Taking into account the expected complexity of geologic problematique during the construction of advanced facilities, this map may well in advance indicate onto potentially sensitive areas wherein the road may disrupt considerably the natural equilibrium, and exert influence onto the devastation of environmental milieu, which in relation to previous practice represents obviously the new quality. The content of geological - oecological map, as proposed has a full sence, in view of the fact that proposed methodology has been already applied in the preparation of general design projects for arterial road routes in Serbia.

Roads being large linear structures may exert essential influence onto: alteration of regimes of surface and ground waters, pollution of existing springs meant for water supply, occurrences of land slips, rockfalls, activation of screes, excessive erosion processes, degradation of natural ambience due to the opening and utilization of natural building materials or formation of waste - dumps. On the other hand, the road may represent also relevant environmental polluters with disposal of solid waste materials by the road washing out of deposits of materials on building sites, accidental pollution during operation etc. may dispurt considerably the natural morphology at the road alignment setting (deep cuts and side cuts), borrow-pits opening (quarries, gravel pits, sand quarries, earthen materials et al.)service roads, construction of the long embankment and frequent crossing of water - flows with bridge structures.

CALCAREOUS NANNOPLANKTON OF THE UKRAINIAN CARPATHIANS PALEOGENE

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Calcareous nannoplankton was investigated in Paleogene of northern and southern slopes of the Ukrainian Carpathians. It was found in some suits because of absence of the various carbonaceous rock masses. To determine the age of nannofossil assemblages there was used the so-called "standard scale" by E. MARTINI (1971). Its subdivisions are well observed in the Ukrainian Carpathians.

Sharp change of nannoplankton assemblages takes place in the Carpathians on the boundary of Maastrichtian and Danian. Their species content is renewed nearly completely, acquiring in Paleocene features. Paleogene nannofossils differ from Cretaceous ones by larger size and availability of groups that evolve quickly. The boundary between Maastrichtian and Danian is not clearly distinguished by lithology.

Paleocene deposits are mainly represented by sandy rock masses. Nannoplankton assemblages of the *Markalius inversus* (NP1), the *Cruciplacolithus tenuis* (NP2), the *Chiasmolithus danicus* (NP3) and the *Ellipsolithus macellus* (NP4) zones occurred in the Lower Paleocene. The only *Discoaster gemmeus* (NP7) zone occured in the Middle Paleocene. Nannoplankton was not found in the Upper Paleocene. Many researchers consider the *Marcalius inversus* zone (NP1) to the developed locally and to occur in certain facies. In the Carpathians it was found in the upper part of the Urdynska suit which was represented by the middle intermittent terrigenous flysh.

Thin-intermittent terrigenous flysh is developed on a level with sandy rock masses in the Lower Eocene. Nannofossil assemblages in these deposits are richer and more various by the species content. The *Discoaster binodosus* (NP11), the *Marthasterites tribrachiatus* (NP12), the *Discoaster lodoensis* (NP13) (Early-Middle Eocene) zones have been observed there. The terrigeneous-carbonaceous flysh, non-typical for the Carpathians, was developed here and there in the Middle Eocene. The *Discoaster sublodoensis* (NP14) and the *Chiphragmalithus alatus* (NP15) zones occurred in the flysh. The Late Eocene is represented by thin intermittent terrigenous flysh. The rocks are diverse. The *Discoaster saipanensis* (NP17), the *Chiasmolithus oamaruensis* (NP18), the *Isthmolithus recurvus* (NP19) and the *Sphenolithus pseudoradians* (NP20) zones occurred there.

Paleogeographical situation has changed rapidly in the Carpathian flysh basin on the boundary of Eocene and Oligocene. The diverse Upper Eocene deposits were changed by dark-grey terrigenous-carbonaceous Oligocene flysh. By changing of the nannofossil assemblages this boundary is not distinct and it is determined by disappearence only of the two species *Discoaster barbadiensis* and *D. saipanensis*. However, now there are known some data, which allow to assume that really distinguishing features of nannofossil assemblages of the Upper Oligocene are considerable. Fine *Reticulofenestra* which are difficult to be diagnosted by simple microscope are numerous here.

The *Coccolithus subdistichus* (NP21) and the *Helicosphaera reticulata* (NP22) zones occurred in the Early Oligocene and the *Sphenolithus predistentus* zone (NP23) - in the Middle Oligocene, the *Sphenolithus distentus* zone (NP24) in the Middle-Upper Oligocene, *Sphenolithus ciperoensis* zone (NP25) in the Upper Oligocene.

It is generally established, that the boundary between Eocene and Oligocene in the Ukrainian Carpathians passes on the roof of the sheshor horizon (VIALOV O. S., 1954), which extends nearly in all the structural-facies zones. In research works it is known as the horizon of globigerine marls or the horizon of large globigerines. To some extent, different results were obtained by calcareous nannoplankton. The NP21 zone occurs in most investigated sections in the lower part of the sheshor horizon, the NP22 zone - in the upper part.

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MOLECULAR PALAEONTOLOGICAL RECORD OF DIATOM CONTRIBUTION TO THE OLIGOCENE MENILITE FORMATION, THE OUTER CARPATHIANS, SE POLAND.

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Organic geochemical studies have demonstrated that many sedimentary organic compounds are derived from biogenic precursor molecules. This observation has led to the concept of biomarkers. Biomarkers are organic molecules encountered in sedimentary rocks which carry information in form of their carbon skeleton, functional groups and carbon isotopic composition. The examination of extracts from the Menilite Formation revealed that highly branched isoprenoids (HBIs) are an abundant group of molecular fossils in some organic-rich shales from the Skole, Silesian and Dukla units [1]. HBIs occur in addition to widespread algal biomarkers such as steranes and dinosteranes, and hopanes of cyanobaterial origin. They are composed of isoprenoid (C5) units resulting in carbon skeletons having 20, 25, 30 or even 35 carbon atoms. In diatom cultures, HBIs have been found in only two out of fifteen investigated species [2]. *Haslea ostrearia* contains C_{25} HBIs. *Rhizosolenia setigera* cultures from Tasmanian waters biosynthesise a C_{30} HBI carbon skeleton but, interestingly, C_{25} HBI occur in a culture of an Atlantic strain of this species instead [3]. Shale samples from the Menilite Formation are strongly dominated by derivatives of C_{25} HBI (up to 3 mg/g TOC), and contain C_{20}, and C_{30} HBI carbon skeletons in minor amounts.

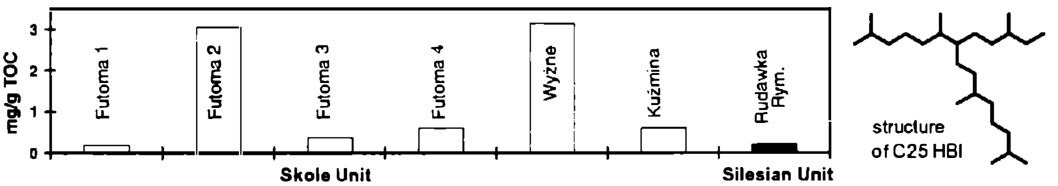

Fig. Concentrations of C_{25} highly branched isoprenoids in samples from the Menilite Formation.

In immature shales from the Skole unit up to 95 % of the C_{25} HBI carbon skeleton occurs in sulphurised form as low molecular weight thiolanes and thiophenes, and bound to macromolecules [1]. The position of the sulphur atoms can indicate the original positions of double bonds in the precursor biomolecule [4] though rearrangement of the double bonds position is possible before sulphurisation. The carbon isotopic composition of the HBI species varies considerably even in the same sample between $\delta^{13}C$=-34 ‰ in free hydrocarbon and $\delta^{13}C$=-24 ‰ in thiophenes (Futoma, the Skole unit). Additionally, a structurally related, novel C_{26} HBI carbon skeleton has been identified in the shales from the Skole and Silesian units [5]. The HBIs are encountered in rocks in which diatom skeletons are not present or are only poorly preserved [1]. Recognisable diatom skeletons are present only in samples from Futoma. These samples contain a neritic diatom assemblage composed of the *Paralis suculata* group, *Chaetoceras* resting spores and *Rhizosolenia* spp. However, the discovery of a few faecal pellets consisting nearly exclusively of *Rhizosolenia* spp. indicates that the preserved diatom flora is the result of strong dissolution of small forms. It shows that *Rhizosolenia* must have been the most abundant group in the water column, suggesting an origin for the abundantly occurring C25 HBIs from these species.

The biomarker investigation of the Menilite Formation illustrates that this approach is complementary to the geochemical and palaeontological studies and provides direct evidence for a significant contribution of diatoms to the sediment. Earlier this has been suggested based on indirect evidence such as a high amorphous silica content and the proximity of diatomites in the stratigraphic succession.

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EVOLUTION OF NEOGENE VOLCANISM IN THE APUSENI MOUNTAINS: GEOLOGICAL, K-AR AND PALEOMAGNETIC DATA

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New K-Ar and paleomagnetic data obtained from volcanic rocks in the Apuseni Mountains are reported. These data changed the picture of the Neogene volcanic evolution in the Apuseni Mountains. During Late Badenian, the volcanic activity started in Bucium-Rosia Montană, Zlatna, Hărţăgani, Brad and Zarand areas with a volcano-sedimentary formation followed by a volcanism grouped on an E-W alignment. Paleomagnetic data show the progressive clockwise rotation of these areas post emplacement. The rotation's amplitude with respect to stable Europe is around 60° for the rocks with the mean age of 14 Ma and 25° for those with mean age around 13 Ma. At about 12.5 Ma, a new volcanic activity started at Deva and migrated towards the NNE direction: 10-11.7 Ma Hărtăgani-Săcărâmb area, 7.4 -10 Ma Roşia Montană - Baia de Arieş area. By this migration a second alignment was fonned, this time having a SSW-NNE direction and characterized by the absence of paleomagnetic rotation.

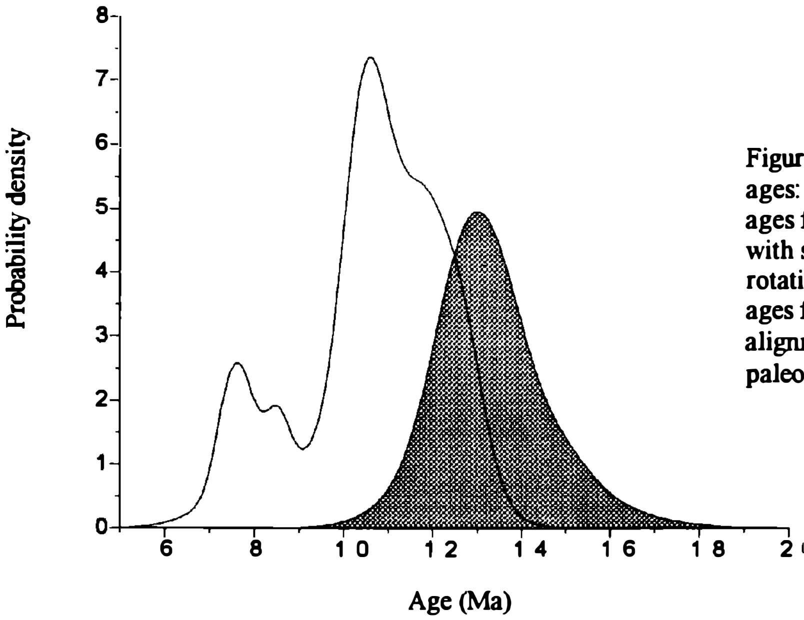

Figure: Histogram of K-Ar ages: shaded area represents ages from the E-W alignment with significant paleomagnetic rotation; hallow area represents ages from the SSW - NNE alignment with no paleomagnetic rotation.

Geochemical data indicate that the first volcanic alignment, developed in the present day coordinates in the east-west direction, has contents in trace elements compatible with an volcanic arc, developed on a thin continental crust. Trace element geochemistry of the second alignment, developed from SSW to NNE, show significant higher contents than values from the first alignment. These data point toward an origin of the volcanism on an active continental margin probably with a thicker crust than in the previous case. These differences in trace element geochemistry are probably controlled by: 1. different positions of the area where magmas were generated with respect to the subducting slab; 2. the evolution of lithosphere during the clockwise rotation and ; 3. heterogeneity in the upper mantle affected by metasomatic processes.

SPHALERITE GEOBAROMETRY AND ARSENOPYRITE GEOTHERMOMETRY APPLIED TO SOME METAMORPHOSED SULFIDE ORES OF THE TULGHES GROUP, EAST CARPATHIANS, ROMANIA

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Metamorphosed stratabound massive sulphides are well known in the terrigeneous and acid volcanic rocks association of the Tulghes group of the Central - East - Carpathian nappe basement. The Tulghes group is polimetamophic. The sulphides are mainly represented by pyrite, sphalerite, galena, chalcopyrite, arsenopyrite, pyrrhotite and the gangue minerals by chlorite, quartz, carbonates, sericite and albite.

The pressure estimation has been done by establishing the composition of some sphalerite grains totally encapsulated in metablastic pyrites so isolated from the subsequent P-T conditions by an inert encapsulating pyrite. The presence of fine pyrrothite inclusions in the same pyrite granoblast shows that a_{FeS} has been buffered of the pyrite- pyrrhotite solvus and the pressure is the dominant factor influencing the sphalerite composition. The values of FeS mole % contents of the poikiloblastically encapsulated sphalerite in the pyrite show a bimodal distribution with a maximum of 16 mole %FeS and another significant one, at 15 mole %FeS. These maximum values reflect the presence of a pressure field at about 3.6 Kb and of another one, much more significant at about 4.4 Kb.

The temperatures have been estimated by the compositional variations (atoms % As) of the arsenopyrite usually in the same samples with sphalerite - pyrite - pyrrhotite assemblage. The analytical values show a grouping of the As contents for the arsenopyrite encapsulated in the pyrite granoblasts (28.27 - 31.51 at %As, $\overline{x}$ = 30.08) and for the grains or nests of arsenopyrite included in a pyrite compact mass (29.07 - 33.30 at % As, $\overline{x}$ = 31.35). The arsenopyrite in direct relationship with the gangue minerals has not been taken into account. The mean As contents of the analyzed arsenopyrites plotted on the T vs.X at% As diagram (Kretschmar & Scott 1976) suggest a temperatures of about 300^{0}C and 370^{0}C respectively.

Interpreting the data using the sphalerite as a geobarometer and the arsenopyrite as a geothermometer, result P - T values in two distinct fields (3.6 Kb-300^{0}C and 4.4 Kb - 370^{0}C) reflecting the conditions existing during the formation of mineral associations. The respective P - T values correspond to the greenschists facies conditions in accordance with the metamorphism of the host rocks.

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THE INVERSE NAPPES – A NEW TYPE OF GEOLOGICAL STRUCTURES

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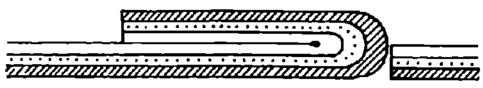
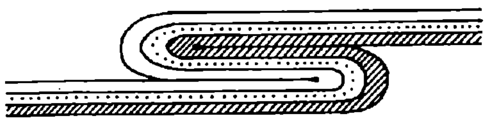
The so-called inverse nappes (from lat. *inversio*: inverted, reversed in position, overturned) are established on Bulgarian territory. These structures are tree in number: one Hercynian – Asturian (relic in West Stara Planina mountain, NW Bulgaria) and two Alpine – Austrian (respectively in North and South Bulgaria). The available geological data show that the relics of both Alpine inverse nappes are spread also in Apusenides, Carpathians and Alps (in the northern branch of Alpine orogene - about 2600 km in length and 300 km in width).

The Asturian nappe is built by the Ordovician - Upper Westphalian sedimentary rocks. Both of Austrian nappes are built by the Cambrian - Middle Albian sedimentary rocks. The uproot igneous bodies are joined in the building of the structures too. The allochthonous sedimentary successions are overturned and they lie in reverse (inverse) stratigraphic order on the normally autochthonous ones. The youngest sediments inside the inverse nappes (around the thrusting surface) determine the time of structure's origin (after Late Westphalian – for the Asturian nappe and after Middle Albian – for the Austrian nappes). The inverse nappes are covered by next sedimentary successions in stratigraphic order (Lower Permian – for the Asturian nappe and Vraconian-Cenomanian – for the Austrian nappes). These sediments are undeformed or slightly deformed and they determine the geochronological interval of the structures forming (about 5-7 Ma, probably shorter).

The amplitude of rock's thrusting is from 15 to 65 km in the different nappe's segments. The deformation of the rocks is plastic. The allochthonous and autochthonous layers are connected in the so-called zone of inversion (hinge) of the nappes. The lack of limb with normal bedding is typical for the inverse nappes, which is the morphological difference from the fold nappes. The disharmony of higher rank folding is expressed clearly between the allochthone and autochthone (respectively size of folds is about 1-2 km and 2-10 km in width). The axial cleavage, schistosity and minor drag folds (into clayey sediments) are typical for the allochthone. As a rule, the earlier rocks' alterations and metamorphism increase upward inside the nappes.



inverse nappe



fold nappe

The available data show that the inverse nappes have different genesis from that of the fold nappes which is known. The inverse structures are formed always on the Earth's surface (in the conditions of low temperature), but not inside the lithosphere. The thrusting is from the axial zone of the sinking mobile belt to its periphery (from high-hydrostatic pressure zone to low-hydrostatic pressure one) as a result of the foundation's contraction.

Definition: The inverse nappe is a structure of plastic rocks' deformation, considerable by size, formed on the continental crust's surface as a result of the consecutively tearing, squeezing out, overturning and thrusting of the rocks in conditions of general contraction and sinking bellow the sea level in the structure's forming zone.

PROTECTION OF GEOLOGICAL MONUMENTS IN THE ERDŐBÉNYE REGION (TOKAJ MOUNTAINS, NE HUNGARY)

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The Erdőbénye half-basin is in the SE margin of the Tokaj Mountains, one of the Miocene volcanic complex of the Carpathian Basin. This area surrounded by Sarmatian andesitic and rhyolitic volcanic cones has been deepened by erosion during the last 3 million years. Valuable geological formations outcropped from the rhyolitic tuff, and have also been explored by mining activity.

The NW part of the area (the so called Ligetmajor) was flooded by one branch of the one-time Sarmatian-Lower Pannonian Sea. In this oligohaline sea branch well-layered clayey, diatomaceous formation with interbedded limnoquartzite was deposited. This 30-40 thick formation has been mined since 1953, and quite well-known fossil assemblage (more than 50 species) has been found in it. Fossils of the sometime forest association (e.g., leaves) are particularly common, and those of hydrophytes, fish and insects also occur.

The double laccolith of the Barnamáj and Mulató Hill is SE of Erdőbénye village, the central settlement of the area. A quarry in the Barnamáj (worked from 1925 to 1983) explored the inner structure of the subvolcanic body. Beside the typical subvolcanic jointing system and the characteristic contact phenomena (reperlitised rhyolite tuff), rich hydrothermal-pneumatolytic mineral association (26 mineral species) has been found in the amygdales of 10-100 cm diameter of the pyroxene dacite. The texture of the rock is microholocrystalline porphyritic. Beside the dominant plagioclase (An_{35-39}), augite and Fe-rich olivine also occur. The hybrid character of the rock suggests a periodical uprise and high contamination of the basic parent magma.

The open mining area could be converted into educational purposes by security intervention, and a geological-mining museum could be formed in the old crushing and sorting building, where rocks, minerals and fossils of the area as well as mining historical relics could also be exhibited. Collection and exhibition of the fossils from the Ligetmajor diatomaceous earth mine would particularly be important since a part of them can disappear due to the activity of the mining and the amateur collectors.

DEVELOPMENT OF JOINTS IN THE FLYSCH SANDSTONES – CASE STUDY FROM A PART OF SILESIAN NAPPE (POLISH OUTER CARPATHIANS)

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Eastern part of Polish Outer Carpathians consists of several NE verging nappes. One of them is Silesian nappe, which consists of two tectonic units: Central Carpathian Depression and Fore Dukla unit. Study area comprises a part of the Fore-Dukla unit called Bystre slice and a fragment of Central Carpathian Depression. Lower Cretaceous to Lower Miocene rocks crop out in this area and for this reason it is possible to trace development of jointing during a long span of time. Diagrams of bedding planes from study area show, that map-scale fold axes are oriented N130E.

In this study the word joint is used as a field term. Joints have been studied in thin to thick bedded sandstones in 23 stations. Joints have been subdivided in two groups: fold-parallel joints and cross-fold joints. Fold-parallel joints contain two sets: L and L' (or L_1) striking parallel or under the low angle to map-scale fold axes. Research has been focused on the cross-fold joints comprising: single set of joints striking perpendicular to map-scale fold axes (T- joints) and two conjugate sets of joints (D_1 and D_2) with the acute bisector oriented also perpendicular to the map-scale fold axes. Acute bisector represents the orientation of maximum stress axis. There is some evidence for prefolding origin of fold-parallel joints: orientation of these joints is similar in two limbs of map- scale folds after rotation of strata to horizontal position. Orientation of T-joints as well as orientation of acute bisector between the conjugate sets D_1 and D_2 and the value of acute angle were determined for: Lower Cretaceous, Upper Cretaceous - Paleocene and Oligocene-Miocene strata.

In the Lower Cretaceous strata T-joints are oriented N45E and the acute angle between conjugate sets is 32° whereas the bisector of this angle is oriented N42E. In the Upper Cretaceous-Paleocene strata T-joints are oriented N41E and the acute angle between conjugate sets is 44°, whereas the bisector of this angle is oriented N48E. In the Oligocene and Lower Miocene strata T- joint are oriented N48E. Acute angle between conjugate sets is 60 to 80°, whereas the bisector of this angle is oriented N47E.

The discussed data may be summarized in the following way: both T-joints and the acute bisector between conjugate sets are oriented perpendicular to the map-scale fold axes within the whole studied stratal sequence except for sites, where sets of cross-fold joints have been rotated close to strike-slip faults. The mean value of acute angle increases from 32° in Lower Cretaceous strata to 44° in Upper Cretaceous-Paleocene strata and 60° to 80° in Oligocene and Lower Miocene strata.

In the present interpretation the orientation of the maximum stress axis was permanent since Early Cretaceous times to Early Miocene times. It appears that the relative value of maximum stress is considered to be positively related to the value of the acute angle between the conjugate sets. That follows that in the study area the value of the maximum stress was increasing during the discussed span of time.

UPPER WEICHSELIAN ENVIRONMENTAL CHANGE LINE IN THE CENTRAL PART OF THE CARPATHIAN BASIN

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11 loess profiles were analysed from different parts of Carpathian basin (5 from the northern part, 6 from the southern part) for geology, sedimentology, Molluscs and macrocharcoal remains. Radiocarbon datings were also carried out.

The loess profiles are proved to have been formed during the last glacial period, between ca. 70.000-15.000 years B.P Most of our data concerns the period of 30.000-20.000 years B.P. Two well developed charcoal layers can be found in this period at some of the sites. Both of them are on the top of a palaeosol. Each of the sites contain one of them. On the basis of palaeoecological investigations of these charcoal layers and the Molluscs founded in them, we can conclude to an environmental change line running east and west in the Carpathian basin.

Picea sp. remains were found in the North, *Pinus sylvestris* in the South, Asian drought and cold resistant Mollusc elements in the North and Balcanic in the South. Although broad leaved trees also appears in the North, but just under favourable microclimatic conditions on southernly exposed slopes, and the biogeographical border line could not have been got over by Central and SE European Molluscs.

Known the recent ecological demands of the pines, the permafrost should have defrosted 2 m for at least two months in summer in the southern parts of the basin. This suggest not tundra climate on the Great Hungarian Plain, as it was previously thought, but rather a mosaic forest-steppe vegetation.

Previous studies showed the tree line border in the middle of the area, but these suggestions are based on palynological examinations. Recently, on the basis of comparing macrocharcoal and palynological data, the decline in arboreal pollen types in samples from stadials is thought to have been caused by physiological changes as a result of bad weather conditions rather than by the decline of trees. Thus, we can reconstruct a wood-wood border analoguous to that can be observable these days in Central Asia.

Nowadays, a similar climatic border line exists at the same place according to the Köppen climatic types. Palynological investigations also suggest something alike, i.e. *Carpinus orientalis* can be found to some extent in Carpathian Basin, but not norther than a line.

METAMORPHIC FEATURES AND GEOTECTONIC SIGNIFICANCE OF THE ECLOGITE INCLUSIONS IN THE LOTRU METAMORPHIC SUITE (SOUTH CARPATHIANS, ROMANIA)

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Several eclogite inclusions appear in the middle- to high- grade basement of the Getic Alpine Nappe (South Carpathians). Their apparently contrasting metamorphic features led to the assuming discontinuities in the metamorphic pile (Hann, 1984) or even "cryptic palaeosutures" (Iancu *et al.,* 1984). Yet, at least some of them are also interpreted as terms of coherent terrains (Iancu & Mărunţiu, 1992).

Three basic types of eclogites can be distinguished on account of their lithologic and metamorphic assemblages, and even more on basis of their structural position in the metamorphic pile of the Lotru Suite. A first type of eclogites is spatially associated to the synmetamorphic thrust of the Semenic Nappe, which contains of the Negovanu Mare Micaschists Formation. The eclogites appear in a mica-rich matrix, are mantled in amphibolitic rinds and associate with garnet amphibolites and quartzites. Most of them are retrogressed. The garnet is strongly zoned (the maximum observed range is $Gro_{17-30}Py_{20-50}Alm_{30-60}$) and frequently consist of several coalesced individuals. In the most complete zoning profiles, Mn has a bell-shaped decrease to the margin, as Mg continuously increases. The core is rich in Ca and often contains amphibole inclusions; the rims are poorer in Ca. Sometimes even an early Ca increase is recorded. Pyroxene is a slightly zoned omphacite; the jadeite content is constant within one sample, but ranges between Jd_{13}-Jd_{50} in different samples. Two growth stages are ubiquitous: an early one in which calcic garnet coexists with amphibole and a late one in which garnet continues to grow along with pyroxene. The p-T path makes up a clockwise loop with peak conditions at 650-750 °C, 2.2-2.6 GPa.

Metamorphic conditions recorded in these eclogites strongly contrast with those in the neighbouring rocks; however the diversity of individual metamorphic histories of the rocks located along the thrust of the Semenic Nappe is confined to four basic types, reflected in characteristic equilibrium conditions and typical zonalities of stiff porphyroblasts like garnet. The overlying Negovanu Mare micaschists display a pseudomonometamorphic prograde zonation of garnet with well-defined bell-shaped zonation of Mn and Ca, and continuous increase of Fe, Mg and Mg/Fe ratio. An external rim with variable thickness has the highermost uniform Mg and Fe contents, as well as low Ca and Mn, marking incipient equilibration of porphyroblasts shells and matrix minerals at ca. 600° C and .6 GPa. The internal zones of the porphyroblasts yield the conditions of an earlier event at some 1.1-1.3 GPa. Porphyroblasts in the subjacent Voineasa Unit gneisses display clear polymetamorphic zonations, in which the internal zones preserve a flattened higher-pressure prograde zonation, while the outer zones are dominated by a complex process of garnet resorbtion and growth under medium-pressure conditions (.6 GPa, 650-700° C), coeval with pervasive neoformation in the matrix. Strictly along the thrust plane, truly monometamorphic rocks do appear. The most representative rocks are garnet amphibolites (±kyanite) and mica-bearing garnet- quartzites. Garnets in kyanite- bearing amphibolites display a long-lived zonality accomplished along a counterclockwise path with peak conditions at 1GPa, 740° C and subsequent tectonic exhumation to .6 GPa, 570° C. Garnet-quartzites recorded a prograde path with peak condition at .6 GPa, 550-600° C. The overall assemblage indicate obduction of sediments and fragments of subducted oceanic crust during collision of two continental blocks, involved in deep-seated thrusting and lithospheric decoupling.

Two other distinct types of eclogites appear inside the Voineasa Unit and associate to a high-grade gneissic complex (the Valea Căprărcasa Complex). The host rocks bear the imprint of peak conditions at 1.1-1.3 GPa 850° C and are only locally overprinted by the sillimanite grade syn-thrusting event. Eclogites are surprisingly pristine. The main type contains pyrope-rich garnet, green diopside and either kyanite or zoisite. Peak conditions recorded reach 2.4-2.6 GPa, 850° C. The other type which subordinately appears in the same context and is equally well-preserved contains $Gro_{10-20}Py_{17-26}Alm_{53-58}$ garnet and Jd_{39-45} omphacite, indicating peak conditions not exceeding 2.4 GPa and 650° C. The assemblage indicates tectonical adjoining of subduction-zone eclogites with mantle eclogites and high-grade felsic gneisses along an older suture.

As the metamorphic conditions document, the eclogitic types appearing in the Lotru Metamorphic Suite mark two main non-contemporary suture zones and imply forming of the present pile by polystadial acretion of several crustal blocks with dissimilar history.

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THE FOHNSDORF BASIN – NEW INSIGHTS FROM SEISMIC REFLECTION LINES

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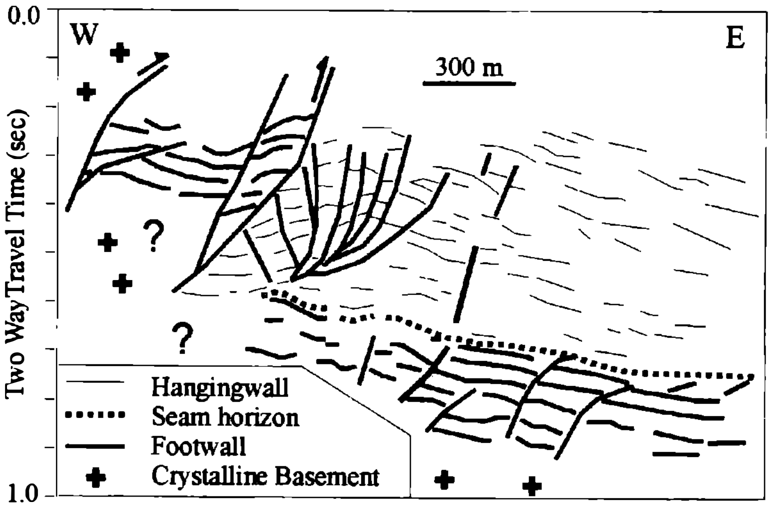
Sinistral faults along the Noric Depression and dextral faults along the Pöls-Lavanttal Fault System played a major role during Neogene eastward extrusion of the central Eastern Alps. The Fohnsdorf Basin formed at the intersection of both systems. It is, therefore, located in a key area for the understanding of the Tertiary evolution of the Alpine-Pannonian realm.

The Miocene basin fill overlies discordantly crystalline basement rocks. It consists of 2000 m thick early Miocene deposits (footwall sediments, seam horizon, hanging wall sediments) and 1000 m thick middle Miocene deposits (Polesny, 1970). According to the classical view, the early Miocene sediments form an asymmetric syncline with a shallow dipping northern limb and an overturned southern limb, which is exposed southwest of Judenburg (Petrascheck, 1924/29). However, because of a vast Quaternary cover, the structure of the basin is still poorly understood.

A NNW-SSE trending seismic reflection line between the Wodzicky dump and Weißkirchen crosses the presumed center of the basin. It shows that the depocenter is located south of Farrach in –1200 m (s.l.) depth. This agrees well with gravimetric investigations (Walach, 1979). The fold axis of the hangingwall sediments is located in a more southern position. Sediments in the Weißkirchen area dip northward at small angles. Overturned sediments cannot be observed. This suggests that the zone with steeply dipping sediments is restricted to a narrow zone along the southwestern basin margin. A change in seismic facies of the footwall sediments occurs a few km north of Weißkirchen. The hangingwall sediments prograded southward over the seam horizon. However, sediment transport from southern directions along the southernmost part of the line also occurred.

The W-E trending seismic reflection line Fo9702 (Fig. 1) is located north of Judenburg in an area where the western basin margin is completely covered by Quaternary sediments. It shows that the western margin is formed by reverse faults, which are SE-striking according to the regional geology (Metz, 1973; Gnjezda, 1988). In the westernmost part crystalline rocks locally overlie footwall sediments. The latter overthrust hanging wall sediments forming an intensly faulted anticline. Taking this into consideration, it is likely that the overturned deposits southeast of Judenburg represent footwall sediments, which were verticalized along the southeastern continuation of the above reverse faults.



The reverse faults form part of the dextral Pöls-Lavanttal fault system and are interpreted as the northeastern branch of a positive flower structure. Probably, coal bearing sediments in the Feeberg valley, which are separated from the Fohnsdorf Basin by uplifted ranges with pre-Tertiary basement rocks (Falkenbergzug, Lichtensteinberg) represent the southwestern part of the „flower“

Fig. 1: Line drawing and interpretation of seismic line Fo9702.

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FORMATIONAL-FACIAL ANALYSIS OF SEDIMENTARY SUCCESSIONS OF THE UKRAINIAN SOUTH AND SEA AQUATORIES AS A BASIS OF GEODYNAMIC DEVELOPMENT RECONSTRUCTION

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For geodynamic reconstruction from the point of view of plate tectonics of geological history of Ukraine South and aquatories the maps of distribution of sedimentary, volcanogenic - sedimentary and volcanogenic successions and intrusive magmatism were composed for 22 stratigraphic levels from Vendian till Pliocene.

On the southern margin of ancient East-European platform Vendian - Qraternary sedimentary cover begins with Vendian in the western (to the west from Odessa - Synop lineament) part of the region. To the east the cover starts with sporadically developed Permian deposits. In Predobrogean deep Valday series of Vendian is of molassoid character what is connected with Late Baikalian movements of Dobrogea. On Lower Prut ledge, which supposes to be a thrust of Dobrogea, firstly volcanogenic-sedimentary rocks are metamorfized and intruded into by granitoids. In Plain Crimea Late Baikalian complex is represented by metamorphized in green schists facies clay - terrigenous, volcanogenic and carbonate formations. Late Baikalian phaze with closing the ocean displayed in absence of Cambrian and Ordovician on most territory in North-West Pre-Black-Sea-Area. Ordovician is absent and presence of Cambrian is questionable in Plain Crimea.

Late Baikalian platform formed suffered new breaking in Ordovician - Silurian. During Paleozoic the region participated in development of the Paleotethys ocean and in forming Hercynian structures that take part in Euro - Asian Hercynian complex represented by geosynclinal and orogenic formations of the divergence and convergence periods: slates, spilitic - diabases, of thin - rhythmic interbedding of limestones and shales, lower grey-coloured and upper red-coloured molassas.

Cimmerian - Alpine stage somehow differently displayed in Dobrogean and Crimean regions. In the first of them the main processes of tectogenesis took place in Cimmerian stage. In Predobrogean deep Middle - Upper Triassic is represented by monotonous carbonate - terrigenous and terrogenous - clayey formations that mark the period of strong and transitory stretching apart. Lower Jurassic is unknown, and Middle and Upper Jurassic represent molassa. In Plain Crimea Middle Triassic Middle Jurassic represent thick terrigenous - clayey succession with wide spectrum of effusive, intrusive and dyke complexes of gabbro-diorite-granite intrusive and andesite effusive formations of lime-alkaline series.

The character of magmatism of Tavrika series (T_3 - J_1) of Mount Crimea (spilitic - diabase formation of toleitic trend, serpentized picrite) and sedimentation (accucmulation of slate and flysch formations) witnesses about epiorogenic rift. The main process of formation of Mount Crimea took place in Lower Cretaceous.

Eskiorda olistostromes (J_1), Bitak conglomerates (J_2), Lower Cretaceous olistostromes and Bilogorsk terrigenes (K_1), Paleogene - Neogene molassas of Indol - Kuban' deep which are distributed in direction from south - west to north - east witness about continuous - discrete process of advancing collision.

CRITICAL REVIEWS OF CARPATHIAN PALINSPASTIC MODELS

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FROM THE ALPS TO THE BLACK SEA A GEOLOGICAL CORRELATION

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The area under discussion include:the Tethyan Foldbelt,the Cimmerian Foldbelt and the adjoining platforms (East European,Scythian and Moesian)

The correlation of the main tectonic units, or group of units, within the Tethyan Foldbelt must prior taken into account the major ophiolitic sutures which group toghether the remnants of the Tethyan oceanic crust bearing domain.In respect with this major sutures can be followed the correlation of the units which proceed from the deformed Tethyan continental margins.The most important and best documented suture in the Tethyan Foldbelt of Central Europe and Balkan Peninsula is the Vardar-Transylvanian-Pienidic-Ligurian Suture (including Triassic and/or Jurassic ophiolites covered by sedimentary sequences of Triassic-Jurassic,Jurassic-Cretaceous or Jurassic-Paleogene ages).A second suture runs along and below the southern border of the Pannonian Depression.It is the South Pannonian Suture (croping out in Fruska Gora and near Zagreb),a branch (sphaenochasm?)of the Tethyan Ocean,joining westward the Gail-Insubric Line.This sutures separate: a/.the European Margin (East and South Carpathians,Balkan,Pontides etc), b/.the Fore-Aulian Block(North Apuseni mts,Central West Carpathians,Austroalpine system etc.) and c/.Apulian Margin (Dinarides and Southern Alps).Within continental margin paleorifts (with within-plate type ophiolites) complicate both the European and Apulian margins.Detailed correlations of the three group of units are presented.A special problem is represented by the paleogeography and position of the Rhodopes (following the age accepted for their metamorphic formations).Two possible models are proposed in connection also with the Strandja structure and position.

The Cimmerian Foldbelt proceed of an intracontinental Triassic aulacogen,situated north of the Moesian Platform and deformed in Lower and Upper Jurassic(+Lower Cretaceous ?).To this foldbelt belong the North Dobrogea Orogene and the Alpine Crimea (South Crimea).The correlation between this two segments is realised along the continental plateau of the Black Sea (south of the Odessa Golf).In North Dobrogea it is possible to determinate that the pre-Cimmerian ,namely pre-Permian,structures may belong to the southernmost part of the Schytian Platform,reworcked in the cimmerian tectogeneses.The closing of the Triassic aulacogene is contemporaneous with the opening of the paleorift situated within the European continental margin (see above).The Cimmerian Aulacogene,or at least a part of it correspond to the souther segment of the Tornquist-Teysseire Zone,namely it was generated as a transtensive right-lateral basin,a relay of the southernmost part of the Mid-Polish Graben,situated actually below or in front of the East Carpathian external nappes (Flysch Zone and Subcarpathians).

The Moesian Platform,situated south of the Cimmerian Aulacogene,separated this last one of the Balkan-Pontide structures of the Tethyan Foldbelt. Since the Cretaceous,more precisely the Upper Aptian-Albian time, the Moesian Platform was situated in a more oriental position joining the Djiroula Massif,which separated the Great Caucasus and the Lesser Caucasus (the last one prolongation of the Pontides). The « splitting » of the paleo-Moesian Platform occurs in the Upper Aptian or the Lower Albian, determinanting the « opening » of the basaltic-type crust recorded in the western and eastern Black Sea.

PHYSICAL-MATHEMATICAL MODELLING POSSIBILITIES IN THE DEEP ELECTROMAGNETIC INVESTIGATIONS OF COMPLEX REGIONS

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Deep electromagnetic investigations of complex geotectonic regions which Carpathian Folded system belongs to are connected with considerable difficulties as to methods and interpretation. Similar to prospecting problems methods of mathematical and physical modelling for regions investigated may help significantly to solve problems mentioned. The following stages are expected to be carried out for successful application of these methods.

1. Gathering and analytical treatment of general geological-geophysical data and development of a-prioric geoelectric regional models.
2. Investigation of models developed using 1D and 2D mathematical and 3D physical modelling, efficiency estimation and choice of an optimal complex of natural geoelectromagnetic observations for the given region.
3. Natural observations using the complex chosen with rational sequence of its separate elements obeyed.
4. Processing and analytical treatment of data obtained and their complex interpretation. Construction of a finite a-posterioric regional model and its testing using solid physical modelling.

Original units for physical modelling and mathematical modelling programs developed in CBSIG NASU which allow to study distribution of electromagnetic field in arbitrary inhomogeneous media made the basis of the above described complex.

The universal laboratory complex is intended for physical modelling of stationary, harmonic and impulse electromagnetic fields in three-dimensional inhomogeneous media excited by plane electromagnetic wave or dipole sources. The complex contains electrolytic tanks of various dimensions and constructions, where one creates multilayer geoelectric sections scale models of cover, consolidated Earth's crust and conductive mantle which has complicated intermediate boundary relief and containes any form of higher and lower resistance inclusions.

The mathematical modelling programs are based on a joint application of the following methods: boundary element technique for 2D inclusions of arbitrary form; method of finite differences for inhomogeneous inclusions; projection-graticule methods; specific fundamental solutions of equations for permanent and varying electromagnetic fields in a half-plane.

Thus physical-mathematical modelling methods may be wanted both at projecting stage of electromagnetic investigations of complex regions and at geological-geophysical interpretation of data obtained. These methods allow not only to make deep investigations cheaper but to increase significantly their probability.

NEW RESULTS ON STRATIGRAPHY, FACIES AND SEDIMENTOLOGY OF LATE JURASSIC TO EARLY CRETACEOUS PLATFORM CARBONATES OF THE AUSTRIAN SALZKAMMERGUT (PLASSEN LIMESTONE FORMATION, TRESSENSTEIN LIMESTONE)

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The Plassen Limestone Formation (PLF) of the Trisselwand near Altaussee/Salzkammergut comprises Upper Kimmeridgian to Berriasian platform carbonates that correspond to a retrograde, transgressive succession. The Formation includes the inner to outer platform and the autochthonous talus. The proximal talus contains abundant echinoids and bryozoa with typical microproblematica including *Mercierella*? *dacica* DRAGASTAN and *Tubiphytes morronensis* CRESCENTI. In the middle part of the talus the siliceous sponge facies, which is widespread along the European northern shelf of the Tethyan sea, prevails. Microfacies are pelletoidal packstones with the typical association of *T morronensis* CRESCENTI and the agglutinated polychaet *Terebella lapilloides* MÜNSTER. The platform-basin transition is marked by the Oberalm Formation transitional facies, which contain *Neotrocholina valdensis* REICHEL and *Meandrospira favrei* (CHAROLLAIS et al.), indicating an Early? Valanginian age. The brecciated Tressenstein Limestone (TL) of the type-locality occurs intercalated in the basin facies of the Oberalm Formation showing that it neither corresponds to coastal deposits (HÖTZL 1966) nor to a „fore-reef talus“ (TOLLMANN 1976). The TL contains clasts of the platform margin and the talus, and in contrast to the allodapic Barmstein Limestones, clasts of the inner platform have not been observed. The occurring hydrozoans/corals have been transported as single components evidenced by their infillings of micritic calpionellid-bearing matrix. The TL s. str. is interpreted as a gravity induced mass-flow deposit that originated from the platform margin / talus and was transported into the basin. Therefore, the platform talus has been included in the PLF. The carbonate platform sedimentation of the PLF ended as a result of drowning during a time (Berriasian) when a global lowering of the sea-level happened. The Early? Valanginian age obtained from the Oberalm Formation transitional facies reduces the stratigraphic gap that exists between the end of the PLF and the beginning of the siliciclastic coarsening-upward cycle of the Rossfeld Formation, starting in the Upper Valanginian (WEIDICH 1990).

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THE FLYSCH-ZONE AND THE KLIPPEN-ZONES OF THE EASTERN ALPS: HOW DO THEY MATCH WITH THE CARPATHIANS?

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Even a cursory glance at the geological map clearly shows, that the Flysch-Zone along the northern rim of the Northern Calcareous Alps and the Central Carpathians must play a common role in the Alpine-Carpathian belt. Despite the congruencies – rootless nappes and units dominated mainly by flysch formations at the frontal position of the orogeny we see striking disagreements – the width, the internal structures and the age, thus showing considerable differences in the paleogeography and tectonic history on both sides.

To clarify the interconnection between the external tectonic units of the Eastern Alps and the Outer Carpathians in detail is made extraordinarily difficult, as the Neogene of the Vienna Basin interrupts the continuity at the surface. This presentation will summarise some important results, impressions and ideas from the point of view of an Alpine geologist looking toward the East, trying to find satisfactory correlations between both sides. It takes into account the many substantial progresses, which have been made during the last decades based on both national investigations and international cooperation.

The narrow stripe of the Flysch Zone of the Eastern Alps in its Eastern section includes three major tectonic units: From bottom to top the **Inneralpine Molasse**, the **Helvetic System** *sensu lato* and the predominant **Rheno-Danubic Flysch**, widely considered to be part of the Penninic realm The predominant formations of the Alpine Flysch Zone are Cretaceous up to Eocene in age. However, Uppermost Triassic to Lower Cretaceous sediments in the so-called **Klippen Zones** display remnants of its original basements.

When trying to compare particular units and formations with the Carpathians we have to consider, that many of the formations are diachronous and become younger toward the East, thus giving evidence of the shifting of the facies from West to East.

The **Inneralpine Molasse** with its Upper Eocene to Oligocene sediments suggests a comparison with the Stanice-Hustopece Formation in the Stanice Unit.

The **Helvetic System,** displayed in the **Gresten Klippen Zone** and – with reservation – in the Hauptklippenzone (Wienerwald), represents slices of the Southern European Continental margin. It thus should find its continuation in the Subsilesian System. Facial congruencies in the Upper Cretaceous and Tertiary are evident, but Jurassic Gresten-like facies are unknown there. From this point of view the comparison with the Pieniny Klippen Zone, dominating the discussion for a very long time, became obsolete.

The **Rheno-Danubic Flysch**, being homogenious in the Western section, splits up into at least three nappes in the Wienerwald area, different in facies and stratigraphic range. It is the **Greifenstein Nappe,** which has the closest relationship with the Main Flysch Nappe in the West and the Magura Nappe (Raca Unit) in the Carpathians and this can be taken as one of the very few well-established links. Accordance can be traced into the Carpathians at least up to the Western Beskides in Poland. A possible connection between the **Laab Nappe** and the Bilé Karpaty Unit of the Magura Group is under consideration. The **Kahlenberg Nappe** and its pre-Cretaceous basement in **the St.Veit Klippen Zone** with its picritic volcanism has no equivalent in the Western Carpathians.

The **Ybbsitz Klippen Zone,** exposed in front of the northern border of the Calcareous Alps, comprises a Jurassic pelagic sequence along with strongly tectonized mafic/ultramafic rocks, draped with a Cretaceous Flysch with an abundance of chromite, represents a dismembered ophiolite suite. Facies and tectonic setting refer to a South Penninic origin and has absolutely no equivalent in the Western and Northern Carpathians. But far to the East, in the East and South Carpathians, an analogous – if not homologous - development is evident in the Sinaia Flysch, particularly in the Severin Nappe. This comparison deserves a closer examination.

From these aspects, the **Pieniny Klippen Zone** in the Carpathians has no comparable equivalent in the klippen zones of the Eastern Alps. Its overall facies, particularly the evidence of the exotic "Andrusov ridge" seems – in the authors opinion – to refer to frontal Austro-Alpine units.

GEOCHEMOMETRICAL CONTRIBUTIONS TO THE METALLOGENETIC MAP OF AUSTRIA.

SCHROLL, Erich.
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The concept of geochemometry, based on the combination of chemical and isotopic data, aims at the development of ore deposit models and genetic classifications in an objective way (Schroll et al., 1994, 1997). Data received from the investigations of fluid inclusions and age determinations enlarge the amount of data. The obtained data system represents a complex network of relations between geochemical, crystal chemical and physico chemical conditions of the formation of geological bodies .

The first test started following the idea of „geochemical guide elements" to group the lead and zinc bearing ore deposits of the Eastern Alps. The dependency from geological setting could be clearly shown (Schroll, 1955). More than forthy years later geochemical data, so far as available, have been used sucessfully for the classification and for the constraints of genetic models compilating the metallogenetic map of Austria (Schroll in Weber,1997).

The use of data of a single characteristic can cause wrong interpretations. The analysis of one component only may be sufficient, but not constraining for the interpretation. For instances, the determination of sulphate sulphur isotopes is a helpful tool to classify evaporites, especially to distinguish betweeen Permian and Scythian-Anisian sea water sulphates. However, the isotopic composition can be influenced by diagenetic processes or mixing. Additionally, a second significant characteristic, sc. the strontium isotope ratio, is necessary for differentiation. The sulphate sulphur composition of barytes is more critically to evaluate. The signature of Devonian seawater are to await in the stratiform barytes from the Graz Paleozoic controlled by the contemporal strontium isotope ratio and the significant low strontium content. The sulphur isotope value of the most other barytes are marked by contemporal seawater, but the time of the mineralization itself could be younger.

Nevertheless, the frequency distribution of univariant data is the absolutely necessary test for homogeneity or heterogeneity not only basically for the application of the other statistic methods, but it is of genetic interest too. For instances, the homogeneity of the isotopes of the ore lead from the Bleiberg type points to the origin from a well mixed source, while the large spread is characteristic for the activity of metamorph water caused by the addition of excess radiogenic lead, such as in ore lead of the tungsten district Felbertal or of the gold mineralizations of the Hohe Tauern. Density diagrams concerning geochemometrical data of the lead -zinc deposit Bleiberg or some pre-Alpidic deposits show at least three peaks, indicating the complex history of their genesis caused by diagenesis or metamorphism.

Bivariant presentations of carbon and oxygen isotopes have been used for the characterization of carbonates , like magnesite and siderite discriminating the gentically different types. The supply of isotope data of siderites is still limited excepting the Erzberg in Styria. Additional data, especially the strontium isotopes too ,are important for constraining interpretations.

The fluid inclusion investigations and the reconstruction of the isotope composition of the ore fluids are a promising way to characterize deposits and to contribute to genetical aspects. According to geochronological data Alpidic activities of ore mineralizations are note around 30, 80, 15o and 200 up to 240 Ma. But the pre-Alpidic memories of fluids seem to be lost.

Unfortunately, the data base is still insufficient for the application of the multivariate techniques. Only for the well-explored Triassic carbonate-hosted lead-zinc deposits the use of multivariate geochemical discrimination was applicable. The affinity and, nevertheless, the temporal difference between ore mineralizations of Anisian and Carnian stage could be demonstrated. The diversity to the classical MTV-deposits is convincingly displayed (Schroll et al.1994)

The geochemometrical studies will be continued and a pilot project is in progress comparing ore deposits of the Eastern Alps and the Western Carpathians (see poster in this session, Andras et al.).

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SEISMOGENIC MODEL OF THE EASTERN ALPINE, WESTERN CARPATHIAN AND PANNONIAN JUNCTION AREA

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The newly-defined seismogenic zones in the Alpine-Carpathian-Pannonian junction area are correlated with: (1) neo-Alpine wrench-fault zones, (2) original thrust planes reactivated as low-angle extensional normal faults, and (3) Alpine deep-seated suture zones, either oceanic or intracontinental.

The most important wrench fault zone is situated between the Eastern Alps and Western Carpathians. It reflects the Miocene extrusion of the ALCAPA lithospheric fragment from the Alpine domain as its northern boundary. The NE-SW trending wrench fault zone is represented by the Mur-Mürz-Leitha and Považie fault systems. The zone is well expressed by flower structures in all seismic lines.

The Miocene back-arc extension driven by the subduction pull in front of the Carpathian orogen and mantle updoming in the Pannonian domain reactivated original paleo-Alpine thrusts as crustal detachment planes. In the Danube basin area these are represented by numerous important faults visible in seismic sections, e.g. the Répce, Sládkovičovo, Rába, Mojmírovce etc. fault systems.

The principal Western Carpathian paleo-Alpine sutures, from north to south, are: the Penninic-Vahic oceanic suture originated during the Late Cretaceous (70-60 Ma), the Čertovica intracontinental suture between the Tatric and Veporic thick-skinned sheets locked some 90 Ma ago, and the Meliatic oceanic suture formed in the Late Jurassic (150-160 Ma), closely related to the Igal-Bükk zone. These suture zones were partly reactivated during the Late Tertiary and represent weakened zones in the modern upper crust. Concentration of important earthquake epicenters correlates well with these weakened belts which serves as a base for the new seismogenic model of the area.

PROVENANCE OF THE MESOZOIC CLASTIC SEDIMENTS FROM THE SOUTH CARPATHIANS, ROMANIA

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The petrography of the coarse members of terrigenous and volcaniclastic Mesozoic sediments from the South Carpathians records evidence of extensional deformation during Liassic to Uper Jurassic and compressional deformation throughout the Cretaceous.

The Gresten facies, Liassic quartz arenites, sublitharenites and arkosic arenites can be related to a major phase of uplift, erosion and sedimentation on Danubian and Getic pre-Mesozoic basement. Liassic clastics deposited in basins floored by Danubian crust were sourced by a petrologic province composed of medium grade crystalline schists, mostly quartzites, plagioclase gneisses and granitoids; this indicates the availability of the Lainici-Paius type Precambrian basement, which was probably uplifted on extensional faults during the Liassic; sedimentary basins were continental in the western part of the South Carpathians, while delta fans accumulated in the central zone. In the Getic area alluvial fan grading upward to fluvial sedimentation took place in typical intramontane basins, and only locally in lacustrine basins.

Existence of Middle-Late Jurassic basaltic and trachytic volcanic centres is recorded by the alkaline volcaniclastic sequences of the Arjana nappe. The lower members of the volcaniclastic-epiclastic succession show interbeds of continental to shallow marine clastics, while the upper members are interbedded with and overlain by carbonate platform limestones; such successions imply that during the Middle to late Jurassic, rifting of the continental crust and associated withinplate bimodal volcanism were accompanied by basin deepening and widening, followed by drifting in the Tithonian.

Throughout the Cretaceous, a metamorphic terrane dominated the source area of deep-water turbiditic sediments which represent remnants of the Cretaceous subduction complex preserved in the Obârsia, Severin and Cosustea cover nappes. This metamorphic terrane was uplifted together with the overlying Jurassic alkaline volcanic successions. Clastic detritus supplied to the Late Cretaceous basinal sediments was mainly derived from the prealpine metamorphic basement of the overriding plate and subordinately from the accretionary wedge. The large amount of metamorphic detritus in the Lower Cretaceous turbidites indicates that the metamorphic complexes of the internal zone (Supragetic nappes) were exposed in the hinterland of the basin accumulating the Sinaia Formation. The presence of Jurassic pelagic material in the sediment dispersal system from the Lower Cretaceous onwards is linked with the uplift and unroofing of the inner parts of the subduction complex, coupled with intense erosion.

Late Cretaceous sedimentation on Getic basement took place in piggyback and intra-arc basins. Terrigenous successions overlying Getic basement and sourced by the same type of crystalline schists, formerly interpreted as sealing the Supragetic thrusts, are reconsidered here as sediments of piggyback basins which have accumulated as a consequence of the emplacement and unroofing of the Supragetic thrusts. Intra-arc basins have formed as a consequence of active faulting in the continental margin magmatic arc which has developed on Getic crust as result of the subduction of Moesia; such basins trap the calc-alkaline volcaniclastic detritus derived from the magmatic arc. Late Cretaceous calc-alkaline volcaniclastic turbidites from the Cosustea nappe, which rework andesitic and basaltic volcanic material of the same magmatic arc, have accumulated very likely in forearc slope basins.

PEGMATITES FROM ARDINO-REGION IN CENTRAL RHODOPES, BULGARIA

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The Ardino pegmatite-field is located in the Central Rhodopes, Bulgaria, 350 km south-east from Sofia.

Pegmatites with big quartz and feldspar crystals in the region of the town Ardino are known from more than 50 years. During the 1950-60 the interest shown to them increased in connection with the search of mineral resources for the Electronic and Ceramic Industry and with the collecting of beautiful crystals by museums and collectors. The last continues up to now.

The pegmatites cut biotite gneisses with still unknown age (Precambrian, according to *Kozhucharov, 1979* or Alpine, according to *Ivanov, 1988*). Published isotope-geochronological data is quite unequivocal, but they suggest a possible Hercynian age of the protolithes, with overprinted Alpine metamorphism in amphibolite facies.

Former authors distinguished two types of pegmatites (*Kostov, 1954*): older ones, that are deformed and foliated, and younger (T=35,4±1.8 Ma, *Peytcheva et al., 1992*), not deformed, connected possibly with not outcropped granites. The not deformed pegmatites have NW-SE direction and bring the best mineral finds.

The minerals were generated by temperatures from over 500° C (the graphic zone) to 290-310° C (adularia). The main minerals of the not deformed pegmatites are quartz and feldspars, and the accessory minerals micas (biotite and muscovite), garnet (almandine-spessartine), tourmaline, beryl, tantalite-columbite, zircon, apatite etc.

We represent here data for the not deformed pegmatite "Latinka-1" It is over 100 m long and up to 6 m widet, differentiated and built mainly by two zones - graphic (potassium feldspar, oligoclase, quartz) and block zone. In the block zone were found chambers up to 3 m high. They are usually filled with clay-sericite mass, in which double-ended quartz, beryl, albite, adularia, muscovite, tourmaline and garnet lie.

Potassium feldspars of the graphic and block zones are monoclinic - "orthoclase" according the classification of *Wright&Steward, 1968*. Their morphology, structure and chemical composition change from the outer to the inner pegmatite zones in connection with the decrease of the temperature. In general Al/Si order decreases in this direction, K-content increases, and this of Na decreases. Rb-content increases from the peripheral to the central zones, and Ba and Sr decrease. The hydrothermal stage marks a new moment in the behavior of the rare elements: in the latest KFs-zone (where adularia crystallize) Rb-content decreases, and this of Ba and Sr becomes greater. Ba is uneven distributed; the highest content of BaO (up to 1.32%) was detected in a zoned adularia crystal, just in the margin with the milky-white KFs. The content of Mn, Sr, P, Zr increases too, but the elements come mainly in self minerals (apatite, zircon), included in adularia.

Albite is very pure and grows in beautiful clevelandit crystals in the cavities.

Quartz was found in a lot of varieties - rock quartz, smoky quartz, milky-quartz, citrine, amethyst. Polychromatic crystals are typical for some cavities, where crystal aggregates of early smoky or milky-quartz have overgrowths of double-ended or scepter amethyst.

All investigated garnets are from the Pyr-Alm-Spess series. Their composition change from $Pyr_{1.47}Alm_{31.80}Spes_{66.73}$ in the outer pegmatite zones to $Alm_{4.80}Spes_{95,70}$ in the central parts of some pegmatite cavities.

"Latinka-1" pegmatite is the only one place in Bulgaria, where morganite is found. Other beryl varieties of the pegmatite are aquamarine and goshenite. The rose morganite color is due to Mn-coloring centers. The goshenite contains Mn- and Fe-centers, and as a result looks colorless.

PRINCIPLE METALLOGENIC UNITS IN THE SW PART OF CARPATHO-BALKANIDES:
Geotectonic Setting and Metallogenic Features

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The south-western parts of the Carpatho-Balkan region are areas of intense tectonic deformation, various types of magmatism and Young Alpine metallogeny composed of different and economically significant deposits particularly polymetallic ones. The most essential characteristic of the area under consideration is the tectonic-magmatic and mineralization processes which are a product of post collision period as well as the influence of compression forces between the African and Eurasian plate. Continued compression activity made possible the collision between the Dinaric and the Carpatho-Balkan micro slabs and their subduction followed by thickening of the continental crust in the collision zone. Discontinuous action of compression forces resulted in partial melting of the root parts of the continental crust and mixing with material of the upper envelop. This pulsation and tectonic-magmatic activities took place several times during Oligocene, Miocene and Pliocene ensuing numerous volcanogenic-intrusive complexes related to significant polymetallic mineralization spatially distributed in several major metallogenic units in the south-western parts of the Carpatho-Balkan region.

Generally, four magmatic belts, connected with regional structures of NW SE general strike, can be distinguished in the area under consideration from west to east. These magmatic belts represent major metallogenic units in the area, as they are spatially and paragenetically related to numerous Pb-Zn, As, Tl, Ag, Cu, Au, Mo, W etc. deposits and occurrences.

The first magmatic belt is situated in the western zone and consists of the magmatism and polymetallic mineralization near Boranje, Srebrenica, Rogozna and Golija. This Tertiary magmatism and mineralization developed west of the major ophiolite belt of the Vardar zone. The basic metallogenic feature of the zone are the polymetallic deposits and occurrences in the Podrinje ore district (the vicinity of Boranje and Srebrenica) in which lead-zinc and antimony deposits predominate, then the numerous of Pb-Zn, W, Mo, Bi, As, Sb, etc. deposits in the Golija district, as well as the occurrences and deposits of lead-zinc, copper etc. in the Rogozna ore district. Various morphogenetic and structural type of mineralization closely related to subvolcanic facies of Tertiary magmatism have been established in these ore bearing sites.

The second magmatic belt consists of the Neogene magmatic rocks and polymetallic mineralization developed within the ophiloite melange of the Vardar zone. The belt consists of the volcanics and ore regions of Rudnik, Kotlenik, Kopaonik, Kozuf and Aridea. In terms of its metallogeny, metasomatic types of lead-zinc deposits dominate here. However, much more specific are the deposits in which the following associations of metals are pronounced: Pb-Zn-Cu-Tl-Au-Sb-As, such as the Alshar rare ore deposit. Carlin type of gold mineralization has also been established in close proximity of the Alshar deposit, which is the first discovery of this type in the southern parts of the Carpatho-Balkan region.

The third zone, also called a contact zone, consists of the magmatic complexes and polymetallic mineralization (mainly Cu, Au, Pb-Zn, Ag) spatially distributed along the contact between the Vardar zone and the Serbo-Macedonian massif or the areas of the Lece-Halkidiki metallogenetic zone. This zone is of northwest - southeast general extension and can be traced for more than 700 km in length. The average width amounts to 30 km. Among others, specific porphyry copper deposits are present in the zone (Buchim, Skuries, Tulare etc.) related to small subvolcanic intrusions of Tertiary magmatism. All of them contain low grade copper and gold.

The fourth zone, also called eastern zone, is located in the Serbo-Macedonian massif and occupies the area of the Surdulica-Osogovo-Tassos metallogenetic zone. Lead-zinc mineralization, accompanied by molybdenum, copper and antimony are the most common in the zone. Metasomatic lead-zinc mineralization is important within the metallogenetic zone. The Sasa and Blagodat deposits comprise the largest part of the metasomatic types of mineralization. However, mention should be made of the lead-zinc deposits related to the fault structures in the quartz-graphitic schists (the Golema Reka deposit). The lead-zinc mineralization of this kind is of lower grade compared to the metasomatic mineralization styles, but it provides larger ore amounts.

METALLOGENIC FEATURES OF SOME EPITHERMAL GOLD DEPOSIT IN THE REPUBLIC OF MACEDONIA

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Investigations and examinations carried out in the territory of Republic of Macedonia determined a large number of gold deposit and occurrences located in different structural-lithologic and metallogenic environments. However, if we talk only about epithermal gold deposits, the number of eventual areas where such mineralization styles are located becomes lower. Namely, epithermal gold mineralization styles in the territory of Republic of Macedonia were determined mainly within the largest Tertiary volcanic complexes such as the Borovic and Plavica deposits in the Kratovo-Zletovo volcanic area and the Alshar and Dudica deposits in the Kozuf volcanic area.

The epithermal ore formations in the Borovic deposit are located within the strongly hydrothermally altered Tertiary volcanics mainly along the fracture zones that are strongly silicified. Gold contents vary from 0.1 to 0,49 g/t Au for samples taken from the surface and from 0.11 to 0.30 g/t Au for samples taken from drillholes. The contents of other indicative elements for epithermal conditions are from 12 to 125 g/t As, from 4 to 20 g/t Sb, from 30 to 690 ppb Hg et al.

The ore mineralization in the area of Plavica is located in intensely hydrothermally alterated Tertiary volcanics (probably andesites and their pyroclastites) or notably within the structure of the volcanic apparatus. Besides gold occurrences, the investigations carried out in this epithermal system determined important copper, lead, zinc molybdenum, silver and other occurrences. Gold content ranges from 0.1 to 1.6 g/t, locally over 2 g/t Au. The average contents of other characteristic elements amount to 5.9 g/t Ag, 457 g/t As, 160 g/t Sb, 7.2 g/t Hg. However, the richest parts in gold occurrences within the Plavica deposit have been established in secondary quartzites distributed as gossans within the hydrothermally altered Tertiary volcanic rocks. Gold content in the secondary quartzites varies widely from 0.1 ppm to over 15 ppm. The Zlatica vein type copper deposit is situated in the vicinity of Plavica. The basic feature of the deposit is the epithermal quartz-pyrite-enargite veins with some gold content. There gold occurs in the silicified parts of the veins, in some parts in the thickened parts of the vein as well, where metasomatic mineralaization is also noticeable. Gold content ranges from 0.2 to 1.6 ppm and copper content amounts to 2% Cu.

In the Alshar deposit gold occurs as two kinds of mineralization styles. The As - Tl - Hg - SiO_2 mineralization style is related to the Pliocene volcanics or to the argillitization zones. The content of individual metals amounts to 0.2 g/t Au, 6 % As, 0.3 % Tl, 45 g/t Hg, 850 g/t Sb, 300 g/t Ba et al. The second mineralization style is related to the silicified tuffs and dolomites. The contents of individual metals in these mineralization zones amount to 3.5 g/t Au, 2.5 to 6 % Sb, 0.75 % As, 0.06 % Tl, 17 g/t Hg, 435 g/t Ba and so on.

The mineralization styles in the Dudica deposits are the least investigated and studied. Nevertheless, we can say that ore mineralization is related to silification zones along the fracture zones of various orientation related to the Pliocene volcanics. Besides epithermal gold mineralization styles there are significant amounts of copper, lead, zinc, silver and molybdenum. Based on available knowledge the largest amounts of gold of up to 1 g/t Au were determined in enargitic quartz veins of 0.3 m in length. Copper is the commonest metal with over 3 % Cu, then silver with about 20 g/t as well as variable selenium, lead, barium contents and large amounts of native sulphur.

In addition to the above mentioned epithermal gold deposits and occurrences, in the eastern parts of the Republic of Macedonia there are several important sites with low gold contents such as those in the region of Kadiica, near Pehcevo and Ilovica near Strumica. In the Kadiica region porphyry system has been established with probable presence of epithermal gold mineralization styles. This is based on the high sulphidization established with the presence of enargite-luzonite association followed by low gold contents. In the area of Ilovica - Stuka epithermal mineralization has been established originating from acid sulphate solutions. Here the increased alunite content ranging from 5 to 20 %is pronounced. Latest investigations in the area determined several small vein structures with low grade epithermal gold presence. On average gold content from 0.1 to 1 ppm Au. Besides numerous small quartz-gold veins located in altered granites, impregnated sulphide mineralization has been established in the area in which gold has also been established, but in amount not exceeding 0.2 ppm.

CONTINUOUS TEMPERATURE LOGGING IN THE TRANSYLVANIAN DEPRESSION AND POSSIBLE CORRECTIONS FOR THE THERMAL EFFECTS OF TOPOGRAPHY AND TOPOGRAPHICALLY DRIVEN GROUNDWATER FLOW

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A study of the subsurface thermal regime in the Transylvanian Depression, a tectonic unit of Neogene age, has been made. Heat flow determinations here are based on borehole temperature measurements, generally to depths less than 1400 m. The continuous temperature logging used provides densely sampled temperature profiles which are useful in studying the thermal effects of topography and topographically driven groundwater flow.

The best measurement conditions are found in water-filled boreholes which ensures a minimum of blurring from the time constant of the probe. Many of the boreholes have a significant air column in which the temperature probe shows a large time delay due to slow heat transfer conditions. Herein is presented a procedure for deconvolution of continuously logged temperatures in the air column. A few stops in the air column are used in order to provide information about the recovery time of the probe in the air. The time constants and heat transfer parameters of the model are determined by least squares inversion.

The thermal effects of topography and groundwater flow in the Transylvanian Depression have been studied using two-dimensional finite element models. The calculations show that the topography induces a decrease in heat flux at hill crests and an increase at the bottom of valleys, the difference being ~ 10% of the mean surface heat flux. The groundwater flow driven by topography shows a strong dependence on the permeability of sediments and a smaller one on the anisotropy. For the average values of permeability characterising the sediments in the Transylvanian Depression no correction is needed for the effect of groundwater flow, which cannot be seen in borehole temperature logs.

GEOCHEMISTRY AND Sr, Nd, Pb ISOTOPES OF MIOCENE AND PLIO-PLEISTOCENE VOLCANIC ROCKS FROM TWO NEOGENE SUB-BASINS OF THE PANNONIAN SYSTEM (STYRIA AND CARINTHIA): GEODYNAMIC IMPLICATIONS

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During the Neogene, the Carpatho-Pannonian Region underwent major tectonic and magmatic events due to the combined effects of roll-back subduction of the European Plate under the Carpathians and the N-S shortening between the Adriatic and European Plates, to the west. There is a general consensus that volcanic activity took place in three phases (Downes, 1996; Mason et al., 1996; Downes and Vaselli eds., 1995): 1) widespread, but poorly studied acid volcanism began around 19 Ma ago in various sectors of the Pannonian Basin (s.l.) and was followed by 2) the formation of a calc-alkaline volcanic arc, active along the Western Carpathians and the northern part of the Eastern Carpathians from about 16 to 10 Ma ago; then the volcanism continued up to 0.2 Ma, shifting progressively southward along the Eastern Carpathian arc whose origin is generally considered to be related to the Miocene subduction followed by detachment of the oceanic crust of the European Plate; 3) an "extension"-related Na-alkali basaltic volcanism which took place sporadically in the Pannonian Basin (s.l.), from about 11-9 Ma up to the Pleistocene.

The volcanism changed the petrogenetic affinity from orogenic-type in the Miocene -the Styrian and Lavanttal Basins- (Karpatian/Early Badenian-Middle Badenian; K/Ar ages: 16.3-14.0 Ma) to anorogenic-type in the Late Pliocene-Early Pleistocene -Styrian Basin- (K/Ar ages: 3.8-1.7 Ma).

The orogenic-type rocks of the Styrian and Lavanttal Basins (high-K calc-alkaline and shoshonitic series) are geochemically distinguishable from those (calc-alkaline and high-K calc-alkaline series) of the Western and Eastern Carpathian arcs, generally considered as the result of active oceanic subduction. In the more primitive lavas of Styrian and Lavanttal Basins, combined analyses of incompatible elements and Sr, Nd and Pb isotopes indicate that, by contrast with the East Carpathians, there is no evidence of a component derived from the dehydration of the oceanic crust. Instead, the data indicate the presence of a component derived from subducted continental crust material in their mantle source. This is compatible with their genesis by partial melting of a lithospheric mantle variably enriched by components derived from continental crust material of the European lithosphere subducted/incorporated in the mantle during the Paleogene N-S subduction/collision which characterized the Eastern Alps/Westernmost Carpathian transept. Such a delayed melting of a recently enriched lithospheric mantle is considered to be activated by the Miocene extensional collapse of the Eastern Alpine chain leading to the formation of the Pannonian Basin (s.l.).

The Plio-Pleistocene volcanics are strongly silica-undersaturated (nephelinites, basanites and tephrites) and have a Na-alkaline affinity. Trace element and isotopic ratios of these rocks are well within the range of ocean island basalts. There is no evidence at all of the presence of a subducted component in their mantle source nor of crustal contamination during their ascent to the surface. All these data are compatible with a derivation from low degrees of partial melting of a typical asthenospheric source.

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PREALPINE AND ALPINE METAMORPHICS OF ALBANIA

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PreAlpine and Alpine metamorphics in Albania occur mainly in the Eastern Terranes, and are represented by Palaeozoic greenschists facies metamorphics, Jurassic subophiolitic metamorphics, oceanic metamorphics and hydrothermal metasomatites; in the Western Terranes (Ionian zone) are found small tectonic slices of metamorphics.

PreAlpine metamorphics occur in the Korabi zone and partly in the Western peripheral unit of the Mirdita zone (Gashi region in extreme North); they are represented by quartz-sericite schists and phyllites, metasandstone, quartzites and greenschists interbedded with metarhyolitic ignimbrites and rare metabasalts and metamugearites, belonging to the volcano-sedimentary formation of the Ordivician Devonian age determined by crinoids, tentaculites, graptoliths and conodonts; similar metamorphic rocks are found as clasts in the transgressive conglomerato-sandstone series (Verrucano) of the Permian - Lower Triassic age. Paragenetic mineral assemblages of the preAlpine metamorphics indicate for greenschists facies conditions of metamorphism caused by Variscan tectogenesis.

Slices and blocks of metamorphics similar to the subophiolitic metamorphics, represented by amphibolite, garnet - bearing micaschists paragneissis and skarn-like marbles cut by thin palingenic plagiogranite veins, are found in the contact zone of salt diapris of the Ionian zone, associated with Triassic WP-MOR -type basalts. Their mineral assemblages show for amphibolite facies conditions of metamorphism which has affected the rift related Lower-Middle Triassic volcano-sedimentary formation. The presence of these metamorphics among passive margin environment without any link with ophiolites, must be taken in consideration in interpretations of the origin of the subophiolitic metamorphics.

Subophiolitic metamorphic rocks of Albania represent a well developed formation with particular geological setting and wide petrographical variety. They occur mainly along peripheral parts of the Albanian ophiolitic belt, at the contact zone with passive continental margins, usually associated with Liassic sinrift volcano-sedimentary formation; small tectonic blocks or slices of these rocks are found among ultramafic massifs, in tectonic melange of the contact zone, and as blocks in argillitic matrix of heterogeneous coloured melange and debris in ophiolitic conglobreccia of the Tithonian. Main rock types of subophiolitic metamorphics are amphibolites, paragneissis, amphibole schists, micaschists and greenschists. Well expressed metamorphic zonality is caused by increasing grade of metamorphism towards contacts with ultramafic rocks. Themobarometric estimations and mineral-paragenesis show for amphibolite-granulite to amphibolite and greenschists facies conditions. Radiometric dating($^{40}Ar/^{39}Ar$ method) shows that subophiolitic metamorphic rocks were formed during Middle Jurassic(162-174 my); stratigraphic data determine their uppermost age boundary as Tithonian. Geochemical data of amphibolites indicate for their MORB and OIB-affinity very similar to the chemical composition of the basalts of the associated volcano-sedimentary formation, which can be considered as protoliths of the amphibolites and amphibole schists; the protoliths of paragneissis and micaschists are pelitic rocks, arenites and cherts of the volcano-sedimentary formation.
The formation of the subophiolitic metamorphics of Albania is caused by the initial ophiolite displacement (intraoceanic thrusting, strike-slip foults etc.) during Middle-Upper Jurassic, followed by dismembering and boudinage of the metamorphic belts.

Oceanic metamorphics (metabasalts) rarely occur at the inner contact aureole of ultramafic massifs with MORB-type basalts of MOR-type ophiolite. These metamorphics are represented by amphibolites and amphibole schists with MOR-type geochemistry, and are cut by diabase dykes. They are supposed to have formed by oceanic metamorphism before the end of the magmatic ophiolitic processes.

Hydrothermal metasomatites are well-developed among volcanics and sheeted dykes of the SSZ-type ophiolites, where they form the aureoles of the volcanogene massive and stockwork-type sulphide mineralisation; their mineral assemblages range from epidote - amphibolite to greenschist zeolite facies with well expressed hypogene vertical zonality.

FIRST PROVES FOR THE EXISTENCE OF ATIAN TECTONIC PHASE ON THE TERRITORY OF BULGARIA

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The description of the folds from 4 lithostratigrafics Sarmatian units - Frangya, Odurtsi, Topola and Karvouna Formations (limestones) in NE Bulgaria - Southern Dobroudja, proves that the process of folding was initiated after the sedimentation and the lithification of the Sarmatian sediments. As general tendency, the axes of the folds are grouped around NE and SW directions (Fig. 1).

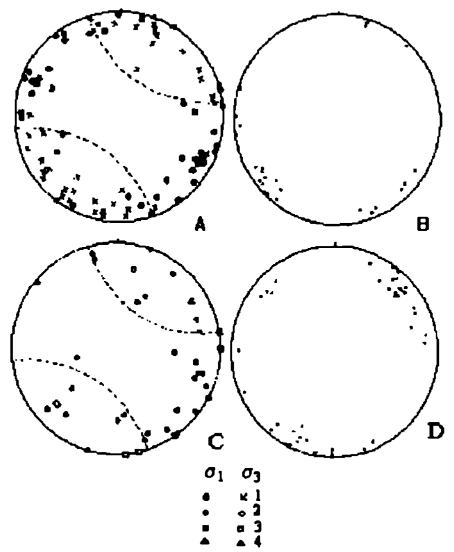

Fig. 1 Comparative scratch stereograms (projection in the upper hemisphere) of the reconstructed maximum σ_1 and minimum σ_3 axes of the post-Sarmatian tectonic stress field (A and C), and the axes of the folds of Odurtsi Formation (B) and Karvouna Formation (D) (Shanov, Karagjuleva, 1996).

Reconstructions of σ_1 and σ_3: 1- Odurtsi Formation; 2 - Karvouna Formation; 3 - Topola Formation; 4 - Frangya Formation.

On 60 outcrops of sediment of Sarmatian age, the shear joints studies permit the reconstruction of the principal axes σ_1, σ_2 and σ_3 of the tectonic stress fields, acting on and deforming the sediments. Two tectonic stress fields are detected. The youngest one follow the reconstructions made on data from Late Pliocene aged limestones in NE Bulgaria, and reflects the Quaternary stress field peculiarities. The older of them, with sub-horizontal axes σ_1 and σ_3 explains the axes orientation of the folds in the sediments of Sarmatian age. The general direction of σ_1 axis has been evaluated by geostatistical methods at azimuth 121^0, and for σ_3 axis - at azimuth 212^0 The standard deviation of the evaluated regional trends is 16^0 The characteristics of the older post-Sarmatian deformations lead to the conclusion, that for the first time are found proves for the existence of Atian tectonic phase on the territory of Bulgaria.

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ELECTRICAL RESISTIVITY ANISOTROPY AND RECENT TECTONIC STRESS FIELD IN SOUTH PIRIN MOUNTAIN (SW BULGARIA)

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Studies *in situ* of the electrical anisotropy, using azimuthal vertical electrical sounding, have been performed on Pliocene and Quaternary sediments in the region of South Pirin Mountain (SW Bulgaria). According to the well known "paradox of anisotropy" the highest electrical resistivity for given distance between the electrodes (Shlumberger array) is measured at the azimuth of the more open system of rock fractures. In brittle rocks these fractures are oriented perpendicularly to the minimum tectonic stress axis σ_3 and in direction of the maximum tectonic stress axis σ_1 (or σ_2 when σ_1 is sub-vertical). For ductile and unconsolidated rocks practical studies have demonstrate that the long and the short axes of the anisotropy ellipse follow, respectively, the directions of σ_1 (or σ_2) and σ_3 stress axes.

The azimuthal vertical electrical sounding has been executed on 4 sites. The maximum length of the array was 40 m. In this way the obtained information was for the electrical properties of the sediments for the first 10 m bellow the surface. The axes of the electrical anisotropy ellipse have been calculated for every distance between the electrodes A and B using the computer program ELLIPSE. The variations at the depth of the long axis of the anisotropy ellipse have been compared to the geological profile of every site (Fig. 1). It has been determinated a clear coincidence between the regional trend of the vertical contemporary stress axes plane [σ_1; σ_2] - N80-90^0 (from earthquake fault-plane solutions) and the long axis of the anisotropy ellipse for the Quaternary sediments.

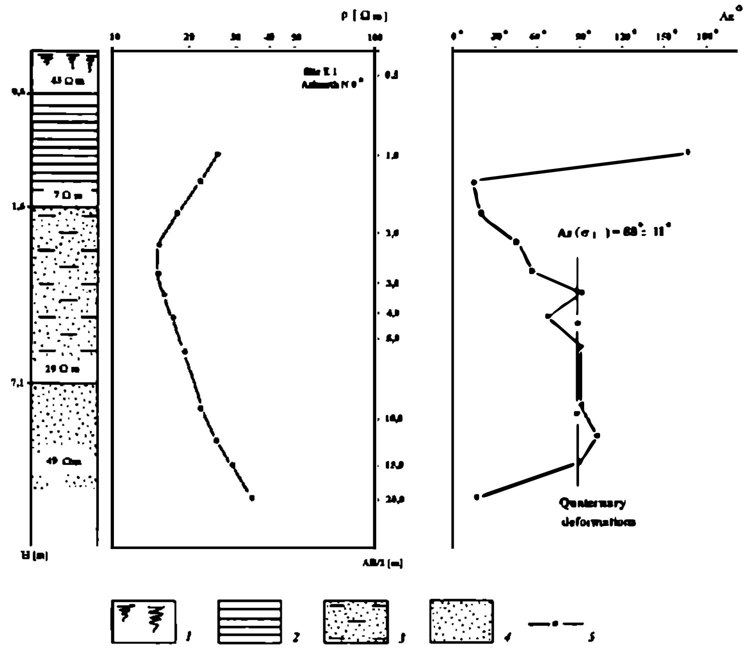

Fig. 1 Results from the interpretation of the azimuthal vertical electrical sounding for the site E 1. Sandanski Formation
1 - soil; 2 - clay; 3 - sandy clay; 4 - sands; 5 - average azimuth of the long anisotropy ellipse axis for the Quaternary sediments.

ON FORMATION AND OCCURRENCE OF MINERAL WATERS OF THE "NAFTUSYA" TYPE WITHIN CARPATHIAN REGION

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The mineral waters (MW) of "Naftusya" type are unique as to their curative effects on the human body, and becouse their deposits are discovered and exploited only in Ukraine. Curative properties of the waters are stipulated by the balneologically active complex of organic matter, dissolved in the water. "Naftusya" MW are recomended at deseases of kidneys, liver, nervous-hymoral system, lithiaeis discases. They favour normalization of chologenic function of liver, excretory function of kidneys, metabolic processes in human body, in particular, they are effective at allergy and diabetes treatments. New curative effect of "Naftusya" MW - restoration of detoxic systems and blood - forming system, disturbed under the influence of low active radiation fields and acceleration the removel of the incorporated radionuclides was discovered by Ukrainian scientists.

As a result of the complex hydrogeological methods it was established that the MW of "Naftusya" type are associated with water - bearing rocks, enriched with the OM. It was proved by the discovery of the Carpatian region of "Naftusya" MW in the lower and Upper Menilitic and Bystritsa Paleogene formations and the Podolian region - in the Silurian occurences.

The results of the hydrogeochemical, the electron - microscopic and palynologic investigations showed, that the rocks maternal matter is the source of the dissolved OM. The maternal mattter of the rocks may be of different genesis, but of similar conditions of formation (in particular, the presence of the definite reduction - oxidation geochemical situation and microflora). In this case, the change of the rock"s OM both of the Carpathian region and the Podolian region of "Naftusya" MW goes like "oil type"

The transition of the OM into the MW, is determined by the physical and chemical rock"s parametres (the fissured state, the density, the rate of distruction, the mineralogical composition) and by the properties of the solute components (polarity, the solubility, the molecular weight, the kind of the chemical bond with rock"s elements).

It is esteblished that the curative properties of the "Naftusya" type MW are stipulated by the definite complex of the balneologically active compounds - the polar, unstable, non - volatile, which are able to complex formation. The groups of the balneologically active OM, which are the nitrogen compounds and organic acids, were distinguished and identified. The group of the polar compounds, inherent only for "Naftusya" MW, which can be used as peculiar "passport" at identification.

The investigation of the mechanism of the formation of the chemical composition of "Naftusya" type MW make possible not only to increase the water reserves up to ten thousends m^3, considered to be unique, but in common with biologists to discover it"s new curative properties.

The methods, developed by the authors gives an opportunity to preserve it"s curative properties more than half - year. It"s use is of prime importance for individuals, victims of the Chernobyl disaster and other environmental disasters.

On the basis of the investigation of the MW of the "Naftusya" type in the Ukrainian part of the Carpatian region, we consider that these MW are extended in the neighbouring Romania, Poland and possibly in Slovakia.

PESTICIDES CONTENT IN MINERAL WATERS OF TRANSCARPATHIANT REGION

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Transcarpathian region is the richest province of Ukraine, its main reacreation resources being mineral waters, climate and landscape. About 50 fields with medical waters of different types are known, among those the most widespread and valuable are carbonic waters. In 1989 and 1997 Institute of Geological Sciences, NAS of Ukraine, carried out examinations of mineral waters fields for the content of strong organochloric pesticides: DDT and its metabolites, HCCH and its isomers, aldrin, heptachlor; organophosphoric pesticides: methaphos, carbophos, phosphomide, phozallon; fluorine-containing pesticides: trephlane and others.

In 1989 there were examined 16 fields that exploit mineral waters of different types: Polyanskoye, Ploskovskoye, Novo-Polenskoye, Svalyavskoye, Golubinskoye, Nelipenskoye, Medvezhye, Shayanskoye (Borzhomi type); Soimenskoye, Kelechenskoye, Uzhgorodskoye, Dragovskoye, Gorno-Tisenskoye (Synegorskoye type), Pasikskoye (Krinitza type). Dr. E.Molozhanova took part in expedition 1989 and the authors express their thanks for her contribution to this work.

In 1997 there were performed determinations in three fields of mineral waters: Luzhanskoye, Poljanskoye, Uzhgorodskoye.

Analysis of mineral waters for pesticides content was carried out in the laboratory for pesticides determination in ground waters and soil of the department of hydrogeological problems, Institute of Geological Sciences, NAS of Ukraine, with the gas chromatographs «Tsvet» (Models 550, 570).

Total concentrations of the examined pesticides in the mineral waters vary in the range of $n \cdot 10^{-4}$ - $n \cdot 10^{-6}$ mg/l; the same diapason of concentrations was typical for surface waters.

In the soils and water-bearing rocks pesticides concentrations are significantly higher and reach decimal fractions of mg/kg. In the mineral waters ΣDDT was detected in 100% of samples in the concentration range $n \cdot 10^{-4}$ - $n \cdot 10^{-7}$ mg/l. Σ HCCH is present in 100% of samples in the concentration range $n \cdot 10^{-5}$- $n \cdot 10^{-7}$ mg/l. Dilor was detected in100% of samples in the concentration range $n \cdot 10^{-5}$ - $n \cdot 10^{-6}$ mg/l. Metaphos is present in 82% of samples in the concentration range $n \cdot 10^{-6}$- $n \cdot 10^{-7}$ mg/l. Carbophos is present in 71% of samples in the concentration range $n \cdot 10^{-6}$- $n \cdot 10^{-7}$ mg/l.

It was established that simultaneously in the same sample there could be present up to 8 substances and their metabolites derivatives of chemical compounds of different groups in the concentrations lower than MPC for water, that could be utilized with social-drinking purposes, however the total effect of their influence on human body is not studied yet.

Analysis of the situation at the mineral water fields in Transcarpathian region revealed primary stages of mineral waters quality changes due to anthropogenous activity of a man, in case the situation would not be controlled this could cause in near future irreversible negative consequences.

Despite the variability of hydrogeological conditions in Transcarpathian there were revealed no reginal correlations between pesticides concentrations in the mineral waters and geological shape of the territory, type and chemical content of the waters.

Pesticide content in the mineral waters is characterized by mosaic character of distribution due to the quantity and assortment of pesticides that are utilized at agricultural lands and forests, protection of underground waters, microinclines, permeability of aeration zone and filtration properties of water-saturated zone, technical state of the wells and regime of their exploitation, permeability of near-well surface, confined and unconfined character of the aquifer.

During the last ten years (1987-1997) DDT content in the waters significantly (for one order) decreased, while HCCH concentrations remained practicaly at the same level. This indicates that HCCH was periodically used at the agricultural lands and forests of Transcarpathian. As soon as DDT is concerned, there were no new income to natural ecosystems, and retrospective pollution gradually decreases.

It's necessary to conduct systematic observations over pesticides content in hydromineral resources, to perform ecological exspertize of the territories to eliminate or diminish negative influence of the pesticides at the expence of change of assortment of the products used, decrease of standards, in some cases - prohibition of their utilization, along with the carrying out fundamental investigations to reveal the main regularities of these substances migration in underground ecosystem, to elaborate the criteria for estimation of danger of simultaneous presence of pesticides belonging to different groups in mineral waters and other natural objects.

FUTURE OF GEOLOGICAL FORMATIONS USAGE FOR HAZARDOURS WASTE ISOLATION IN CARPATHIAN REGION.

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Presently there are no enough storage facilities in Ukraine for safe disposal of radioactive wastes (RAW) and hazardous chemical wastes (HCW) placed in deep geological formation. Accumulation of these wastes occurred during last decades. According to the developed state program of radioactive waste management, it is planned to construct the national RAW storage, and provide possibilities for regional storages creation. The program of HCW control is still being developed. If to take into account that, potentially, the total amount of HCW is much grater than of RAW, the similar approach to HCW disposal may be used.

Ciscarpathian foredeep and Transcarpathian foredeep may be pre-selekted in Carpathian region for RAW and HCW disposal. The greatest interest represents the Ciscarpathian foredeep. It includes Internal and External zones. The Internal zone is characterized by significant folding of deposits with wide occurrence of tectonic fracturing. Within the External zone, the folded deposits are overlapped by powerful mass of Neogene clay deposits. This zone is of primary interest.

For further more detailed study, the two groups of sites within Ciscarpathian foredeep external zone were selected. The first group of site is located in the Krukenichskay zone. In its geological structure, the Dashavian suite is mostly interesting for RAW and HCW storage. The suite, having total thickness 1000 m, is composed of clays, calcareous aleurolites, tuffs and rare interbeds of sandstone. The clays dominate (up to 65 -70%). The intercalations are present rich of organics. The last factor is positive, since organic promotes sorbtion of radionuclides and chemicals. In mineral structure of clays, the hydromica and montmorillonite are dominating. Montmorillonite- one ofthe best sorbent among the minerals in the clay rocks. It is also a positivi factor witch increased the perspactive of Dashavian suite. The second site is situated 40-50 kilometers north-west of Kolomyia. Prospective for RAW and HCW disposal is the Kosovian suite having thicknesses to 400 meters. The clay are dominated. The layers are present enriched with organics.Clay deposits of Dashavian and Kosovian suites are of very low permeability and water content. Confined to this formations are highly-mineralized fluids typical for zones of weak and very weak water exchange. Groundwater contains high concentration of sodium, chlorine, iodine and bromine. By their genesis, they are metamorphozed sedimentation waters. This provides evidence of high degree of filtrational isolation of rocks. Close similarity of geological and hydrogeological conditions of examined sites to those of oil-gas deposits located to the south also indicates their high isolation. So, from standpoint of hydrogeological and geochemical conditions, clay formations of external zone Ciscarpathian foredeep are optimal for RAW and HCW disposal.

It was found that within the Transcarpathian depression the geological conditions most favorable for hazardous waste burial existed in its eastern part known as Solotvino depression. This is due to its favorable reservoirs (rock salts and zeolitic tuffs) and suitable geological and flow conditions (presence of several aquicludes and low filtration properties of the reservoirs)

The rock salts within the traced Danilov-Tereblya brachyanticline are seemed to be favorable. They are represented by low-grade salts of no commercial value enriched with clay particles. The brachyanticline contains a group of stocks, with the Tereblya salt stock most favorable for waste burial.

The salts are known also as a regional aquiclude in respect to Novoselitsa formation represented by zeolitic tuffs. A sequence of Novoselitsa tuffs favorable for burial occurs at a depth exceeding 1,000 m in the zone of stagnant groundwater flow regime. In addition, the Novoselitsa formation exhibits a considerable sorptive capacity due to high zeolite content (up to 40-60 %). Noteworthy also is Teresva formation that seems to be favorable for waste burial due to its tuffs enriched with zeolites and exhibiting low permeabilities at depth marks exceeding 500 m.

As to seismic conditions in Ukrainian Transkarpathian and Ciscarpathian depressions they are assessed as permissible due to the fact that the Southen Carpathians serve as a barrier in respect to the major tranregional seismic origin in Vrancea region (Romania). At the same time the local seismic origins are relatively low active and short-ranged wich needs further research.

STRUCTURAL POSITION, OIL AND GAS POTENTIAL AND DEVELOPMENT OF HYDROCARBONACEOUS RESOURCES IN THE UKRAINIAN SECTOR OF THE BLACK SEA

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The Black Sea Basin with the thick (about 16 km) sedimentary cover is the intercontinental depression structure, which contains a number of troughs and arches. The East-European Platform, Scythian and Misean Plates and Kimmeridges of the Mountainous Crimea have continuation in the bounds of the Black Sea shelf and continental slope. The joint zone between the East-European Platform and Scythian Plate is traced in sublatitudinal direction, represents the suture along the system of deep faults, and is accompanied by the depressions including the Karkinit-North-Crimean Trough and Dobrudga Foredeep. The thickness of their sedimentary formations is equal 8-9 kilometres respectively.

The Karkinit-North Crimean Trough is the main oil-and-gas-bearing region of the Black Sea. The most of explored reserves and the main hypothetical resources of oil, gas and condensate are placed here. The large volumes of sedimentary formations in the trough, the presence of argyll-carbonaceous series, reservoirs, cap rocks, structural forms, availability of necessary thermobaric conditions have caused here high prospects of oil and gas content.

Deep exploration drilling in the Ukrainian sector of the Black Sea has began on Golitsyn structure in 1971 and the first industrial gas influx was received in 1975. Up to now seven medium and small by reserves gas and gas-condensate fields have been discovered at 30-55 m sea depth: Golitsynske, South-Golitsynske, Shmidta, Shtormove, Arkhangelske, Krymske and Odesske which are connected with terrigen-carbonaceous formations of Cretaceous, Paleocene and Oligocene. In 1997 5the new field Besimenne was discovered and now the gas reserves are calculated. The Golitsynske, Arkhangelske and Shtormove fields are in development. Total initial potential resources of hydrocarbons which mainly are in gaseous condition exceed one billion tons of standard fuel.. Degree of development of potential resources in the trough is about 2-3%.

The elaborated in 1995 Program of the hydrocarboniferous resources development in the Ukrainian sector of the Black Sea up to 2010 assumes to realize the large volume of exploration and exploitation drilling and to produce several million tons of oil with condensate and several billion cubic metres of gas.

Nature protection measures which were realizated during the development of hydrocarboniferous resources promoted of safe realization of seismic prospecting, drilling, field development and gas transportation. Monitoring of ecosystem state testifies that these works did not create the negative influence on the offshore ecology. In connection with intensification of operation which is planned in the Black Sea it is assume to elaborate and to realize the complex of measures for guarantee of full ecological safety.

FEATURES OF GEOLOGICAL STRUCTURE AND OIL AND GAS PRESENCE OF THE CARPATHIAN PLATFORM AUTOCHTHONE

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The well know model states that the Carpathian folded-mountainous structure was plucked from the initial base and thrusted over the foreland to which it was not genetically related. Theoretically the amplitude of the thrust is estimated as more than 80 km although it is only 35 km by the seismic and boring data.

The Ukrainian Carpathian platform autochthone is a new trend of oil and gas exploration. Its prospects are determined, except of large amplitude of the Carpathian overthrust, by presence of the thick reservoirs within the Paleogene, Cretaceous and Upper Jurassic deposits as well as fluidscreens - clayey Miocene molasses of the autochthone discovered by the seismic data and paleogeographic reconstruction.

Hypothetical structural-geological model of the Ukrainian Carpathian Autochthone is created and based on the following data:

- paleogeographical restoration of the Carpathian basins and the adjacent foreland making use of palinspastic reconstruction;
- restoration of paleogeomorphological forms which originated at the cuesta-like margin of the foreland during the periods of removal of clastic material from the foreland into the deep water flysch basin;
- geophysical evidences about the present depth of the Carpathian alochton base and the pre-Mesozoic surface of the autochthone (foreland);
- maps of geomagnetic Vize vectors which define, on author's opinion, the position of the platform autochthone margin under the Carpathian overthrust sheet

There was recovered a number (up to 10) new paleovalleys and the first attempt to separate the Mesozoic-Paleogene formations of the Carpathian platform autochthone by paleocanyons have done using the satellite photos.

A screening role of the flysch thrust surface is proved too. Except of the Lopushna structure with high debit oil field, there is more than 10 of large uplifts on the 5,5-9 km depth in the autochthone where hydrocarbons could be preserved according to the data of the lithification rock degree. Three stratigraphic brothels of 6-8 km depths have been recommended to drill.

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BEDDING PLANES ABIOGENIC PATTERN IN COAL-BEARING CARBONIFEROUS OF LVOV - VOLYN BASIN.

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The basin is situated within the Lvov Paleozoic Depression and the western slope of the Ukrainian Shield. It is the south - west part of the Lvov - Lublin basin, the largest part of which is placed in Poland. The Carboniferous (Visean - Early Baschkir) coal - bearing formation 1400 m in thickness consists of interbedded sandstones, aleurolites, mudstones, limestones and coal seams. Two subformations:the lower weak coal bearing marshy-marine and the upper hieghly coal bearing alluvial – limnic – marshy – lagoonal - compose the formation.

With litologo-facial studying different abiogenic structures were distinguished et first. **Flow jet tracts** are presented by moulds on aleurolite beds lower surfaces. On ends of flow marks are conical sharping and raised above a bed plane. And opposite ends are widened and merge with bedding surfaces. Flow structures 0,3 - 0,5 cm wide, 0,1 - 0,2 cm height, 0,5-1cm and more long are strick oriented at the same direction. The distance between current marks is from 0,2 - 0,3 cm to 1 cm and more. **Ripple marks** are placed on the upper surface of aleurolite and seldom mudstone or limstone beds. Wave asymmetrical rippl 0,5-6 cm in distance between cusps and 0,2 - 0,5 cm in flutes depth dominates. Ripple index is 2,5 - 3,0. Corresponding indications of current rippl marks are 1 - 3 cm, 0,2 - 0,3 cm, 5 - 15 cm. **Rain prints** in the form of numerous round or oval pits sometimes with small swelling along a periphery are distingyished on the upper surface of aleurolite beds. The pits diameter is 2-6 mm and 1-2 mm depth. Structural distribution on bedding planes is uniform and oval flutes are oriented at the same direction. **Gassing signs traces** are situated on the upper surface of mudstone beds. Usually they are in the form of round mounds 0,6-1,2 cm diameter, to 0,5 cm height with a small flute in the centre and numerous small radial rugae. The another variety of gassing signs is in the form of not deep pits to 1 cm in diameter with wrinkled walls,rounded by not high swellings. There are small horizontal planes or hollows in the pit centre. Pits and mounds are isolated, but sometimes are formed congestions. Dessication cracks traces are timed to mudstone beds overlained aleurolites. They are pronounced as a network of polygonal cracks filled in overlaing aleurolites. Cracks (2 mm wide, to 2 - 3 cm depth) separate mudstone beds into sections with different dimensious and shapes. **Dessication cracks traces** and flow marks are designated the most rarely. Another abiogenic structures are developed approximately equally. But in vertical sequence they are detectid the most often in the upper coal bearing subformation with the higher development of continental and transitional sediments. Abiogenic structures which were characterized in this paper are widely used for the definition of enviromental conditions and correiation of basin coal-bearing deposits.

HYDROCARBONS IN ORE DEPOSITS OF THE UKRAINIAN CARPATHIANS

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The Ukrainian Carpathians are the Alpine complicated fold-nappe structure fonned as a result of a collision of island arcs and the Pannonian plate with the Eurasian continent. This structure is extended from NW to SE and involves three main parts: external one- the Pre-Carpathian foredeep, central one -the Carpathian fold flysch area and internal one - the Transcarpathian intermontane depression.

In the Pre-Carpathian foredeep there are gas deposits within the Tortonian and Sarmatian sediments of the external zone, oil deposits are in the Upper Cretaceous-Gelvatian sediments of the internal zone, also under the nappe of the Skybova zone of the Fold Carpathians, and within the Cretaceous-Eoceane sediments of the same zone. In the Transcarpathian depression several small gas deposits are known.

In the Carpathian fold flysch area there are only small oil-and gas manifestations in boreholes and mines, and also hard bitumen and maltha in mercury deposits and rarely in shows of mercury-antimony-arsenic mineralization. Within the external zone of the Pre-Carpathian foredeep besides gas deposits there are native sulphur and celestite deposits localized within sulphate-carbonate sediments of the Tortonian and Sarmatian, and also shows of celestite within the Turonian limestones and marls. It is suggested that mineralization was formed as a result of interaction between ascending hot hydrocarbon chloridic solutions and sulphates of host rocks. In the internal zone of the Pre-Carpathian foredeep near by the Beregovoy thrust stratobound sphalerite-galena manifestations are localized within the Helvetian carbonate-sandstone-clay sediments. Ozokerite lenses and layers are known in the Starun, Polyarky, Truskavets, Dzvynyachy lead-zinc manifestations. Mercury is found in the Truskavets manifestation (native mercury) and also as geochemistry anomalies in the Lyucha manifestation and the Kosiv area.

In the Flysch Carpathian, between the Transcarpathian depression and the Skyba zone, within the Cretaceous and Paleogene fold sedimentary rocks, there are «marmarosh diamonds». They are colourless transparent double-headed quartz crystalls and are found in calcite veinlets or as individual segregations on walls of joints, sometimes among arsenic, antimony-arsenic and mercury mineralization. It is suggested that crystallization of this quartz was from slight salinated water-methane solution under temperature 130-180°C and pressure 20-48MPa. Besides gas hydrocarbons within «marmarosh diamonds» there are oil and paraffin inclusions. Within the Flysch Carpathians, near by the border of the Transcarpathian depression, there are mercury deposits and shows containing asphalts and crystalline hydrocarbons (karpatite, curtisite). Among these are deposits of the Olenevo ore field localized into pipes and dykes of the Plyocene basalts, and also Keretski ore manifestation within flysch. An early mineral association is represented by Pb, Zn, Fe sulphides, a late one-by calcite together with marcasite, cinnabar, asphalt, curtisite, karpatite. The latter mineral is dawsonite. It is noted correlation of mercury and organic carbon.

Mercury bitumen-bearing deposits and manifestation are widespread in the Vyshkovo ore field situated on the south side of the Transcarpathian depression. They are localized into minor intrusions of the Low Pannonian quartz diorite porphirite, granodiorite porphyry and host rocks (Pannonian and Sarmatian tuff-sandstone-clay molassa). The first stage is represented by carbonates (320-180°C) and base-metal sulphides, the late one-by quartz, carbonates (250-100°C), metacinnabarite, cinnabar and carbon matters. Among these are gas hydrocarbons, oil matters, asphalt, antraxolite, paraphin, curtisite.

By and large for the Ukrainian Carpathians it is outlined the ore-bitumen zoning. Within the central zone (SW slope of the Fold Carpathians) there are shows of cata-metagenetic quartz of the «marmarosh diamond» type, and also late mercury-antimony-arsenic manifestations sometimes with small quantity of kerites, paraffin and oil. Near by the both borders of the Transcarpathian gas-bearing depression there are mercury-bitumen deposits and manifestations, which contain the early base-metal association, and late mercury mineralization accompanied by hard, viscous and liquid hydrocarbons.At the boundary of the Pre-Carpathian foredeep and the Fold Carpathians there are oil deposits and also base-metal deposits containing late bitumen (ozokerite, oil), native sulphur and mercury. Still further, in the external zone of the foredeep, gas deposits and native sulphur, celestite and barite mineralization is often found. Gas hydrocarbons were involved in their formation.

THE REASONABLE ASSUMPTION AS TO THE CARLIN GOLD TYPE IN THE CARPATHO-DINAR REGION

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Gold-mercury-antimony-arsenic deposits of the Carlin type of important commercial significance are discovered in numerous regions of the World. They are placed within collision zones and are attracted to a thrust of an oceanic crust over autochthone represented by flysch or craton formations. These deposits are related to post-collision development, sometimes accompanying by extrusive magmatic activity.
The Carpatho-Dinar region is the part of the Tethyan Eurasian matallogenic belt (TEMB), characterized by some specific features. The belt was formed during Mesozoic and Post-Mesozoic times in the area of the former Tethian ocean along the southern margin of Eurasia. Main features of geotectonic evolution of the area, where the TEMB was formed, are described by S. Jankovich (1997).
Within the Carpatho-Dinar region it is distinguished the Late Alpine collision (island arc- contitent and microcontinent-continent)areas experienced post-collision development with formation of volcanic-intrusive alkali-basalt complexes. There are deposits and ore manifestations of Au-Hg formation connected paragenetically with these complexes and within localized metamorphic base complexes of structural blocks, within volcanic-sedimentary complexes of oceanic crust and flysch complexes of transitional crust.
The Nokeswill type ore shows is situated in listvenitized ultrabasites, the Carlin type deposits is in jasperitized carbonate formations of different complexes, the Gold-Quarry (Kuchus) type deposits is in argillized silicate rocks (often in flysch series).

Deposits of all types are often closered together in space and situated along the regional upthrust front of oceanic crust complexes over sedimentary complexes of the transitional crust. Ore veins (in intrusive rocks) and ore shear, breccia and desintegrated zones (in the Jurassic flysch complexes) occur as well as stratabound mineralization in dolomites, limestones, carbonate siltstones and sandstones. Mineral composition is the same for deposits of all types: native gold (predominantly with size up to 1mkm), cinnabar or metacinnabar, realgar and/or orpiment, stibnite, thallium, sulfides and sulpharsenides, marcasite, quartz, carbonates, baryte (sometimes fluorite), sericite or clay minerals. Sometimes in the vertical ore formation series there are transitions to deposits of Au-Sb, Au-Sb-W, Au-As, Au-Ag-Pb-Zn formations. Ore deposits of Au-Hg formation (and the Carlin type in particular) fall in the low-temperature ones, related to activity of submarine or sub-aeral hot springs, which is accompanying the recent magmatism.
The Triassic-Jurassic carbonate strata widespread within the West Carpathians, and also known in the North Hungary, Apuseni Mts, external zone of the Marmarosh massif and Vardarides is specially interesting for prospecting of the Carlin type deposits. The Nokeswill type Au-Hg-Sb-As(Tl) mineralization is the most probable in Vardarides, where the Jurassic-Low Cretaceous ophiolite formation is widespread, and also in Apuseni Mts and Ukrainian Carpathians. It is possible to discover the Gold-Quarry (Kuchus) type deposits within the Cretaceous-Paleogene flysch strata to the north of the Pieniny zone in the West, Polish and Ukrainian Carpathians, and also to the NE and east of the Marmarosh massif upthrust over the Carpathian flysch in Ukraine and Romania.

Integrated palynology (spores-pollen and dinoflagellate) of the Upper Cretaceous formations in the Tisza Unit (S Great Hungarian Plain) correlated with nannozones

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Upper Cretaceous formations of the Tisza Unit in the Villány- and Mecsek Zone were studied.

The palynological and nannoplankton investigation of these formations was focussed onto the elaboration of palynozonation and onto the correlation of nannozones.

Formations of the Bácska area (Szank-, Csikéria Marl- and Bácsalmás Formation) were ranged to the Late Santonian - late Late Campanian Odontochitina (dinoflagellate) Assemblage Zone: Isabelidinium microarmum-, Tarsisphaeridium geminiporatum- and Alisogymnium euclaense - Dinogymnium digitus Subzone and into the Longanulipollis bajtayi - Longanulipollis lenneri-, Pseudopapillopollis (pollen) Assemblage Zone: Interporopollenites sahi-. Plicapollis -Subtriporopollenites Subzone. That here introduced palynozones were correlated with CC16 - CC22/23 Nannozones.

The Körös Formation on the basis-breccia (Kom-2, -10, -13 bh) and the Izsák Formation (Nádudvar-SE-3 bh) was compared with the middle part of the previous Bácska profil.

The terrigenous type Körös Formation (Kom-E-1, Kom-4, -7, -8 bh) was ranged to the Coniacian ?CC12 - CC13 - Santonian CC16 Nannozones correlated with the Oculopollis - Complexiopollis Dominance Zone. These strata are comparable to the Lower Turonian Gátér- and Vékény Formations.

Based on the palynological data the sedimentation went on in the inner- and outer shelf environment in the mediterranean territory of the Normapolles Phytogeographic Province during the Late Coniacian - late Late Campanian period.

MINERALOGICAL ZONATION OF BEREGOVO ORE FIELD AS A REFLECTION OF STRUCTURE OF PALEOHYDROTHERMAL SYSTEMS

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The epithermal deposits of Beregovo ore field (Transcarpathion region, Ukraina) are located in neogene Intracarpathian volcanic belt that extended from Styavnica stratovolcano (Slovakia) up to Apuseni mountains (Romania). The ores are localized in explosive caldera (diatreme), which is filled of fused rhiolitic tuffs and breccias. The structure of ore-forming paleohydrothermal system was regulated internal heterogeneity of a pear arisen with its formation. The interior of a caldera consists of the convoluted vertical or inclined plates of tuffs of a different structure and in a consequence it has strong heterogeneity of permeability properties of rocks. This rocks was overlaid by clays and tuffites of caldera lake, which later fill in by failure breccias of rhyolite extrusions, that extruding along western edge of caldera.

In a stage of lithification of tuffs were transformed into quartz-albite-adularia metasomatites. The activity of paleohydrothermal system was begun after formation of extrusion of rhyolite. It s divided into four stages: sulphides, chalcopyrite-quartz, carbonate-quartz, and carbonate-quartz-goethite. During each stages and all-in-all hydrothermal process, in time decreases of the temperature, the role of deep fluid and waters of caldera lakes sediments (on dates of stable isotopes H, O, C) and increase a ratio of meteoric water and oxidizing potential (appearance of barite, jarosite and alunite at the end of three last stages). One and those channels of a filtration control the parageneses of each stage. It distinctly is displayed as centers of mineralogical zonation.

The mineralogical zonation of three levels is break down:

1. Metasomatic zonation, which reflects interactions between acid hydrothermal solutions and host quartz-albite-adularia, rocks. It is shown through development along channels of filtration strongly porous sericite rocks with increase of the contents of kaolinite to top. Gradually, with distance from a channel the degree of transformation of host rocks was decreases. In rocks, that filling of lake's cut, channel of filtration is exhibited as kaolinite-dickite zone, those surrounded to by alunite-content rocks.
2. Zonation of stage's parageneses reflecting an evolution general dynamics of paleohydrothermal system and exhibited in a diminution of a field development of products of each succeeding stage. The mineral aggregates of each stage are absent in the channel and are concentrated on the boundary quartz-adularia and quartz-adularia-sericite zones. Frequently aggregates of early stage was to precursor for products of backward stage: sulphides aggregates for chalcopyrite and electrum of second stage; carbonates for hematite and that is like
3. Mineralogical zonation of allocation paragenesises and single minerals or its properties within the limits of each stage. It reflected, first of all, processes of mixing of deep solutions, meteoric and sedimentic waters, boiling of solutions and condensation a steam in meteoric waters; dynamics of interaction ore forming solutions with earlier aggregates.

AGE OF THE ANDESITIC ROCKS IN THE SUB-SILESIAN UNIT (OUTER CARPATHIANS)

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Occurrence of huge blocks of redeposited andesitic rocks are known from the late Cretaceous deposits of the Sub-Silesian unit in the Żegocina area. The Sub-Silesian Unit forms a narrow, strongly tectonised belt along the northern margin of the Silesian Nappe. It also lies beneath the Silesian Nappe, and both nappes are locally refolded and as result, the Sub-Silesian unit occurs in tectonic windows within the Silesian Nappe. In one of the windows (Żegocina window) within the Late Campanian-Maastrichtian sequence there are horizons of marly shales which contain blocks of limestones, granites, biotitic gneisses and volcanic rocks. These sediments represent deposits of sub-marine slumps. The volcanic blocks which dimension can reach length of tens of metres are generally represented by: 1 - porfiritic andesites composed of light plagioclase and dark minerals (amphibole-mainly augite, pyroxene and biotite) within fine-grained mass; 2 - andesitic tuffs and tuff-breccia. Palinspastic reconstruction implies that that part of the Sub-Silesian Unit was connected with a submarine slope bordering the Outer Carpathian Basin from the north,, and source of andesitic rocks were connected with that area.

The main problem is the age of andesitic extrusions and an attempt was made to date that andesites using zircons. The andesitic tuffs contains following groups of zircons - A: poligenetic (lower than 0-12mm in size); B: massive, abraded prisms; C: idiomorphic crystals - needles and elongated prisms; D: idiomorphic crystals - homogenetic, co-magmatic group. The isotopic age was determined in Institute fur Geologie und Dynamik der Lithosphaere, Univesitet Goettingen. U/Pb dating of A and B fractions suggests age 2338 +9.6/-9.4 Ma and U/Pb dating suggests age 144 +41/-45 Ma. The A and B probably represent mainly detritic zircons derived from the Precambrian basement, and groups C and D represent co-magmatic zircons as they have had a much better chance of having grown in the andesites. Unfortunately the error is large but analytical data may suggest a late Jurassic - early Cretaceous 'andesite' event within the northern part of the Outer Carpathian Basin that was a source for andesite blocks. The isotopic (Ar/K) age of biotites from biotitic gneisses determined in Isotope Geoscience Unit S.U.R.R.C East Kilbride, UK is 542.7 +/- 11.4 Ma and 546.6 +/- 11.2 Ma. It is concordant with earlier data of other authors and that shows that also rocks from the metamorphic substratum were a source for exotic rocks. Grant Polish Comm. Sc. Research 413/P04/96.

LOWER CRETACEOUS OUTER CARPATHIAN BASIN - A TRANSITION FROM RIFTING TO COMPRESSION

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Outer Carpathian Basin developed during the Jurassic and the early Cretaceous on the southern margin of the North European Platform (NEP), flanked from the south by Pieniny Klippen Basin. Jurassic-early Cretaceous evolution of the Outer Carpathian Basin can be divided into several stages: 1 rifting of carbonate platform being the southern part of the NEP; 2 - downwarping of southern margin of NEP and generally quiet sedimentation; 3 - compression and intensive sedimentation; 4 - period of downwarping and quiet sedimentation.

During the **first** stage, the NEP started to be rifted and incipient relatively small, local basins developed. In proto-Magura basin rifting probably started already during the Lias-Dogger time (Poiana Botizei), whereas in the western embryonic Silesian basin (Morava, Cieszyn-Bielsko) and in the Eastern Carpathians (Rachov Zone: Kamiennyj potok Beds - Black Flysch Zone; Ceahlau: Sinaia Formation) rifting began at the turn of the Jurassic. These incipient basins were filled out by dark redeposited marls followed by calcareous turbidites. Their source areas were adjacent, uplifted parts of carbonate platform. The deep faults were ways of migration of teschinite or basic lavas and tuffites. The **second** stage (Hauterivian, Barremian, partly Aptian) was connected with general downwarping of the south, inner part of the NEP, probably due to the cooling effect of underlying lithosphere. That stage is characterised by occurrence of dark silty, siliceous shales on the almost whole part of the Outer Carpathian Basin (Vezovice shales, Spas shales and their eastern equivalents. Only locally, especially along the northern margins of the Carpathian basin, small submarine clastic fans, connected probably with marginal listric faults have been developed (Grodzisko sandstones). Hitherto data suggests that sedimentary-tectonic evolution of the Magura basin was different. The **third**, compressional stage (Aptian-Albian) were connected with the Aptian tectonic movements, folding and overthrusting, which took place in the Southern and Eastern Carpathians. The effects of these movements can be traced westward, from the South Carpathians, along the Marmaros Massive and the Rachov Unit up to Svalava. They were also marked by appearance of thick turbiditic complexes (Biela Tisa Fm., Sipot Fm.) and syn-orogenic facies (Soymul Fm.). It is logical, that compressional movements had to affect also more western part of the Outer Carpathian Basin which was direct continuation of the Eastern Carpathian Basin. Also in that more western part of the Carpathian Basin sedimentation of thick turbiditic complexes (Lgota Beds, Gaize Beds) started at the turn of the Albian. Also observed syn-sedimentary folds in the Albian sediments outcropping in the SE part of the Silesian Unit (Bystre scale) was probably effect of contemporaneous compression. During the **fourth** stage, at the boundary between the Albian and the Cenomanian all the source areas ceased to be active, the sedimentation of autochthonous deposits began and later on a distinct change in structural plane of the Outer Carpathian Basin commenced. Some likeness in succession of the stages distinguished within the Outer Carpathians can be also traced westward from the Carpathians in the Rhenodanubian Domain. Grant Polish Comm. Sc Research 413/P04/96

DEEP-SEA FANS AND APRONS SYSTEM OF THE GODULA BEDS SILICICLASTIC SEDIMENTATION (CARPATHIANS, TURONIAN-SANTONIAN)

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The Godula Beds belong to the thickest and most widespread formations of the Silesian unit in Carpathians. The Godula Beds appear as a complex of glauconitic sandstones and grey-greenish shales that occurs above the Lgota Beds of Variegated Shales and below the Istebna Sandstone.

The Godula Beds have been here subdivides into ten lithofacies: conglomerates, sandy conglomerates, conglomeratic sandstones, sandstones, sandstone-mudstone couplets, mudstone-sandstone couplets, mudstone-siltstone couplets, mudstones, pebbly mudstones and penecontemporaneously deformed deposits (Ghibaudo, 1992). On the basis of vertical facies transitions, bed thickness trends and structural/textural characteristics, a number of facies sequences has been identified and interpreted in terms of sedimentation within channels, depositional lobes, levees (?), interchannel areas, lobe and fan fringes, and non-channelized apron-type settings (Mutti & Ricci Lucchi, 1975; Shanmugam & Moiola, 1988; Reading & Richards, 1994). Palaeoflow indicators point to the overall transport direction towards the north-east and east, although considerable palaeoflow differences have been noted both between the individual facies and palaeogeographic regions.

The regional stratigraphy of the Godula Beds can be related in some way to the global eustatic curve of Haq and others (1987), particularly with respect to the strong, short-term regression during the late Turonian which appears to be recorded by the thick, coarse-grained complex of depositional lobes in the middle Godula Beds. Other global tendencies cannot easily be linked to any Godula sedimentary trends and may even remain discrepant with them. The early Turonian transgression was coeval with the onset of Godula deposition, which suggests that the global sea-level rise did not match the fast uplift of the Silesian ridge. The probable Coniacian transgression was superimposed on the waning uplift rates within the western part of the ridge and, simultaneously, on their abrupt waxing to the east. There is no evidence of any genetic link between weak sea-level oscillations superposed on a crude regressive trend and Godula deposition during Santonian times.

The Godula Beds originated in the Silesian basin within the shifting system of submarine fans and aprons Deposition resulted in a „piedmont"-style lithosome extending along the toe of the northern slope of the Silesian ridge. The wedge-shaped geometry of the lithosome can be inferred from its dimensions: 250 km in length, 50 km in width, and over 3000 m. In thickness which decreases northwards and eastwards.

Sedimentation showed a distinct pattern. During the first uplift stage of an island, the sedimentation was dominated by non-channelized flows which were fed from a linear source attached in the nearshore zone. The inception of channels took place gradually, and the distributary-channel network migrated laterally depending on the changing configuration of the basin floor. All fans tended to prograde in the direction consistent with the plunge of the basin axis. Paradoxically, the subsidence rate was faster in the western, shallower part of the basin, most likely due to the very rapid sediment accretion in this area. Hence, the faster denudation in the western part of the Silesian cordillera was the underlying cause of its faster uplift due to isostatic rebound. The maximum clastic input took place during the periods of coincidence of tectonic uplift with isostatic fall and eustatic sea-level drop, as happened to a full extent during the late Turonian.

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SEQUENCES OF THE LITHOFACIES AND DEPOSITIONAL INTERVALS IN THE SEDIMENTARY SERIES OF CARPATHIANS

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The analysis of vertical succession of layers aims and finding characteristic, well defined sequences. In flysch strata they may be represented by turbidite, channel or lobe sequences, in river deposits by channel or alluvial plain sequences.

Markov chains procedures represent in sedimentology an effective tool in studying a vertical sequence of some or a dozen or so various facies, present in long profiles with hundreds or thousands of layers.

Markov chains confine numerous different procedures, among others matrices of: amount of transitions, frequency of transitions, differences between the amounts and frequencies of transtions observed and expected; as well as successive powers of frequency transition matrices and equilibrium vector (Schwarzacher, 1975).

Diagrams represent a graphical visualisation of estimation of these procedures. The diagrams of matrices of differences between transitions expected and observed make possible the construction of modal sequence, i.e. such that is the most common in a profile, regardless of genetic implications. This may be a succession departing of that which results from deposition mechanism as it included various disturbing phenomena, such as erosion of interfingering of various sedimentary types. Modal sequences are, thus, a specific photography of a profile.

The diagrams of matrices of differences between transitions expected and observed enable also reconstruction of a model sequence, i.e. such which shows genetical implications resulting from the nature of depositions mechanisms. A properly reconstructed model sequence eliminates effects of concealing factors, for instance such as erosion.

Markov chains procedures have been used in studies of the Carpathian flysch sedimentary series (Słomka T., Słomka E., 1997). The analysis was carried out on a sequence of over 10 000 depositional intervals from several long field profiles. The intervals were described using the classification of Ghibaudo (1992). One direction of transitions is a characteristic feature of a model diagram; the transition always proceed from coarse- and fine-grainded sediments, reflecting thus a decrease in dynamics of gravitation flows are the major depositional mechanism. A modal diagram gives a completely different picture. Three groups of intervals with diversified grain fractions may be distinguished; also there appear numerous reverse intervals, from low- to high-energy ones. Model (genetic) sequences, based on the modal diagram, indicate the domination of sedimentation from dense turbidity currents (Lowe, 1982), gradually deposing increasingly finer material, often with transition to traction. Episodes of mass deposition with transition to traction, or deposition from weak bottom currents are less frequent. A high amount of modal sequences recognised, that are almost exclusively of the two member character, points to existence of distinctly isolated sub-environments within deep-sea fans (Shanmugam G., Moiola R.Y., 1988): channels, depositional lobes, and inter-channel zones. In these zones sediments were deposed by precisely defined mechanisms: mass deposition, traction, or settling from suspension.

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GEOPHYSICS OF DIFFERENT PHYSICAL FIELDS INTERACTION

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The problem of improvement and development of diagnostic methods for geological objects is close connected with the search of new physical effects for rocks and discovery of more informative parameters. One of the perspective directions in this plane is studying of the secondary physical processes stimulated in the medium by an influence of external physical fields

Within the framework of traditional petrophysic the properties of rocks are formally considered as stable ones. though as multiphase sytem, and depending on concrete conditions. in most cases they are characterized by unstability that is connected with energy exchange with external medium.

The main idea and gist of interaction methods is that under the influence of the field of one physical nature upon heterophase system one can observe its echo in the secondary fields. but as a rule. of the other character. that arise due to its deflection from equilibrium state.

The cycle of theoretical and experimental researches on interaction of mechanical and electromagnetic fields has been carried out. Correlations that describe such an interaction have been obtained. the effects that in addition appear in heterophase medium have been modelled and quantitatively valued.

The employment of effects of mechanoelectromagnetic interactions for rock studying. elastic wave that is spread in such hetergeneous medium is capable to change its characteristics in the whole and every component among their number. and to cause the changes of state. secondary effects. one of which is a rise of variable potential difference. One can receive the new informative diagnostic parameters by the way of studying new phenomena that appear in saturated mediun under the influence of elastic energy and on this base to create the new methods of investigation.

Taking the model of layered medium as an example. it was established that a potential of polarization measured in conditions of an influence of elastic energy reaches greater value, and morphology of the curve is more differential within the section. in other words. the influence of ultrasound increases a contrast of objects division by structural-lithological peculiarities of the medium's elements. The signal observed actually is a potential of polarization that arises under the influence of acoustic impulse and it may be interpreted as acoustically cansed potential. Described phenomenon may be considered as independent one. first considered from the position of zone-energetical structure of interphase border that defines its novelty in the whole. It should be spoken about new phenomenon in ion-conducting media that we have determined as acoustic-caused polarization.

Thus the cycle of theoretical and experimental investigations made it possible to receive principally new data on physical processes in rocks and to underline the complex of new diagnostic parameters that give the reasons to speak about the new trend in physics of rocks that we have described as petrophysics of field interactions.

THE LOWER MIOCENE CORE COMPLEX OF THE METAMORPHIC UNDERPLATE CRUST IN THE EAST SLOVAKIAN BASIN BASEMENT.

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Pre-Neogene basement of the East Slovakian Basin (ESB) is built up mostly by metasedimentary rocks with Penninic-like lithologies (Iňačovce-Krichevo Unit - IKU). The metasedimentary sequence of the IKU comprises of the Upper Triassic variegated phyllites and marbles, the Jurassic and Lower Cretaceous formations of black phyllites, calcphyllites and greenschists and more arenaceous phyllitic formations partly also with Nummulites-bearing metasandstones. The metasedimentary rocks are frequently associate with metaultramafites, metatuffites, chloritoid schists, etc. The rock complexes of the IKU, including those of the Eocene age, undergone MP/LT metamorphism (Mu + Pg + Prl + Qz, Prl + Ch + Ctd; IC = $0.295\pm0.062°2\theta$; metaanthracite stage of VR), which responds for < 20 km depth of undeplating. The underplated slate series in the ESB basement are notable for scaly fabrics and subduction/accretion style of deformation. With respect to non-metamorphosed Mesozoic and Paleogene rocks of the adjacent Centrocarpathian units, the metasedimentary formations in the ESB basement appear to be core complex.

Structural features of the IKU procceded from underplating during subduction, deep tectonic burial and uplift and core complex unroofing. The underplating is recorded mainly through soft-sediment deformation, large amounts of flattening stain (particulate and cataclastic flow, diffusional mass transfer and crystal plasticity processes etc.) and by duplex accretion processes (disharmonic, isoclinal or chevron-like folding, dense crenulation cleavage systems etc.). The underplate duplex accretion is also evidenced by overthrusting of the ophiolitic rocks above the Eocene metasedimenary formations. Later stage of deformation is characteristic by a more brittle character. Mainly kink bands structures are typical for this collisional? stage. Presence of large amount of brittle transtensional and extensional structures as fault surfaces with strike-parallel slip direction, extensional veins and cataclastic fabrics is probably connected with post-collisional uplift and extensional unroofing of the East Slovakian core complexes. The uplift was also followed by the retrograde postmetamorphic alteration of the core complex rocks.

The vertical displacement of core complex started in the Oligocene with high volume of uplift rate and reached the zircon FT blocking temperature around 20 Ma. It was forced by strong hinterland extension within a broad dextral wrench corridor following the main lithotectonic boundary (Klippen Belt). In this zone the orogenic wedge above the underplated complexes was destabilized by transpression and transtension. Wrench tectonics supporting by buoyancy and ductility of the underplated complexes arised to a large-scale extensional unroofing of footwall unit. Final emplacement of the core complex at the basin floor was controlled by the Middle Miocene back-arc extension with maximum subsidence and calcalkaline volcanism in the Transcarpathian Depression, as a consequence of roll-back of the Outer Carpathian Krosno-Moldavian subduction, and cooling of upwelled mantle.

HYDROCARBON POTENTIAL STRUCTURE ADJACENT TO VOLCANIC CENTERS IN THE EAST SREDNOGORIE REGION

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The attention of great number of explorationists has been focused to the region of East Srednogorie. However because of the complicated geological structure and insufficient seismic and gravity data lots of them presume the region as non-potential for hydrocarbon areas in Bulgaria. In the article it is made an attempt to study the possibilities for existence of normal sedimentary settings involving oil and gas traps for the region beneath the volcanic sediments or in the vicinity to magmatic bodies, integrating seismic, gravity and geological types of information.

The geological and geophysical data indicate that during the time of Jurassic a basin with significant extent opened wide to the South and existed in the South part of the East Srednogorie region. At the end of Jurassic the anticline and syncline structures have been formed as a result of post depositional events. The Triassic and Jurassic sediments are represented by conglomerates, sandstones, siltstones and limestones. The terigenous - carbonate Oligocene series have been deposited in a normal salty basin at the environment favorable for development and preserving of the organic matter. In the region of Moesian platform and the Forebalkan, the Triassic, Jurassic and Cretaceous sediments represent stratigraphic units perspective for oil and gas accumulations with economic importance. The East Srednogorie region is characterized with frequent interruption of sedimentation, heavy magmatizm and active tectonic processes conducting to forming of Paleozoic, Triassic and Jurassic structures.

According to the seismic data interpretation the anticline structure in the East Srednogorie region is a natural phenomenon, as it is located in the vicinity to magmatic bodies. The vertical derivatives of the gravity anomaly have been studied for a plane above the ground. The part corresponding to the structure is characterized with absence of Upper Cretaceous magmatic behaviors and reduction of the volcanic sediments thickness. The gas-oil-water contacts are identified on the seismic sections of instantaneous amplitudes and phases and on the seismic field records beneath the top of the anticline structure. AVO analysis has been applied to offset gathers and offsets are converted to angles of incidence θ by ray tracing through the definable velocity model. The results show increasing of the amplitudes with increasing offset for the locations of gas-saturated sands. At the depths less than 900 m beneath the top of the anticline structure the respective interval velocities decrease with depth and the difference is more than 20 percent. These contrasts in the velocities have been explained by the presence of gas-saturated sands.

The precise outline of the location of gas-oil and oil-water contacts and mapping of the deposit corresponding to the structure in the region of East Srednogorie is necessary being carried out during the stage of detailed prospecting and drilling works.

METAMORPHIC EVOLUTION OF THE NIZKE TATRY MTS. (WESTERN CARPATHIANS), SLOVAKIA

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ORIGIN OF LITHIUM, RUBIDIUM, CESIUM AND STRONTIUM IN FORMATION WATER OF AUTOCHTHON MESOZOIC DEPOSITS OF POKUTSKO-BUKOVYNSKI CARPATHIANS

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Water-bearing layers of autochthon Mesozoic deposits of platform formation of the Pokutsko-Bukovynski Carpathians are found under the moved folded formations of the Skybovi Carpathians and The Pre-Carpathian depression at the depths more than 4000 meters by number of boring wells for oil and gas. They as a whole form the common hydrogeologically closed water-bearing complex of the quasi-stagnant regime of the formation water The layer water in the interval of the depth between 4098 and 5474 meters within the areas Lopushna, Petrovetska, Biskiv (32 samples of water). These are largely sedimentation chlorine-calcium brines of the chloride calcium-sodium composition and of the total mineralization more than 200 g/l. There are found high concentrations of microelements, such as lithium (29.7 mg/l), rubidium (4.8 mg/l), cesium (0.7 mg/l), strontium (812.8 mg/l), in this water. To clearing available springs of these elements in the formation water their concentrations in the containing rocks was analyzed (34 samples of rocks). From the results it is concluded that sandstone contains heightened (in as compared with their Clark concentrations) concentrations of lithium, cesium, one order higher (as related to its Clark concentration) content of strontium and almost one order lower content of rubidium. Limestone is also characterized by the heightened contents of lithium and cesium, but contains somewhat lower concentrations of strontium and rubidium. In the argillite concentration of lithium, slightly lower as compared with Clark concentration in clays, contents of rubidium and cesium significantly lower than their Clark concentrations and heightened quantity of strontium have been found. According to these results clay rocks can be one of springs of rare alkaline elements in the formation water and sandstone can be springs of rubidium. Strontium can be received in the layer water only from limestone.

Coefficients of migration of rare alkaline elements and strontium were calculated to quantitatively estimate the available migration of these elements from containing rocks to formation water, by this formula

$$\mu_e = \frac{n\left(C_{f.W} - C_{s.W.}\right)}{\gamma \cdot C_r}, \text{ where}$$

n – middle porosity of rocks of complex, %;
γ – middle density of rocks of complex, t/m³;
$C_{f.w.}$ – middle concentration of element in layer water of complex, g/m^3;
$C_{s.w.}$ – concentration of element in oceanic water, g/m^3 ;
C_r – middle concentration of element in rocks of complex, g/t.

The coefficients of migration of lithium, rubidium, cesium and strontium are 2,4 %; 1,2%; 4.3 % and 7 7 % respectively. Taking into account the development history of the region and the peculiarities of physical-chemical conditions of Mesozoic complex of rocks, transition of elements in such quantities from containing rocks to formation water seems quite available.

MAIN JURASSIC – CRETACEOUS PALEOGEOGRAPHIC AND TECTONIC UNITS OF THE SOUTH CARPATHIANS

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From the tectonic and regional paleogeographic point of view, within the Jurassic-Cretaceous geostructural edifice of the South Carpathians, four groups of tectonic units can be distinguished: Getides, with a continental lithosphere, Obirsiides, with an oceanic lithosphere, Danubienides, with a continental lithosphere and Severinides, which in the internal part had a Getic-type basement and in the external part had an Obirsia-type basement. Considering the age of the tectogenesis, within the mentioned tectonic units two major groups of tectonic units can be observed: Austrides, which took part in the formation of the Mesocretaceous (Austrian) chain, and Laramides, Neocretaceous in age, which participated in the formation of the Neocretaceous (Laramian) chain. The former are represented by the Getic Nappes = Getic Nappe phase II (apart of the Supragetic Nappes; Sasca-Gornjac Nappe, Godeanu Nappe, characterized by the Cerna basin, the Codlea – Cristian – Brasov formations inclusive; Borascu Nappe), the Severin Nappe, and the Obirsia Nappe (Obirsia ophiolitic struture) obducted over the Danubian. The latter are represented by a part of the Supragetic Nappes, the Getic Nappe phase II (a series which has the Obirsia Nappe in the base and the Supragetic Nappes at the upper part), and the Danubian Nappes (Arjana Nappe, the innermost one; ?Urdele Nappe; Sirinia Nappe; Presacina Nappe; Iuta Nappe; Cosustea Nappe; Cerna Ilova Nappe, characterized by the Cerna Basin which has two digitations: the Cerna Nappe, Laramian, cover nappe and the Schela Nappe, probably New Kimmerian in age. All the mentioned nappes are characterized by the facies of the basins with the same name.

The lithostratigraphic, geophysical data as well as the hydrocarbon indications from the Baile Herculane waters point to a thrusting of the Danubian (Cerna-Ilova Nappe) over the frontal units: Moesian Platform and possibly some equivalents of the Moldavides and/or of the foredeep.

The Obirsia Realm also includes the Jurassic – ?Lower Cretaceous ophiolitic rocks with Oxfordian radiolaria of the Obirsia Nappe. The sediments that generated these rocks were deposited at great depths, below the Calcium Carbonate Compensation Depth, in the Obirsia Basin.

Within the Getic Realm, three Jurassic – Lower Cretaceous deposition basins have been recognized: Supragetic Basin (?), Resita Basin and Borascu Basin. The Gura Vaii – Sovarna – Vinturarita formations belong to the eastern marginal facies of the Resita Basin.

Within the Danubian Realm several deposition areas have been recognized, as follows: Arjana (the innermost one), ?Urdele, Sirinia, Presacina, ?Iuta, Cosustea and Cerna (the outermost one) basins, typical of the Cerna-Ilova Nappe. The facies of the mentioned basins characterize the nappes with the same name. Within the Cerna Basin the effects of the new Kimmerian tectogenetic phase can be observed. Generally, the stratigraphic successions of these basins start with a mainly detrital facies in the Liassic, continental downwards and marine at the top. There follows a marine, mostly gritty-carbonatic facies in the Dogger-Callovian, often marly in the central depression zones. The Malm-Neocomian stresses out a mostly basinal and slope carbonatic facies. The carbonatic platform occurs only in the Supragetic, Resita, ?Urdele and Cerna Basins in thew Lower Createceous (in the Cerna Basin also in the Upper Malm). The Borascu Basin is characterized by an argillitic-detrital-carbonatic facies, Barremian - Aptian in age.

The Severin Subduction (?) basin is encompassed in the Junction zone between the Getic and Danubian realms. It starts with the basinal facies of pre-flysch type, with basaltic rocks, of the Azuga Beds, Kimmeridgian-Tithonian in age, and continues with the basinal – turbiditic facies, of flysch type, Berriasian – Barremian in age, of the Sirinia and Comarnic Beds.

After the finishing of the Mid-Cretaceous (Austrian) chain, the subduction through moved toward the exterior, in the Danubian Realm. Thus, the Danubian Through was formed, which started with the pelagic-eupelagic, pre-flysch facies of the Nadanova Formation and continued in the Upper Turonian – Lower Maastrichtian with catastrophic facies of olistostroms associated with flysch-type turbiditic facies.

NEW PALEOGEOGRAPHIC, STRATIGRAPHIC AND TECTONIC CONFIGURATION OF THE DANUBIAN CERNA BASIN (ROMANIA)

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Within the Jurassic - Lower Cretaceous stratigraphic succession of the Cerna Basin. two depositional areas can be recorded: a central, depressionary area within the Cazane and Retezat Mountains and a marginal area. The western marginal area occurs in the Muntele Mic Widow and the eastern marginal area within the Mehedinti Plateau - Mehedinti Mountains - Paring Mountains.

In the central, depressionary area, the Liassic deposits are represented by sandstones and clays identical with those belonging to the Baia de Arama Formation. The Dogger deposits are represented by calcareous sandstones and sandstony limestone similar to those belonging tothe Virful lui Stan Formation and the Callovian Lower Kimmeridgian deposits are represented by pelletal and intraclastic, grey-black limestone with silicolits, resembling those of Cerna Virf Formation. The Upper Kimmeridgian - Lower Tithonian deposits are represented by basinal, often nodular limestone with Saccocoma sp. representing the Ponicova Formation. The Upper Tithonian - Neocomian deposits are represented by basinal limestone with Calpinonelids, forming the Ivanici Formation.

Within the autochtonous of the Schela Nappe, the mesozoic rocks are represented only by the Schela Formation, weakly metamorphosed, Liassic in age, in Gresten facies with coals.

The Urgonian deposits of the Cazane Formation represent the Barremian - Aptian equivalent of the Tismana Member within the eastern marginal area. The Upper Jurassic - Lower Cretaceous limestone from the Retezat Mountains are known as the Dealu Cornetului Formation, due to the impossibility to differentiate the mentioned litostratigraphic units.

The Jurassic - Lower Creatceous stratigraphic succession of the eastern marginal area begins with the Baia de Arama Formation, Liassic - Aalenian in age, being 20 - 250 m thick, continental, in Gresten facies. It follows the Virful lui Stan Formation, Middle Cretaceous in age, having 5 - 20 m thickness, represented by quartz bearing, fine sandstones with ammonites and spathic, sandstony limestone. The Cerna Virf Formation is Callovian Lower Kimmeridgian in age, being 200 m thick, being represented by skelletal, intraclastic limestone with silicolits downwards (the Cornetu Mare member) and lacking of silicolits upwards (the Cornetu Mic Member). The Upper Kimmeridgian - Lower Tithonian Valea Pragului Formation is 100 m thick, represented by pachyodont and coral bearing carbonate platform limestone. The Dilma Mare Formation is continental. unconformable, discontinuos, with thickness up to 5 m, being represented by a ferruginous alteration crust at the Jurassic - Cretaceous boundary. The Sohodol Formation is Lower Berriasian in age. unconformable, continental, with paludal - lacustrine sequences and marine interlayers, 10-100 m thickness, being represented by sandstones and limestone. The Busesti Formation is Upper Berriasian - Aptian, often unconformable, being divided in three members: 1. the Pocruia Member, Lower Berriasian Valanginain, 1650 m thick, represented by slope limestone and carbonate platform; 2. the Sodoiesu Member, Hauterivian? in age, 30-50 m thick, represented by micrites, marly limestone, grey-black coloured; 3. the Tismana Member, Barremian - Aptian, 400 m thick, represented by Urgonian limestone.

Within the western marginal area, in the Muntele Mic Window, were recorded coarse quatz-feldspar sandstones identical with those of the Baia de Arama Formation; fine quartz sandstones with carbonatic matrix identical to those of the Virful lui Stan Formation; recrystallised, grey - black layered limestone with silicolits resembling the Cerna Virf Formation, massive, recrystallised, white limestone suggesting the Valea Pragului Formation, with an oligist and hematite level, equivalent of the Dilma Mare Formation and massive, white-grey recrystallised limestone corresponding to the Busesti Formation. The last two sequences, corresponding to the Valea Pragului and Busesti Formations were named the Piatra Ilovei Formation.

INVESTIGATION OF LOCAL CRUST AND UPPER MANTLE STRUCTURE INFLUENCE ON DYNAMIC CHARACTERISTICS OF SEISMIC WAVES IN THE UKRAINIAN PART OF CARPATHIAN REGION

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Carpathian region of Ukraine is a part of Alpine seismoactive belt of the Earth. Sharp questions of geodynamics study and safety maintenance are of great importance here. The geodynamical investigations are necessary for the solution of the seismic risk problem and for solving mineral prospecting tasks in the region. Going out of this fact a lot of attention was constantly given to the questions of deep strucrure study of Ukrainian Carpathian region and neighboring territories. Seismic sounding profiles I, III; deep seismic profiles II international pass here, which contain the information up to depth of 70 km, and on separate plots — up to 120 km. Besides, on the territory of region complex refracted wave method profiles were conducted describing structures on depth up to 20 — 30 km. The top part of a cut up to depth 3 — 5 km is more investigated in details with the help of drilling data on oil and gas. Utilizing regional seismic observation data and interpretation methods we shall shortly stay on methodical aspects of a litosphere deep structure study in the region. Thus the initial data will be served by records of strong remote and weak close seismic events, which are registered on seismic stations of Carpathian region. We are studying the regional seismicity. It determines the necessity to have a model of a structure and geodynamics of the region. On the other hand — the earthquakes will deliver the information on medium structure. As method of study of a medium deep structure inversion of the wave forms, observable on various seismic stations, into parameters of deep structure models is offered. Dynamic of structures, composing litosphere in the region, is investigated by study of earthquakes source mechanisms, occurring on structures borders and inside of them. The map centers of the earthquakes, that had taken place on territory of Ukrainian Carpathian region and neighbor territories with magnitudes M> 3 for period from 1670 till 1997 is obtained. The maximum number of strong earthquakes occurrence we have on border between Pannonian depression and Carpathian rocky zone. The display of seismicity is also observed in most of Pannonian depression, Fold Carpathians on the territory of Fore-Carpathian deflection and on edge of East-European platform. The seismicity, connected with Carpathian arch, delivers the information about deep structure and dynamics. The map of the time occurrence and value (class — K) of the strongest earthquakes is also constructed. The level of seismic activity of the territory is testified by the centers of earthquakes, which have taken place on the territory of Western areas of Ukraine and near to its borders during the period 1990 till 1997. From the investigation of the location of the centers of earthquakes with magnitudes more than 1 it is understandable that at the given stage fast geodynamic movements in the region are revealed, the part of energy of which will be released in earthquakes. Such situation determines necessity of study of deep medium structure and its dynamics to give answer to the question, in what place dangerous seismic event may be realized. Thus strong deep and weak shallow-focused earthquakes may cause dangerous conditions in the investigated region. Going out of this the protection of ecologically dangerous industrial objects on the territory of Western areas of Ukraine against earthquakes represents an important scientific and practical problem. The control for a seismic situation in Ukraine is carried out by the system of seismic and geophysical stations, directed by the Geophysical Institute. Seismic stations "Lviv", "Horodok", "Chernivtsy", temporary seismic station "Khreshchatyk", "Khotyn" and magnetic observatory "Iv.Frankove" are located on the territory of the East-European platform, seismic stations "Morshyn" and "Kosiv" — on the Front-Carpathian deflection, seismic stations "Mizhirja" and "Rakhiv" — on the Fold Carpathians. The territories, which they supervise have a similar structure in the geological plan, to that existing in seismic-active region on the border between Poland and Slovakia. The Trans-Carpathian deflection, which is the part of Pannonian depression is supervised by a network of 3 seismic and 4 geophysical stations on the territory of Ukraine. The equipment for digital registration is installed on 4 seismic stations now. To them stations “Chernivtsy", “Kosiv", "Nyzhnje Selyshche", "Trosnyk" are concerned. The equipment permits to make calibration of seismic channels regularly. On one of the channels a source pulse, and on the other — the reaction of the other recording channel is registered. Knowledge of the complex frequency characteristic of the seismic path permits using algorithms of solving of direct and inverse problems to determine true significances of displacements, velocities or accelerations on the records of digital seismograms. It is supposed to make modernization of recording equipment by introduction standard European supervision systems and technologies of data processing during our work over the theme for the PANCARDI project.

KARST PROCESSES IN THE SHOUMENSKO PLATEAU (BULGARIA)

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The Shoumensko plateau (73 sq.km) is the highest residual plateau with inverted relief in Northeastern Bulgaria. It is composed of Upper-Cretaceous karstified carbonate complex, overlying terrigenous Low-Cretaceous rocks. The geological structure contributes to the identification of the Shoumensko plateau as an independent, completely drained hydrogeological unit.

The present-day karst landforms consist of karrens, fields of lapies, sink-holes, uvalas, karst valleys, niches and 12 explored caves. The longest cave is Zandana (2 200 m) and the deepest one - the Tainite Ponori (-105 m denivellation at a length of 1600 m).

The current karst processes occur in temperate-continental climate (the mean annual temperature is ranging from 9.5 to 11° C and the average annual precipitation is about 600-650 mm). The regime surveys, carried out, give an idea of the activity and dynamics of karst processes. Karst corrosion affects the whole massif in the conditions of active tectonic events. Carbonate denudation (determined by Poulina's methodology) for the entire massif is estimated at 13 mm/1000 years on the average and the total one - at 24.4 mm/1000 years. The analysis indicates space-and-time differentiations. The highest denudation rates (166 mm/1000 years for the carbonate denudation and 198 mm/1000 years for the total one) are observed during the spring high waters within the Zandana cave's catchment area.

It has been established that the contemporary karst processes are being additionally influenced by the anthropogenic factors.

MORPHOGENETIC TYPES OF GOLD MINERALIZATION IN THE BUCIM ORE DISTRICT (Eastern Macedonia)

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The Bucim ore district is situated in the middle parts of the Lece-Halkidiki metallogenetic zone and is characterized by productive contents of porphyry mineralization. Besides this mineralization, iron skarn deposits related to subvolcanic dikes and sills of the Neogene magmatism can be found in the central parts of the district, and vein type lead and zinc mineralization has also been established in the marginal parts of the district. Various morphogenetic types of gold deposits, studied in detail in this paper, can also be established in several, first of all, the marginal parts of the porphyry system. Besides in porphyry deposits, gold has been established in skarn deposits in characteristic silicified riffs in listwenites, alluvial-deluvial gold deposits, in quartz conglomerates of alluvial layers as well as gold in metamorphics. Gold contents in individual types is variable but has been established in all types mentioned.
The most productive gold concentrations have been determined in the Bucim and Borov Dol porphyry copper deposits. In the Bucim deposit gold, along with other main ore minerals, commonly occurs round the andesite necks intruding the crystalline basement of the Serbo-Macedonian massif. Gold has been established in pyrites, magnetite, quartz etc. However, the basic gold bearer is chalcopyrite. Gold content in chalcopyrite varies from 0.19 to 50 ppm. The average gold content in the Bucim deposits amounts to some 0.34 ppm.

Within skarn deposits gold has been established in the Damjan deposit. It occurs as fine dispersions both in skarn and magnetite mineralization. However, in this deposit gold has been established in higher concentrations along silicified and limonitized fault zones. Gold content ranges from 0.1 to 0.44 ppm.

The gold in silicified riffs in the Bicim ore district occurs as a specific morphogenetic type. It occurs as silicifications along fault structures at the contact between serpentinites and alterated metamorphics such as gneisses and micaschists. Besides at the very contact, silification can also be found in fractured serpentinites. Gold has been established in silicified parties in association with magnetite, chromite, pyrite and limonite. On average, gold contents range from 0.16 to 0.41 ppm always accompanied by low silver contents.

Latest investigations performed in the Bucim ore district discovered, for the first time, the presence of listwenites localized along fault structures at the contact between serpentinites and volcanic intrusions of Neogene volcanism as well as at the contact between serpentinites and gneisses. Associations of carbonates, talc, serpentine, olivine quartz, calcite, fuchsite, magnetite, hematite, sulphide minerals etc. have also been established in listwenites. The presence of fine dispersions of gold have also been determined in the silicate matrix and in limonite grains of the association. Geochemical examinations discovered the presence of low gold contents from 0.1 to 0.28 ppm Au, always accompanied by low silver contents ranging from 0.8 to 1.7 ppm Ag. Increased Bi, Ga, Cu, As etc. have also been found. Microprobe examinations on spinels determined the presence of mineral phase of gold.

Eluvial-deluvial type of gold has been determined on the skarn iron mineralization in the Sopur site. They are brecciated eluvial layers determined in situ. Detailed investigations (shallow drillholes of 20 m in depth) in the eluvial-deluvial layers determined variable but high gold contents. However, mention should be made that gold was determined in almost the whole interval of drillholes. Gold contents amount from 0.1 to 12 ppm occurring as small-grains of irregular distribution in the mineralized mass. Microprobe investigations indicated high presence of chromium spinels, magnetites and limonites of gold and palladium mineral phases.

Gold in Paleogene series has been established as directly related to the quartz conglomerates. The conglomerates comprise the basal parts of the Paleogene series grading into sandstones, clays and limestones towards the upper parts. Latest examinations indicated the presence of very low contents of gold (from 0.03 to 0.1 ppm). It occurs as fine dispersed gold in quartz conglomerates and the matrix material around them.

In the Bucim ore district gold has also been established in alluvial layers. It is a material that was washed away from primary types already discussed. Presence of native gold, fairly small-grained or as small sheets has been established in the layers. Only six sheets in the Kriva Lakavica have been determined in 90 sheets per pan. The largest number of 7 grains of gold were determined in one sheet only, and 1 to 3 grains in others. Gold occurs as thin sheets of 0.2 to 0.6 mm in size in association with scheelite, tourmaline, pyrite, chalcopyrite, magnetite etc.

CHRONOSTRATIGRAPHY - THE CENOZOIC TIME SCALE

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In the Cenozoic - Erathem we are left with several historical and inadequate terminologies and terms like: TERTIARY and QUATERNARY and with a globally used stage system without the necessary global back-ground for global correlations.

A closer and non-emotional look to these socalled global stages and their chronostratigraphic boundaries and to the GSSP's of the Cenozoic Systems and Series boundaries defined and agreed lately by the ISC demonstrates the inconsistencies of these boundaries in their relation to the chronostratigraphic regulations and the chronostratigraphic dilemma we are facing by these facts.

To achieve a consistent Cenozoic Chronostratigraphic Time Scale following decisions are postulated and should be taken:

(1) Final elimination of the 18th century terms „TERTIARY" and „QUATERNARY"

(2) Offical subdivision of the CENOZOIC Erathem into a PALEOGENE and NEOGENE System

(3) Definition and stratotypification of the Paleogene Series boundaries, the Paleocene-, Eocene- and Oligocene-boundaries and the Neogene Series boundaries, the Miocene-, Pliocene-, Pleistocene- and Holocene- boundaries by globally correlatable and acceptable GSSP's.

(4) Subdivide the Paleogene and Neogene Series into officially accepted Subseries (Lower-, Middle- and Upper-Subseries), stratotypified by globally correlatable and acceptable GSSP's.

(5) Provide by this chronostratigraphic Subseries concept the base for the correlation of the existing and useful regional stage concepts in the Cenozoic.

(6) Accept the various Cenozoic Stage Systems in usage as regional stage concepts only, without any global interpretations and assumptions, since they primarily reflect by their original definition the geodynamic history of a regional area only.

Following these recommandations we would stabilize the Cenozoic Chronostratigraphic Time Scale and make it to a constistent and useful stratigraphic tool.

ONE BILLION YEARS OF EARTH HISTORY AND 30.000 YEARS OF HUMAN SETTLEMENTS.
„KULTURPARK - KAMPTAL" - A TOURIST-PPROJECT AT THE SE EDGE OF THE BOHEMIAN-MASSIVE, AUSTRIA.

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The southeastern edge of the Bohemian Massive, a rolling country side, is geologically characterised by various tectonic units made up by crystalline and sedimentary rocks of Proterozoic, Paleozoic and Cenozoic age.The first traces of human settlements and cultural relictes date back to 30.000 years B.P. - which points to the long and continuous settlement history and cultural tradition of this region.

The weak industrial development of this area and the decreasing agriculture, but rich natural and cultural heritage of this region convinced the development agency of Lower Austria „ECOPLUS" to fund a regional geologic-prehistoric-historic cultural project to develop tourisme. The project was named after the main river Kamp „Kulturpark Kamptal"

In this project the long lasting geologic history and the intensive geologic scientific tradition provide some of the fundamental elements: This geologic history formed the base of the geomorphologic evolution of this landscape over the past one billion year, its floristic and faunistic history is documented by fossils and finally this geologic evolution provided and still provides the basic natural resources used by the early settlers as well as by the present population in trems of minerals, stones and agriculture and finally triggered the cultural evolution.

For the visiting tourist a primary introduction to this geologic evolution of this region is provided in a new and modern exposition at the Krahuletz Museum in Eggenburg. The „red thread" of this basic museum information follows the line from the wealth of the minerals of this region to topics like minerals form rocks and rocks from the landscape, respectively rocks are the mediators between the lithosphere and the biosphere expressed by the developpment of various soils. This geologic exposition is illustrated by exceptional mineral, rock and fossil specimens, explanatory texts and pictures as well models and „do it yourself" stations.

After a visit to this exposition the touristic visitor is prepared to explore and follow the geologic history of this region himself throughout the landscape. Scattered over the entire region of the „Kulturpark" area he will find at selected outcrops and fieldstations special explanations and small expositions which offer the story of this specific point and the possibility to collect minerals, rocks and fossils. With his finds he can come back to the Krahuletz Museum and try determine his finds by himself at the „do it yourself stations"

The book „Erdgeschichte des Waldviertels", which is available already in its second edition, provides a profound geologic general view.

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THE QUATERNARY DEPOSITS OF THE LOWER STREAM OF THE SAVA RIVER (BETWEEN ŠABAC AND OBRENOVAC)

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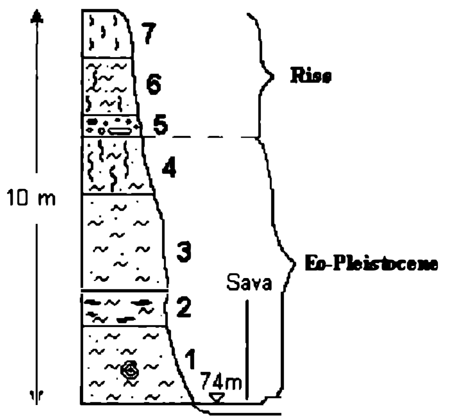
In this paper, Quaternary deposits of Posavo-Tamnava (between Šabac and Obrenovac) are described. As a result of geological mapping in 1996. and 1997., and earlier reconnoitering during the work on *Quarternary of Posavina, Podunavlje and Donje Pomoravlje* project, geological map of investigating area, two geological sections and geological column are presented. Origin and dynamics problems of Quaternary deposits, in terms of morfogenetical, sedimentological and biostratigrafical analysis are interpreted. Data which are received by the specialistic investigations (sedimentology, petrology, palaentology and radioactive dating) are given through the description of lithostratigraphical units. Genesis and Stratigraphy problems are intepreted on the basis of the upper data. Many local geological sections, columns and (where it was possibille) fotos of characteristic locations are given with text. Also, as an integral part of text, there are shematic table of quarternary sediments and four palaeontological tables with macrofauna.

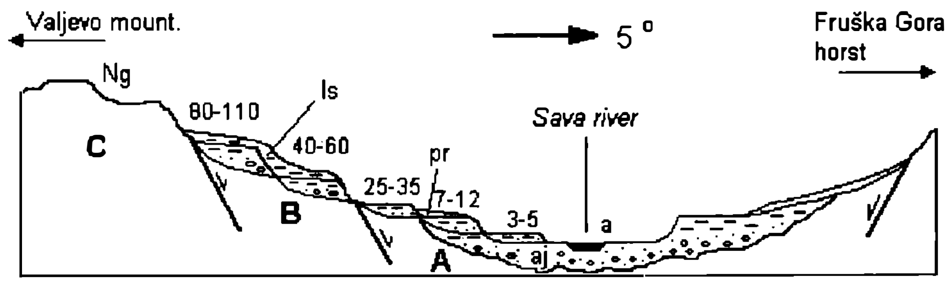
TYPICAL GEOLOGICAL PROFILE WHERE WAS PROVED RIVER ORIGIN OF "POLYCYCLIC RIVER SEDIMENTS" - EOPLISTOCENE



1- Sandy clays with Planorbis planorbis (with humps)
2- Darkly gray to black organic clays
3- Same as 1, but secondary changed
4- Epigenetic changed sandy clays
5- Gravels
6- Same as 4
7- Recent beds

On the basis of previous investigations it is found that some Quaternary sediments of Posavo-Tamnava are maked by the rivers not lakes, as earlier investigators considered. Lithological features of sediments, palaeontological material which are founded in this ones and morphological characteristics of separated lithostratigraphical units, points on mentioned conclusion. Besides the river sediments, there are proluvial, colluvial, aeolian (for the first time separated at the Posavo-Tamnava region) and mixed delluvial-aeolian quarternary sediments. Genesis of the loess-like (which occurrs like slope cover) sediments at the Posavo-Tamnava region are presented from aspect of the leading teories, treating origin of loess and loess-like deposites in the world. At the end, hronology of tectonics and palaeogeografical evolution, in order to better recognize of dinamics of deposition and erosion during the Quaternary period, were given.

SCHEMATIC GEOLOGICAL CROSS-SECTION ACROSS THE SAVA VALLEY



A- Intesive neotectonic lowering area; B- Transitional area with mainly lowering;
C- Neotectonic lifting area; a- Recent Sava valley; 3-5, 7-12, 25-35, 40-60 and 80-110- Older river terraces with their relative altitudes; ls- Delluvial-aeolian cover;
Ng- Neogene sediments

PRINCIPES OF KARST AQUIFER REGULATION AND SOME CARPATHIAN KARST CASE EXAMPLES

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Karst aquifers are one of the main sources of water supply in Carpatho-Balkanides. The large water reserves, the good quality of water as well as the relatively favorable conditions of protection in mountainous catchment area offer very good prospects for sufficient water supply to be provided in the future. On the other hand, when only natural springflow is captured, numerous problems arise during the recession (summer-autumn) period.

Artificial regulations means applied water intake structures within aquifers, especially in the discharge area with the aim of balancing the regime. Any water intake structure which modifies the natural regime may be considered as regulation. By water intake within deeper parts of karst aquifers (below the peak elevation of discharge), artificial water management is made possible. In such a system even partial reduction in the karst natural springflow is in the function of increasing exploitable source of ground water. In this way the aquifer is over-pumped however provided additional water in the periods of aquifer recession (critical drought period). Artificial intake provides for the balancing of the regime, with a possibility of total replenishment which represents additional reserves due to the increased infiltration of water from precipitation or surface flows in catchment areas.

For artificial regulation, certain preconditions must exist. Deeper zone of aquifer is necessary (karstification below the base level of erosion and geological reserves of ground water). The spring should be of the ascending type and karst contact to be made of permeable or partially permeable sediments (with the occurrence of underground discharge). In this respect, the best conditions in karst of CB are provided by the Tertiary and Quaternary sediments, which are often relative barriers to karst ground water flow.

The examples of karst aquifer regulation and control are relatively numerous, especially in Slovakia (Kullman,1990) and Yugoslavia (Stevanovic,1994). In the last few years several successful projects has been developed for water supply in Serbian Carpathians. Regulation of regime of Beljevinska and Zlotsko sources has been carried out for the large industrial center Bor with double increase of minimal capacity (four wells provide additional 100 l/s without reducing natural springflow). For the city of Knjazevac, horizontal gallery in lower part of aquifer in discharge zone of Sinji Vir spring, provide 220 l/s instead of 140 l/s of natural springflow. Successful results were obtained by pumping test from 70 m deep siphon channels of Modro oko spring near the town of Nis.

One of the largest projects has been developed for regional water supply for the towns in the region of Timok. The investigations included the test of long-standing pumping from the siphon channel of Mrljis spring, during which almost twice as large yield was obtained compared to the natural regime of discharge (from 165 to 320 l/s), with a cone of depression in the broader zone of exploitation field of only 1 m and without influence of surface waters of the river flowing near the spring. The water regulation project includes, water abstraction from vertical wells up to 100 m deep at four most favorable localities, about 500 m in diameter from Mrljis spring. The capacity of wells during pumping tests were 50-120 l/s, with total amount of 320 l/s (in November 1997). This will also provide the possibility for making a larger impact in the karst aquifer in the necessary periods of groundwater recovery. A hydrodynamic model of karst aquifer has been used one of the bases for the forecasting of the conditions and possibilities for ground water recovery in this area.

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THE ALLUVIAL AQUIFER PROTECTION FROM INDUSTRIAL WASTE WATER POLLUTION

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When solving the problem of population water supply of Republic of Serbia, ground water presents one of the most significant resources of which the alluvial aquifer is noted as a most water abundant one.

The recharge of these water storage is achieved by the surface (river) water, which quality could be jeopardised by untreated water which are sometimes directly disposed to the river.

Owing to the hydraulic connection achieved between the surface and underground flow, industrial waste products such as: heavy metals, phenols, aromatic substances, fats, amino products, fat acids etc. can easily reach groundwater.

Thus, the subject of this work is discussion on that issue and measures which should be taken to protect the quality of this aquifer groundwater.

HYDROCARBON POTENTIAL OF ROCKS FROM OZIROVO FORMATION

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Ozirovo Formation is represented by terrigenous - carbonate sediments and it has been wide spread in the Forebalkan, the South Moesian Periplatform zone and Moesian Platform. The thickness reaches 600 m, aged as Lower-Middle Jurassic (Sinemurian-Aalenian). Many gas and oil shows are observed as well as en oil flow of aromatic-naftene-methane type.

The hydrocarbon potential assessment have been based on data obtained through classic and modern geochemical analyses on samples of 40 wells. The different lithologic types from the tectonic units are characterized by the abundance, the type and maturity of Organic Matter (OM).

The rocks are classified using the average content of Total Organic Carbon (TOC) in The lithologic section. The TOC content increases from West to East and from South to North. The sediments are described as poor (<0,50%) and fair (0,50-1,00%) based on the abundance of TOC. The good ones (TOC - 1,00-2,00%) are established mainly in West Forebalkan and North-Kneja terrace. The clayey sediments are differentiated with fair to good and in some places with excellent content of OM.

The genetic type of the organic matter is mixed. The zones with predominantly marine (I, II) type are defined. They are related to the clayey sediments, which are deposited under relatively deepwater marine conditions. In shallow marine basin predominates the terrigenous (III) type of OM. The depositional environment vary from anoxic (Pr/Ph<1,00) to oxic (Pr/Ph>1,00) The hypersaline (Pr/Ph<0,60) environment occurs too.

Three zones of maturity are established. For the Moesian Platform the "oil window" (R^0 0,65-1,15%) zone is fixed. For some places of West Forebalkan, Tarnovo and Lukovit depressions the "gas generation" (R^0 1,1-2,00%) zone is determined. In the Central Balkan the sediments have high maturity (R^0 >2,00%).

The clay sediments are the main source rocks. Their oil generation potential is related mainly to the region of the Moesian Platform, and gas generation potential - the West Forebalkan and the South Moesian Periplatform.

USE OF NATURAL TRACERS FOR ESTABLISHING THE ALIMENTATION REGION OF A KARSTIC AQUIFER

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The directions of groundwater circulation in limestones aquifer, be it thermal water or water with no elevated temperature, are sometimes difficult to establish, especially if limestones are involved in the formation of the terrain of a complex geo-tectonic structure. A good example of such thermal waters are the springs of Rgoska Banjica near Knjazevac, in the eastern Serbia. The karst springs appear on the terrain that is composed of the rocs massifs of different age and lithologic composition. They were folded in several orogenic cycles, when the Paleozoic, Mesozoic, and paleogenic sediments were folded in a system of folds in the northwest-southeast direction, and when large tectonic units were formed, namely: the Tresibaba anticlinorium, Timok trouch syncline, and the Tupiznica - Knjazevac syncline. These folds are separated by the general faults marked for the extent of lowering of their wings, as well as for the horizontal shift of the blocs of the order of several tens of kilometres.

The Tupiznica - Knjazevac syncline represent a special hydrogeologic unit. At the farthest north-west part of its wing, the local faults caused the epigenetic, so that, after carving of the Svrliski Timok riverbed in the Barremic-Aptian limestones, the rmalsprings were uncovered in a narrow and short gorge. The epigenesis is documented by the wide river-valley upstream from the gorge entrance. Karstification of the Barremic-Aptian limestones in the zone of spring outflow is visible only at the level of the alluvial plane and several metres above it, as the limestones are covered by the Aptian limestones, marlous limestones, limestones, marls shales, and sandstones in an alternate sequence, s a practically water impermeable complex. At the surface of the terrain, the limestones forming the syncline wings are also very karstified. However, within the syncline, where they reach deep levels, the karstification, determined by radial tectonics, was directed and intensively developed only along the faults, which hinders identification of the possible directions of water circulation, as the fault routes are masked.

THE NATURE OF RELATIONSHIPS BETWEEN MUNTELE MARE GRANITE AND PEGMATITE BODIES HOSTED BY NEIGHBOURING METAMORPHIC ROCKS IN APUSENI MOUNTAINS (ROMANIA)

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In order to establish the nature of an eventual relationship between Muntele Mare granite and pegmatite bodies hosted by metamorphic rocks in eastern part of intrusion, we have been led our researches in following directions: macroscopically and microscopically description of mineral associations; the order's degree of potassium feldspars; the variation of major and minor elements' amounts in minerals and pegmatites -- as whole rocks -- in relation to their positions in the investigated area; the variation of feldspars and muscovites' temperatures in relation to pegmatite bodies' positions in the investigated area.

Metamorphic rocks hosting pegmatite bodies in eastern part of Muntele Mare granite belong to mesometamorphic (series) group of Someş, represented by micaschists, (para)gneisses, migmatites, rarely amphybolites and quartzites. In these mesometamorphic formations, recently studies led by Dimitrescu (1994) put in evidence the development of an anticlinal structure with an SW-NE orientation. Moreover the relief height decreases after the same direction (from SW towards NE).

The repartition of potassium feldspars' triclinicity in pegmatite occurrences revealed three ranges of values having, in the field, a morphology that *mimics* the development area of the anticlinal structure. Moreover, we have been put in evidence the disposition of lowest values of triclinicity on the anticlinal flanks, this parameter increasing in occurrences occupying positions in the neighbouring of anticlinal axis. In addition, a similar variation was observed after SW-NE direction, in other words with the increasing depth of pegmatite bodies.

The study of major elements amounts' variation in feldspars and muscovites -- after SW-NE direction -- revealed a change limit of correlation sign between Na and K (in feldspars), respectively Na/K, K/Ca and Na/Ca pairs (in muscovites); this limit has a WNW-ESE orientation in the field.

Our geochemical investigations in terms of finding a rule of variation for major and minor amount values in pegmatite forming minerals and pegmatite (as a whole rock) showed geochemical anomalies superposing each other in some areas as follows: Crişeni area, middle to upper part of Calului valley; middle part of Şoimului area; upper part of Iara valley. Geochemical researches revealed: positive anomalies for Sn, Nb, Ga and a negative for Ti -- in *muscovites*; positive anomaly for Mn and a negative one for Ti -- in *tourmaline*; positive anomalies for SiO_2, Al_2O_3, K_2O, Na_2O, respectively for Ba, Pb, Li, Sn -- in pegmatites as a *whole rock*.

Finally, in our attempt to establish the temperature of feldspars and muscovites forming pegmatites from investigated area we have been able to put in evidence some lines of equal temperature that have a morphology likewise to that of triclinicity fields.

In our opinion the morphology of triclinicity fields and that of equal temperature lines suggest the control of anticlinal structure concerning the genesis of pegmatite bodies. The process generating anticlinal structure induced physical parameters' values able to generate a *metamorphic differentiation* and even a *partial melting* of rocks that led to an arises of pegmatite bodies. Moreover, our results suggest the control of depth on the genesis of pegmatites too. Geochemical anomalies revealed by our researches range after a curved line with a similar morphology to those found out for triclinicity fields, respectively for temperatures isolines. In this respect, we believe that we have been revealed a line on which parameters responsible for the pegmatites arising (*depth of genesis*, *distance on vertical/horizontal between pegmatite bodies and anticlinal axis*) superpose, generating favorable P-T conditions to the development of belated stages (pneumatholyte-hydrothermal) in pegmatite evolution process.

In conclusion pegmatite bodies hosted by metamorphic rocks in the neighbouring of Muntele Mare granite have no genetic relationships with the granite intrusion and they took place by metamorphic differentiation, respectively anatectic processes. On the other hand, we do not exclude the possibility that residual fluids generated by post-pegmatite granite intrusion had a metasomatic influence on already existing pegmatite bodies, point that could explain to, at least partially, the geochemical characterization made by us.

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NEOGENIC VOLOCANISM OF THE CARPATHIAN-PANNONIAN REGION AS A NEW STANDPOINT OF THE PROBLEM

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Geodynamical conditions of forming of Neogene magmatic formations of the Carpathian-Pannonian region are regarded here. Among several opinions the most frequent in the research works is that one according to which Neogenic volcanism corresponds to the insulararched one and is connected with subduction of the oceanic crust. But such a statement which is based on the positions of classicalplate tectonics, nowadays is seriously objected by modern mobilistic conceptions and it is not confirmed by new actual data. The conclusion on the absence of any subduction processes in Neogenic development was made on basis of genuine analyses. It is noted that remains of oceanic crust, which could be preserved here after closing of the Tethys ocean, were tectonically overlapped by crustal microplates till the end of Paleogene.

Their forming was conditioned by stripping in the lower crust stage, i. e., in the zone of high plustic crust asthenolayer. Movement of the upper fragile crust layer, as a result of blocking, moderated under the effect of regional tangential pressure which forced the whole western segment of the Alpine belt and together with which the Pannonian basin formed common geodynamical system, but in the lower layer there took place hirizontal displacement of viscous-plastic substance and its forcing into the margins of the inner continental collision on the boundary of the Pannonian basin and the Folding Carpathians. In the process of such deformationof the lower crust stage there took place dissipative warming-up of the crust and underlying mantle, being quite sufficient for the beginning of volcanism. Geological data confirm thedimentional coincidence of mass evacuations with that very Alpian belt area which was already at the continental stage of development in Neogene. Moreover, the new data of petrochemical and geochemical analyses of Neogene volcanites synonymously testify that the melts were formed owing to remelting of granitic-metamorphic layer without participating of the mantle matter. Dissapative warming-up of the the high plastic asthenolayer timed to the lowerpart of continental crust interprets not only the cause of volcanic processes in the Pannonian depression, but reduction of the earth's crust thickness within its limits, as well as the high heat flow that disproves the view of existence of hypothetical mantle diapir fold.

PARTICLE SIZE MEASUREMENT: A TOOL FOR UNDERSTANDING THE HISTORY OF SEDIMENTS

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During recent years, the study of the thermal evolution of oil-bearing sedimentary basins has become an important topic for understanding the genesis of economic mineral deposits such as metals and hydrocarbons. Basin analysis, a tool used for understanding the burial processes in basins, relies on the analysis of organic matter to determine temperature histories. Because clays are major constituents of rocks in sedimentary basins (about 30 weight %), with authigenic illite-smectite being especially abundant, they should provide additional useful data for the evaluation of basin models through direct analyses of their particle sizes and ages.

Illite-smectite mixed-layer clay is the most common mineral phase in the clastic sediments. It originates from the transformation of clastic smectite into illite during diagenesis. Illite-smectite crystals are composed of stacks of very thin illite and smectite crystals that have water and exchange cations absorbed on their basal surfaces. Illite-smectite is widely used as paleothermometer for buried shales, and, together with other clay minerals, records the histories of many geological events, starting with deposition of the sediment. Important information concerning illite-smectite history is contained in its particle size distribution, and in its individual particle clusters. Measurements of thicknesses of very thin illite particles have been made on different samples from sedimentary formations of the Western Carpathians using electron microscopy (TEM, HRTEM) along with a new techniques for particle size measurements using X-ray diffraction (Bertaut-Warren-Averbach technique - Drits et al. 1998, Eberl et al. 1998) together with HRTEM of samples intercalated by polymer.

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THE ENVIRONMENTAL IMPACT OF ACIDIFICATION IN THE MAIN SLOVAK MINING DISTRICTS

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Environmental risks connected with mining activities become more common and dangerous in the recent period. Acidification and toxic elements distribution are the main problems in this field in Slovakia. Several abandoned or active precious and base metal deposits are characteristic by the presence of large amount of pyrite - the most serious source of acid mine drainage (AMD). Pyrite oxidation catalyzed by bacteria together with lack of neutralizing components (like carbonates) produce acid waters with low pH (range between 1.7 to 4) and extremely high contents of dissolved components that reaches up to 50 000 mg/l in Slovak sites. Major components of AMD are sulfates and iron very often along with high content of Al that is mobilized under low pH conditions. Al in mobile ionic form is one of the major risks of AMD. Our investigation documents its high cyto and genotoxicity. Contents of other toxic elements like As, Cd, Zn, Cu, Pb, Sb may reach up to hundreds or thousands of ppm. It depends on mineral association of the particular deposit. High contents of dissolved components cause another problem that are secondary minerals. Large amount of Fe oxides/hydroxides with various degree of crystallinity and ordering along with sulfates are formed after mixing of AMD with surface or ground „fresh" waters. pH increase of such a mixed water rapidly changes equilibrium in the system and large amount of salts rapidly precipitate out of AMD. The volume of highly hydrated precipitates may reach up to 1/3 of the original AMD volume. Large quantity and volume of the precipitates represent another environmental risk of the AMD. Fe-precipitates are formed in broad pH range and can attenuate variable (often very high) amount of potentially toxic cations and anions.

The interaction between AMD and environment causes serious problems and damages. (1) In the soils there is direct dependence between decreasing pH and increasing amount of exchangeable Al which is toxic to plants. (2) Secondary minerals, mainly sulfates, are forming on the top of desertified soils and represent "stored acidity" (3) Acidification causes degradation of soils and changes in their physical and chemical properties. (4) Distribution rate of acidification is determined by morphology and geology of the region.

Based on the results we have designed reliable methodology and mineralogical techniques for prediction, remediation and prevention of the problems with AMD.

NATURAL WILD FIRE PRINTS IN WÜRM LOESSEY LAYERS OF THE CARPATHIAN BASIN

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Charcoal layers were found in about 37 localities of loessey layers of the younger Würm period in Hungary. Detailed sedimentological, palaeontological and geochemical study on 9 localities in the Tokaj-Kopasz Hill environment has been made. The most important results are as it follows:

-- Charcoals in the sediment were resulted by taiga fire. This fact is proved by their characteristic macor- and microstructure as well as their SEM and simultaneous thermoanalytical identification.

-- A selective P accumlation can be found in the dispersed charcoal layers. Despite of podsolization the clay mineral is a smectite-illite „mixed layer" structure.

-- According to the radiocarbon dating these wild fires happened between 25 000 - 28 000 BP.

-- Actual geological studies on wild fire of Picea forest in the Altai Mountains (Russia) have also supported the reconstruction of the event.

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Biostratigraphy of the Gosau-Group (Upper Cretaceous; Eastern Alps).

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The Gosau-Group of the Eastern Alps comprises a series of synorogenetic formations from Late Turonian to Eocene age. Terrestrial to deep marine clastic sediments reflect the different phases of the orogeny. The sediments are trapped in isolated synorogenic basins, each of them with its own subsidence and sedimentation history (WAGREICH 1991). Abundant and diverse macrofossil faunas are indicative for a shallow marine environment for periods of slow subsidence and nearshore conditions. Correlation is based on ammonoids (KENNEDY & SUMMESBERGER 1996) and inoceramids (TRÖGER & SUMMESBERGER 1994) as well as on micro- and nannofossils (e.g. WAGREICH 1992). Palynological investigations (SIEGL-FARKAS 1994, DRAXLER 1997) integrated with nannofossil research (WAGREICH & SIEGL-FARKAS 1996) in terrestrial environments lead to results correlatable with stratigraphical scales in marine sediments. The transgression in the western part of the Eastern Alps (Brandenberg , Tyrol) is of Upper Turonian age (*deverianum*-Zone; SUMMESBERGER & KENNEDY 1996). The lower part of the *Subprionocyclus neptuni*-zone is represented by a terrestrial coalbearing formation the Gosau basins of Brandenberg, Strobl-Weißenbach and Neualpe/Rußbach (Salzburg). Marine conditions re-occurred towards the end-Turonian *Germari*-Zone (KAPLAN & KENNEDY 1994) represented by *Reesidites minimus* (HAYASAKA & FUKADA) and *Barroisiceras haberfellneri* (HAUER) and co-occurring *Didymotis costata* (FRIC) and *Mytiloides scupini* WALASZCZYK & TRÖGER. *Forresteria alluaudi* (BOULE, LEMOINE & THÉVENIN) seems to indicate Early Coniacian (Bad Ischl; SUMMESBERGER 1985). Mid-Coniacian ammonite faunas with *Peroniceras*, *Tissotioides* and *Metatissotia*, *Scaphites* (SUMMESBERGER 1985) are present together with *Cremnoceramus* div. sp. and *Platyceramus* div. sp. at Strobl/Weißenbach and Nussenseebach. Late Coniacian ammonites (e.g.: *Gauthiericeras margae* (SCHLÜTER) and *Paratexanites serratomarginatus* (REDTENBACHER)) occur in the Upper Coniacian S of Salzburg. Late Coniacian *Volviceramus* occurs in the basin of Gosau. Basal Santonian is marked by the co-occurrence of *Texanites* and *Cladoceramus undulatoplicatus* (TRÖGER & SUMMESBERGER 1994). In the Late Santonian *Placenticeras polyopsis* (DUJARDIN) is abundant. ammonites and inoceramids are rare in the Campanian due to flyschoid sediments and conditions below CCD. Recently discovered faunas from the Gams basin (Steiermark) are of Early (*Bidorsatum*-Zone) and of Late (*Phaleratum*-Zone) Campanian age. Late Campanian ammonites and inoceramids occur rather in the shallower marine deposits of the Neue Welt basin situated at the eastern end of the Alps (e.g. *Pseudokossmaticeras brandti* (REDTENBACHER)). Also *Pachydiscus neubergicus* (HAUER) indicative for the Maastrichtian occurs only in the eastern and southern part of the Northern Calcareous Alps. Abundant Upper Campanian/Maastrichtian inoceramids ofthe Neue Welt basin first described by ZITTEL (1862-1868) are currently under study (TRÖGER).

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DISTRIBUTION OF THE HIGH- AND LOW-LATITUDE NANNOFOSSILS IN THE UPPER CRETACEOUS SEDIMENTS OF THE OUTER WESTERN CARPATHIANS

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Mixing of low-latitude (Mediterranean/Tethyan) and high-latitude (Boreal) species in the nannoplankton assemblages was observed in the Upper Cretaceous sediments of the Outer Western Carpathians in the Waschberg Zone, Ždánice Unit and Magura Group of nappes (Raca and Bílé Karpaty units) in South Moravia (Czech Republic) and Lower Austria. Depositional areas of these geological units are supposed east of their present locations and, as a whole, they may be included into the warm-temperate realm within the framework of Tethys. Autochthonous epicontinental Cretaceous sediments of the cold to temperate Boreal realm occur farther to the north and northwest. The depositional area of the Ždánice Unit and Waschberg Zone was situated on the southeastern passive margin of the European Platform, while the Pieniny-Magura depositional area is considered to be a periplatform terrane of the Tethyan mobile realm.

Two corridors between Tethyan and Boreal realms can be supposed on the southeastern border of the North European Platform: 1. Bohemian/Saxonian Cretaceous Basin which was a narrow shallow-water strait connecting the Alpine sea with the North European basin probably in the interval Upper Cenomanian Coniacian and which represents the northernmost extension of the Tethyan realm (Kollmann et al., 1998), 2. Polish Trough (Peri-Tethyan basins) which probably connected the northern Tethyan basins (Outer Carpathians) since Turonian-Coniacian until Maastrichtian-Paleocene (Malata and Poprava, 1997).

Common occurrence of latitude-restricted nannofossils documents that the sediments were deposited in the transitional area between the Tethyan and Boreal bioprovinces. Nevertheless, the degree of influence by the above mentioned bioprovinces was a function of both the geographical position of the basins and geological time:

Ždánice Unit and Waschberg Zone.

- Turonian and Coniacian nannofossil assemblages are very close to those in the Bohemian Cretaceous Basin. The influence of this depositional area by Boreal bioprovince is documented, above all, by the presence of *Thiersteinia ecclesiastica* which is suggested to be an exclusively high-latitude species.
- Campanian and basal Maastrichtian sediments are characterized by the presence of both low- and high-latitude species. Low-latitude nannofossils are represented by genera *Quadrum* and *Ceratolithoides*, high-latitude species by *Monomarginatus quaternarius, M. pectinatus, Biscutum coronum,* and *Neocrepidolithus watkinsii* was observed.in the Campanian/Maastrichtian boundary sediments of the Waschberg Zone.
- Late Maastrichtian sediments were studied only from the Waschberg Zone where nannofossils show affinity rather to the Boreal realm. This is supported by higher number of high-latitude species such as *Cribrosphaerella daniae* and *Nephrolithus frequens*. Nevertheless, presence of low-latitude nannofossil species *Lithraphidites quadratus* was also recorded here.

Magura Group of nappes.

- Late Campanian and basal Maastrichtian nannofossil assemblages are of the Tethyan bioprovince character where only minor penetration of high-latitude species is observed. A usual component of assemblages is represented by low-latitude nannofossils that include specimens of genus *Ceratolithoides, Quadrum sissinghii* and *Q. trifidum*. High-latitude species also occur here but in small numbers, such as *Biscutum coronum, B. magnum* or *Prediscosphaera stoveri*.
- Late Maastrichtian nannofossil associations are generally characterized by increasing penetration of high-latitude species, which is confirmed by higher quantities of species *Prediscosphaera stoveri, Biscutum coronum, Cribrosphaerella daniae* and *Nephrolithus frequens*. Low-latitude species are represented here by *Lithraphidites quadratus* and *Micula murus*.

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BIOSTRATIGRAPHIC CORRELATION (FORAMINIFERS AND CALCAREOUS NANNOFOSSILS) OF THE KARPATIAN AND BADENIAN SEDIMENTS IN THE CARPATHIAN FOREDEEP, CZECH REPUBLIC.

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Biostratigraphic conclusions based on the study of foraminifers and calcareous nannofossils were carried out for the Lower/Middle Miocene boundary sediments of the southern and central part of the Carpathian Foredeep in Moravia (Czech Republic). The attention was focused on the Karpatian-Badenian transitional strata, i.e. on deposits where foraminifers with *Globigerinoides bisphericus* and genera *Praeorbulina* and *Orbulina* appear for the first time. These sediments can be compared with the "Grunder Schichten" of the Alpine-Carpathian Foredeep in Lower Austria.

The following foraminiferal and nannofossil associations were recognized in the Karpatian and Lower Badenian sediments in Moravia:

- **Lower part of the Karpatian (interval with *Globigerina* div. sp.)** which comparable to the "Laaer Schichten" of the Alpine-Carpathian Foredeep in Lower Austria. Foraminiferal assemblages contain planktonic species, such as *Globigerina ottnangiensis*, and benthonic species with *Pappina primiformis, P. breviformis* and *Uvigerina graciliformis.* Nannofossils are characterized by the presence of helicosphaerids (*Helicosphaera ampliaperta, H. scissura, H. carteri,* very rare *H. mediterranea* and others).
- **Upper part of the Karpatian - lower part of the Badenian (interval with *Globorotalia* div. sp. and *Globigerinoides* div. sp.)** which can be compared with the lower part of the "Grunder Schichten" The interval is characterized by the first occurrence of foraminifers *Globigerinoides bisphericus, Globigerinoides* div. sp., *Globorotalia* div. sp. and rare *Praeorbulina* ex gr. *glomerosa, Orbulina suturalis* and *Vaginulinopsis pedum.* In contrast, specimens of genus *Pappina* and *Uvigerina graciliformis* occur here for the last time. As for the nannofossils, *Helicosphaera waltrans* and *H. walbersdorfensis* appear here for the first time in association with rare specimens of *H. ampliaperta.* In addition, *Sphenolithus heteromorphus* and *Discoaster* div. sp. were observed only in low numbers.
- **Marginal facies and basal interval of the Lower Badenian (Tegel)** which can be partly correlated with the upper part of the "Grunder Schichten" The foraminiferal assemblages contain *Globigerinoides bisphericus, Globigerinoides* div. sp., *Globoquadrina* div. sp., *Orbulina suturalis* and high number of *Globorotalia* div. sp. Nannofossil assemblages are characterized by relatively common *Helicosphaera waltrans.*
- **Pelites of the Lower Badenian (Tegel) also including "the lower horizon with *Vaginulina legumen*".**

In the foraminiferal assemblages, *Uvigerina aculeata, Lenticulina echinata, Vaginulina legumen* and *Planularia* div. sp. appear, and, on the other hand, stratigraphically important species *Globigerinoides bisphericus* is not present anymore. The nannofossil associations are characterized by the absence of *Helicosphaera waltrans*, and by a higher number of specimens of genera *Discoaster, Calcidiscus* and *Sphenolithus heteromorphus.*

From the above mentioned data it is evident that nannofossil species *Helicosphaera waltrans* has a short vertical distribution which probably corresponds with the stratigraphic range of foraminifer *Globigerinoides bisphericus.* This interval can be compared with the M4b and M5a (sub)tropical zones sensu Berggren et al. (1995). The M4b/M5a zones boundary was postulated as the Lower/Middle Miocene boundary. In the Paratethys, the Karpatian/Badenian boundary is also correlated with the Lower/Middle Miocene boundary by Spiegler and Rögl (1992).

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MICROSTUCTURE AND GEOCHEMISTRY OF MINERAL VEINS AS INDICATORS OF STRUCTURAL DEVELOPMENT OF A FLYSCH SEQUENCE: CASE STUDY FROM MAGURA NAPPE, OUTER CARPATHIANS (POLAND)

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Near the Pieniny Klippen Belt the Paleogene flysch of the Szczawnica Formation (Magura Nappe) is tightly folded and cut by joints of four sets (I-IV) and numerous small-scale faults. The joints of the sets I and II were formed before folding, whereas those of the sets III and IV originated during and/or after folding. Most of the small-scale faults are of a post-folding age. Miocene andesite dykes and sills are common in the region. Calcite and quartz- calcite mineralization is ubiquitous. An advanced diagenesis of the flysch indicates heating of this region up to 150-180° C. It has been considered that the heating and at least part of the mineralization were related to the andesite intrusions.

Fibrous quartz and calcite occur on some fault surfaces. Most of the joints are healed by calcite and quartz-calcite mineralization, creating simple and composite veins. Simple veins occur on joints of all sets (I-IV). They are filled either by columnar calcite or by drusy calcite. Composite veins occur only on joints of the sets I and II. In these veins, columnar calcite forms marginal parts, while centres are filled with blocky quartz and calcite. Cross-cutting relationships indicate that: (1) the blocky quartz and calcite post-date the columnar calcite, (2) the columnar calcite of the composite veins pre-dates that of simple veins filling set III and IV joints, and (3) the drusy calcite represents the last stage of mineralization.

Micro- and mezostructural observations indicate that the mineralization is largely of post-folding age, except for the first stage of columnar calcite mineralization filling the sets I and II joints. It is likely that the last mineralization is of pre-folding age. This sequence of mineralization differs from the sequence of jointing.

Calcite composition changes from strong ferrous columnar calcite to ferrous blocky and drusy calcites. Cathodoluminescence reveals colour variations. Orange columnar calcite from the set I and II joints is darker then that from the set III and IV joints. However, isotopic composition of calcite shows only slight variations. The d18O values vary between -7.9 and -9.8 % (PDB). The highest d18O values are characteristic for the composite veins, filling set I joints. The d13C changes from -2.8 to -3.8 % (PDB). In composite veins, d13C for the blocky calcite is lower than that for the columnar calcite. All d18O and d13C values from the veins are lower then those for calcite cement of the country rock (d18O= -6.8, d13C = -2.5). For the columnar calcite there is strong positive correlation between d18O and d13C (R=0.98). 87/86 Sr isotope ratios for blocky calcite range from 0.708337 (set II joints) to 0.708717 (set I joints).

Studies of fluid inclusions in blocky quartz suggest a strong pressure fluctuation. Quartz from the set I joints was formed in two phases: the first one occurred at 1.1-2.0 kb and 197-210° C, while the second one at 0.8-1.85 kb and 163-175° C. Quartz filling the set II joints was formed at 0.8-1.3 kb and 163-188° C. Salinity of aqueous phases ranged from 0 to 3.1 wt. % NaCl equivalents.

The d18O and d18C values suggest precipitation of the columnar calcite from interstitial waters and a considerable exchange between the interstitial water and vein-related fluid during formation of drusy and blocky calcites. Strong fluctuations of pressure and salinity accompanied by cooling occurred during crystallization of blocky quartz and calcite. Some faulting was contemporaneous with quartz-calcite mineralization. The Sr isotope ratio precludes hydrothermal water connected to andesite volcanism as a direct source of the fluids. The source of the regional heating thus remains unclear.

SEARCHING FOR VOLCANIC CENTERS OF MIOCENE ACIDIC EXPLOSIVE VOLCANISM IN THE PANNONIAN BASIN (HUNGARY)

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The Neogene volcanic activity started in most of the Carpatho-Pannonian area with explosive eruptions of acidic magma, giving rise to large volumes of volcanic tuff sequences, known in the Pannonian Basin as the "Lower-, Middle- and Upper Rhyolitic Tuffs" Our multidisciplinary study has shown that they can be characterised by a unique set of lithologic, petrographic, chemical and paleomagnetic features and K-Ar ages. The Bukk Foreland is a key occurrence area of the acidic tuffs, where all three sequences occur. Two of them (the "Lower Rhyolitic Tuff" and the "Middle Rhyolitic Tuff") were examined in detail from volcanological point of view.

Eruptive centers may be buried beneath younger sediments within the deeper parts of the basin. The type (plinian and/or ignimbritic) and volumes of eruptions, as inferred from lithologic and petrographic features of the tuffs, strongly suggest that the source volcanoes may have been of large silicic caldera type, possibly with resurgent doming in their central parts. Furthermore, the occurrence of phreatomagmatic explosive products within the lithological columns of both tuff complexes suggest magma-water interactions which are expectable in shallow marine environment. Searching for eruptive centers of the two tuff complexes was undertaken by (1) identifying transport directions of tephra in the lithologic and paleomagnetic record, and (2) looking for supporting arguments in the available geophysical record and drilling data. Lithologic indicators of transport direction of tephra include thickness and grain-size of fallout pumice lapilli layers, imbrication in non-welded ignimbrites, bomb-sag assimetry in phreatomagmatic deposits and obsidian fiamme size. Orientation of magnetic anisotropy in welded ignimbrites is a reliable paleomagnetic indicator of transport directions. These features suggest a north-east to south-west oriented dispersal axis of the fallout tephra in the Lower Tuff Complex, and convergence of transport directions north-east of Mezõkövesd in the basin. In this latter area an elliptic positive gravity anomaly occur; its size and shape are compatible with a buried caldera structure, as a possible source for the Middle Tuff Complex. Thick andesite lavas reached by boreholes in the area further support this hypothesis. Along the south-western extension of the dispersal axis of the Lower Tuff Complex fallout tephra, an elliptic positive anomaly of the vertical component of the magnetic field was found, as a possible indicator of a second buried caldera structure south of Demjén, within the basin, which may be responsible for the eruption of the tephra in the Lower Tuff Complex.

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GENETIC AND GEOMORPHOLOGIC RESEARCH OF THE CONTACT ZONE OF BÜKK AND GÖMÖR REGIONS

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The Uppony Mountains are an old, elevated margin of the base of the Hungarian Medium-height Mountain Range. It is part of the Gömör-Borsod structural unit, which virtually appears as a strange unit in its surroundings, showing close genetic connection with the S-Alpine-Dinarian region.
Although the researches on the geological characteristics of this area were started as early as the end of the 19th century ad lots of researchers tried to solve the problem, no complex structuro-morphological model has been constructed yet.

The low horst-structure is bordered by two main structural belts. It is overthrust to its young Miocene foreland along the Darno line in the North, whereas it is separated from the Bükk Mountains by the problematic Nekézseny reverse fault in the South then faulted down and was covered by young Miocene sediments in the East and West. The Uppony Mountains occur as an imbricated structure with NNW vergence and steep pitch formed mainly by Devonian and Carboniferous rocks. There are well researchable outcrops of a Senonian conglomerate with mixed genetics in the southern edge of the area whereas the lower ridges are covered by small spots of Miocene sediments protected from erosion. The original contacts of the formations are hard to reconstruct, because of their mainly tectonic or discordant characteristics.

The Uppony Mountains are interpretable as an allochthonous, elevated part of the base-complex of the Bükk Mountains, which was imbricated and overthrust to its younger foreland by stresses coming from SE. This movement is demonstrated by the studied outcrops, geological cross-sections, by microtectonic measurements and by the position of Triassic blocks situated near Uppony. Based on structural and sedimentological research the Upponyian overthrusting movements might have started at the beginning of the Upper Cretaceous period, the consequence of which might be the overthrusting of the Gömör-type Paleo-Mesozoic series in the forehead region of the Palaeozoic masses. Then coming near the surface it showed renewed overthrusting movements, the most important of which might be at the Oligo-Miocene border and in the Pliocene-Pleistocene period.

The tectonic structure determined the development of geomorphological characteristics. The valleys were formed along the main overthrusting belts or along the transverse or diagonal faults. These trends are demonstrable even in the covered foreland, which indicate the effect of reactived base-structure on its young sedimentary overlying beds.

GEOLOGICAL INTERPRETATION OF GRAVITY DATA AND DEEP SEISMIC PROFILES OF THE WESTERN PART OF SLOVAKIA (WESTERN CARPATHIANS)

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Southwestern Slovakia belongs to the most interesting regions of the Western Carpathians from the point of view of solution of relation to the Eastern Alps, Bohemian Massif and Pelso Unit. Geological interpretation of the structure of the Western Carpathians in the mentioned region is complicated in consequence of considerable thickness of the Tertiary filling in the Danube and Vienna Basins. A good information for solving of the structure of pre-Tertiary units of the given region are geophysical data – seismic reflection profiles, areal gravimetry and magnetics, magnetotelluric sounding and VES (vertical geoelectric sounding). For interpretation of the sturcture of the territory of interest we selected the seismic transect 3T (6, 12 sec., see Fig.). This profile line is parallel with the magnetotelluric profile MK-3 (varga, nemesi in Nemesi et al. 1997). The southern delimitation of the Bohemian Massif we identify with the Mur-Mürz line, designated as the Zohor fault system on the territory of Slovakia. This contact is well interpreted in the seismic profile 3T as a deep transform fault of SW-NE direction limiting deep delimitation of the tatricum. The Tatricum as the lower tectonic unit of the Western Carpathians is correlated with the Lower Austroalpine Units. The tatricum is uncovered in the Malé Karpaty Mts. and may be well interpreted in the pre-Tertiary substratum of the Vienna Basin as far as the Mur-Mürz line and in direction to the Danube Basin as far as the tectonic contact with the Veporicum (higher tectonic unit correlated with the Middle Austroalpine Units). The Rába – Hurbanovo fault line, in the southern part of the Danube Basin represents the contact of units of the Central Western Carpathians with the Pelso Unit (Balla et al. 1990, Horváth 1993, Vozár 1996). High values of the geothermal field (heat flow) interpreted as attenuation of the lower crust are also evident in the seismic profile 3T. The interpreted structures represent unroofing of the central part of the Danube Basin where we suppose dismantling of the Tatricum lower crust. In some works this picture was intepeted as dismantling of the Southern Penninicum (Gabcíkovo Depression). The depth of MOHO discontinuity in the central part of the Danube Basin is at the value of 9 sec. (about 27 km).

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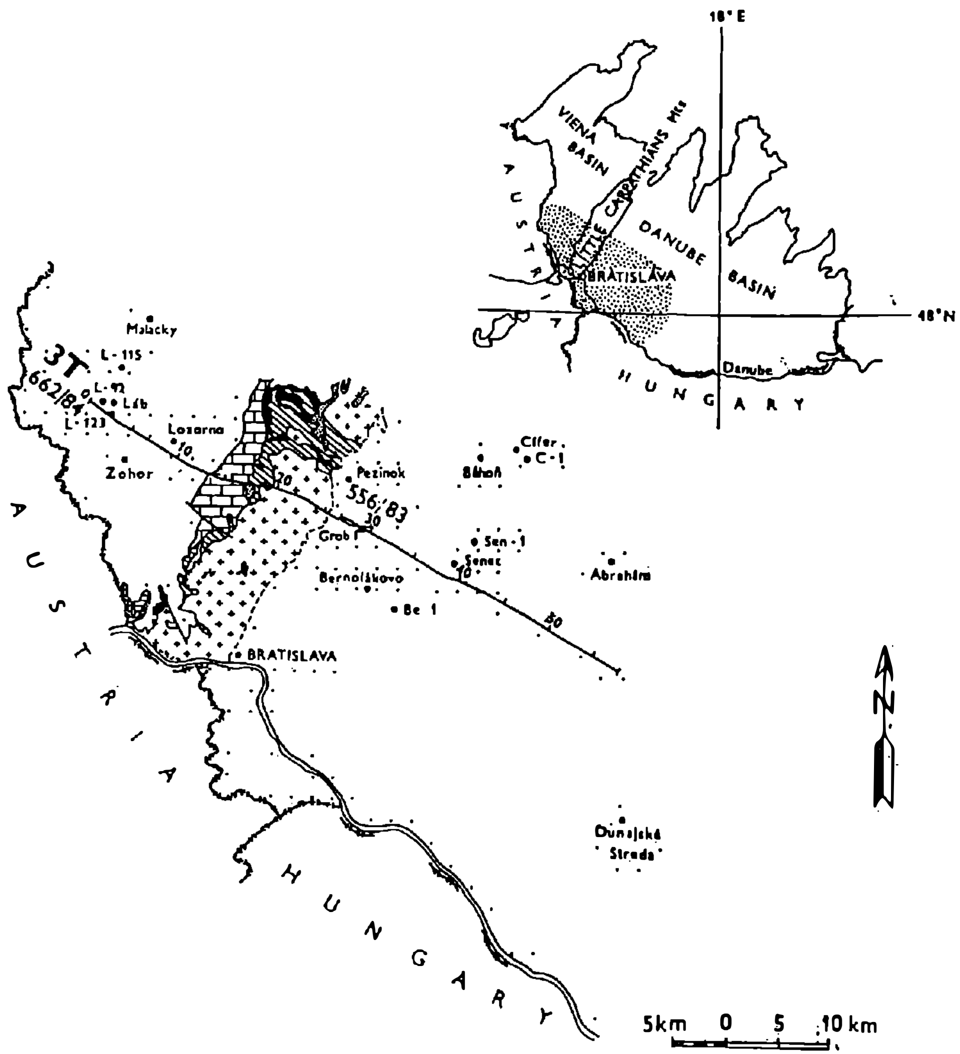

PRE-MESOZOIC TERRANES OF HUNGARIAN PART OF TISIA MEGAUNIT

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Tisia Megaunit is regarded as lithosphere fragment broken of the southern margin of Variscan Europe during the Jurassic and after complicated motions it occupied present tectonic position in the Miocene and forms the basement complex of southern Hungary and considerable parts of East Croatia and North Serbia as well as West Transylvania (Romania). Referring to the Pre-Alpine periods it is regarded as a composite terrane, but after them (during the Alpine events) it appears as e very large terrane characterized by rather uniform Mesozoic and younger formations settled on the Variscan (and older?) crystallines and overstep Paleozoic sequences.

The crystaline mass of Hungarian part of Tisia Megaunit is subdivided into three terranes and eight subterranes as follows:

- Drava Terrane
  - Babócsa Sub-Terrane
  - Baksa Sub-Terrane
- "Para-Autochton" Terrane
  - Mecsek-North Plain Sub-Terrane
  - Middle Plain Sub-Terrane
- Szeged-Békés-(Codru) Terrane
  - Kelebia Sub-Terrane
  - Tisza Sub-Terrane
  - Battonya Sub-Terrane
  - Sarkadkeresztúr Sub-Terrane
- "Outliers" (wedges, nappe-vrecks and remnants)
  - Horváthhertelend Unit (terrane)
  - Szalatnak-Unit (terrane)
  - Ófalu-Unit (terrane)
  - Tázlár-Unit (terrane)
  - Álmosd Unit (terrane)

CENOZOIC SPHERULE LAYERS IN HUNGARY

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Scanning proton microprobe (SPM) as complementary technique to electron microprobe analysis (SEM-EDAX) has been used for measuring elemental composition of spherules occuring in Upeer Pannonian and Quaternary sediments.

By the continuous corses of borehole Nagylózs -1, Zsira-1 and Sopron-89 Miocene, Pliocene and Quaternary sediments were uncovered in the western part of the Little Hungarian Plain, NW Hungary. In the Upper Pannonian layers accumulated continuously under moderate circumstances we have found tiny sphare, drop-like and filement shape objects. These are amber to light brown smooth glassy objects of 300-1600 µm decorated with acicular vesicular or grains of crystal (chillcrystals), and contain microbubbles of gas. On the basis of their normative composition, they are Ca-rich orthosilicate glasses bearing some accessories (Fe, Mn, Ti, Ba, K, Na, S, Ni, Nb, Zr, Sc,P, Cl).

In the Lower Pannonian layers the 1-3 µm size „extremly small microsherules" have smooth surface with no structure, and can not be mistaken for biogenic objects. They have very interesting chemical composition (REE-spectra).

In the micro-bodies are suppesed to be of extraterrestrial origin (impactite or Ca-rich micrometeorite?).

Magnetic spherules collected from the alluvial plain of the Danube River in Hungary are very various in their morphology, chemical composition and their surface structure and texture. It is obvious because a natural enrichment of the materials from the surrounding area happened in this fluviatile basin. By our studies three main genetic types were distinguished:

-- meteritic dust spherules and spheroids,

-- impactite-globules,

-- objects of uncleared origin (igneous-metamorphic).

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Preliminary study of mineralogical data from Tisovita –Iuti (South Carpathians, Romania) ophiolites complex, in dunite and troctolite rocks

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Abstract:The rocks which we studied are located in the olivine cumulates unit, in the lower part of the Tisovita – Iuti Ophiolitic Complex (TIOC)(Maruntiu et al,1984, 1997). This paper deals with mineral chemistry for olivine, spinel, pyroxen, plagioclase, amphibole and cryptic variation of spinels within the troctolite and dunite rocks of an ophiolitic transition zone. Troctolite rocks are characterized by the olivine-plagioclase association with small amounts of amphibole, spinel and clinopyroxen. In the case of dunitic rocks the studied mineral association is the following: olivine, plagioclase, spinel and amphibole. For the dunitic rocks olivine occurs as a cumulus phase whereas plagioclase forms an intercumulus phase. The later is generally strongly transformed. In the case of troctolite rocks the crystallisation order is reverse, the plagioclase becoming an early cumulus phase before olivine and clinopyroxene with intercumulus features. Both types of rocks, dunite and troctolite presente well developed and striking adcumulus textures (J.P.Bard., 1980).These cumulate rocks are characterized by a higher Fo content ($Fo_{90,1-91,9}$) and a lower anorthite content (An_{53-91}). The chemical analyses show that the spinels are chromian spinels. The values of Cr#=(100xCr/Cr+Al) and Mg#=(100xMg/Mg+Fe^{+2}) in the examined spinels are similar to values typical for abyssal peridotites (Dick &Bullen,1984,fig.1) (Cr#=24-36, Mg#=61-69 for dunites and Cr#=23-36, Mg#=56-66 for troctolite rocks).

Some spinels show a cryptic variation which are resulted from subsolidus re-equilibration and diffusion of the cations as Mg^{+2}, Fe^{+2} and Al between olivine, pyroxene and amphibole. Clinopyroxene are in a small amounts and is represented by diopside. Amphiboles are represented by tremolite, tremolite-hornblende, tschermakite, pargasite and pargasite-hornblende.

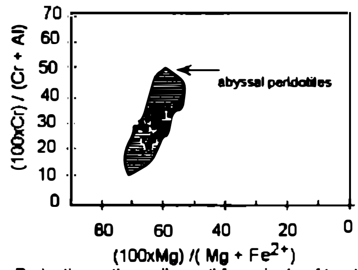

Fig.1 - Projection ratios cr# - mg# for spinels of troctolite and dunite rocks,Tisovita - Iuti area.
The abyssal peridotite field (after Dick & Bullen, 1984)

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MAGNETITE AND ILMENITE FROM THE OMAN-FAKIJA PLUTON, EASTERN SREDNOGORIE, BULGARIA

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The studied Fe-Ti oxides are the most widespread accessory minerals in the Oman-Fakija pluton and their amount range 1-8% in the basic rocks (pyroxenite, gabbro and quartz-gabbro - I intrusive phase); <1-3% in the intermediate rocks (quartz-monzonite, monzonite, monzodiorite - II phase), and <<1-2% in the small bodies and dykes of quartzmonzodiorite-porphyrite, monzonite-porphyrite, and granodiorite-porphyrite (III phase). The Fe-Ti oxides in these rocks are encountered as magnetite with ilmenite exsolutions and as homogeneous magnetite with dimensions for the both varieties being 0.05-1 mm (the I phase) and 0.02-0.06 mm - for the II and III phases. Ilmenite exsolutions in the magnetite are presented by lamellae whose thickness decreases from the basic rocks (~0.2 mm) to the rocks of the II and III phase being, respectively, ~0.04mm and 1-5 μm. Individual ilmenites beyond the magnetite crystals are rare and are found in the basic rocks (I) only. The relative amount of the magnetite with ilmenite exsolutions is found to decreases from the early intrusive phase (50%) to the late one (5%).

The total content of the minor elements (Ti, Al, Si, V, Mg, Mn, Cr, Ca) in the magnetites studied is comparatively low (0.2-3.47 wt%). The compositions of the homogeneous magnetite and the magnetite from the magnetite-ilmenite intergrowthes for each of the considered rock are very similar indicating that the formation of the former magnetite and the latest transformations in the coexisting magnetite and ilmenite have been performed simultaneously under the same physicochemical conditions. The higher contents of Ti and V (TiO_2 - upto 1.8% and V_2O_3 - upto 1.1%) are established in the magnetites from the basic rocks; Al and Mg are encountered in increased amounts (Al_2O_3, MgO - upto 1.1%) in the magnetite from the middle-basic rocks; Si (SiO2 upto 1.3%) is most typical minor element for the magnetite from the latest rocks.

Increased and variable contents of MnO and Fe_2O_3 and low contents of other minor elements (Al, Si, Ca, Cr, Mg) are characteristic for the ilmenites studied. According to its composition, the mineral can be specified as Mn-bearing ilmenite (basic rocks), and as Mn-ilmenite and Fe-pyrophanite (the rocks of the II and III phases). The significant variations in the MnO and Fe_2O_3 contents observed in the mineral are considered as a result of the uneven-developed of the postmagmatic fluid attacks on the rocks.

THE HIGHIS MASSIF (ROMANIA), AN EXAMPLE OF BIMODAL ALKALINE ANOROGENIC ASSOCIATION

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The Apuseni Mountains represent the eastern edge of the Tisia terrane, a broken fragment of the Apulian promontory, and were formed during the Alpine (Middle Cretaceous-Miocene) orogeny. Their lithotectonic units were accreted as discrete terranes during the Carboniferous closure of the Variscan ocean. These units are made up of various polymetamorphic basements and Palaeozoic-Mesozoic (up to Late Cretaceous) covers. In the south-western Apuseni Mountains, the Highis-Drocea Unit comprises a Palaeozoic volcano-sedimentary thinned crust intruded by an alkaline anorogenic magmatic complex and an Upper Cretaceous sedimentary cover. Highis-Drocea and Biharia Units were affected simultaneously by a shearing event in greenschist facies conditions before the Middle Cretaceous overthrusting event. In the mylonitic shear belt, Highis and Bârzava massifs represent undeformed relicts.

The Highis alkaline massif is an example of coeval anorogenic magmatism resulting from the interaction of mingling-mixing and differentiation processes at mid-crustal levels. The complex comprises basic (gabbro, diorite, quartz diorite, dolerite and minor wehrlite) and felsic (syenogranite, monzogranite, alkali feldspar granite, quartz syenite) end-members displaying sandwich-type relationships. Significant volumes of hybrid granodiorite are exposed in between. Various types of mafic magmatic enclaves (MME) illustrate the extent of mixing process by resorption and mantling of K-feldspar by plagioclase, presence of quartz droplets coated by fine grained amphibole, biotite, apatite and Fe-Ti oxides, compositionally zoned and/or acicular amphibole and K-feldspar trails crossing the boundary of MME. The suite follows an evolutionary trend akin to the rapakivi association. The plutonic assemblage is crosscut by bimodal dyke swarms. U-Pb determinations on zircon yield Middle Permian ages, other methods indicate younger resetting episodes.

Mafic-felsic magma interaction is illustrated in binary diagrams where mixing inprints are superimposed to the differentiation trend. Trace element (e.g. Nb, Y, Zr) contents correspond to within-plate compositions. Chondrite-normalized patterns display slight REE fractionation, increasing Eu negative anomalies and " tetrad effects " in the most evolved facies. Pervasive post-magmatic albitisation and greisenisation marked by high alkali, F, B, Sn, Nb, Ta and REE contents developed through fluid-rock interaction in subsolidus conditions. Geochemical data suggest that the Highis alkaline massif originated in an enriched mantle source.

LET'S GIVE SPACE TO THE URBAN NATURAL ENVIRONMENT

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ABSTRACT

The urban environment is considered to be incompatible with the natural environment and the nature conservation.
But living in towns and cities does not mean that we have to renounce completely our relation with nature. On the contrary, town-dwellers need an every day contact with nature, without making a special effort for it. This contact improves the quality of human life.
The success of this demand is quite feasible if environmental issues are integrated and of priority in planning perception and if the objectives of sustainable development are taken seriously into consideration and unsustainable demands are eliminated. Going over the environmental carrying capacity, in no way means amelioration of life. It means an abuse in real needs and realistic wants, it is the concept of *"Hybris"* of the ancient Greeks.
Sustainability in this context means that urban planning provides for the maintenance of the environment natural qualities and characteristics and its capacity to fulfill its full range of functions, including the maintenance of geodiversity and biodiversity. Urban planning should provide at least for the maintenance of the critical natural capital, and the constant natural assets.
Regarding the geological environment, the critical natural capital is the minimum of the geological sites that can represent the geological history of the urban area, and the constant natural assets are the sites that can be replaced by other similar sites, within the same area, in case of destruction.
In Britain, a country with long tradition in natural conservation, English Nature, the State Conservation Advisory Body, recommends that people living in towns and cities should have:
An accessible natural greenspace less than 300 metres (in a straight line) from home;
Statutory Local Nature Reserves provided at a minimum level of one hectare per thousand people;
At least one accessible 20 hectare site within 2 kms of home, one accessible 100 hectare site within 5 kms of home; and one accessible 500 hectare site within 10 kms of home.
Accessible natural greenspace is land, water or geological features which have been naturally colonised by plants and animals and which are accessible on foot to large numbers of people.
Of course in some modern cities this will be hard to achieve in the short term, but it should be a long term aim, through a protection of free spaces policy.
In the case of Athens, the capital of the Greek state and the cradle of the ancient Greek civilization, the conditions are far away from the above mentioned.
This means that although Athens has a low percentage of free spaces compared to other European capitals -hardly 2-3% of its total surface- these areas gradually disappear due to constructions pressure. This percentage, continuously in decrease, is already very low according to international specifications.
The pessimistic belief that things can not be improved is not true and it is even dangerous because everything is let prey to the voracious mouth of ground speculators.
The truth is that even in the most overcrowded areas there are areas of greenspace which allow for some hope, all the more because most of these areas are of statutory regime and consequently no difficult expropriation procedures are necessary.
A really relevant policy is needed, one that also includes measures on decentralisation, protection of the forests around the cities, limitation in the city plans expansion etc.
It is worth to mention here that in the whole of Attica, generally the lower free space percentage characterizes the western, more degraded areas which are in great contrast with the northern wealthy ones.

GEOCHEMICAL CHARACTERISTICS OF BAUXITES IN WESTERN SERBIA (YUGOSLAVIA)

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The bauxite-bearing region of western Serbia is restricted to the zone of Internal Dinarides, in which are known numerous occurrences and deposits of karstic bauxites Cretaceous in age. In this spatious zone, in the territory of Serbia are known Lower Cretaceous bauxites of Poćute, Tara and Mačkat, and Upper Cretaceous bauxites of Metohija. Bauxites are of boehmite and diaspore types with variable participation of alumina, silica and iron. They are characterized by high variability of chemical coposition, especially reflected in alumina and silica constituents. There are both high grade bauxites with low silicia, and poor quality bauxites grading into clayey bauxites. The bauxites include, beside basic constituents, also a distinct association of microelements.

Results of studies of geochemical feature of bauxites are very useful from both scientufic and practical point of view. By a modern access in researches of ore occurrences and deposits the problems concerning origin of elements and parent materials, as well as complex conditions of origin of karstic bauxites, could be satisfactory solved. Contents of individual chief elements and microelements are remarcably increased so that in certain cases they have, beside the scientific, also the economic importance.

By geochemical and mineralogical studies of bauxites, it has been established that its occurrences and deposits in the zone of Internal Dinarides of Serbia are of completely uniform mineral and chemical composition, as well as of similar geochemical features. Bauxites of the boehmite type are characterized by vertical distribution of boehmite and kaolinite. The chief feature is appearance of maximum boehmite content in the medial part of the layer, until the kaolnite contents increase from the roof to the floor. Analogous feature is that the highest Al_2O_3 contents are in the central part of the bauxite column, whereas SiO_2 increases from the roof to the floor. There is also a positive correlation of TiO_2 and Al_2O_3, meaning that high aluminium contents are accompanied by increased titanium grades.

By geochemical studies it has been established that in bauxites may occur a lot of rare metals and other elements as microelements, which in some deposits may attain cosiderable concentrations. Beside the economical importance these elements represent remarkable metallogenic indicators. In such a way the augmented concentrations of Cr, Ni, Co, Mn, V, La, Sr and others are found. The increased Fe, Cr, Ni and Co contents indicate that a part of material, which bauxites derived from, comes from ultrabasic and basic rocks. For all bauxites in western Serbia is characteristic vertical distribution of microelements. It has been found that their concentrations increase from the roof to the floor, and that maximum concentration of individual elements appeare directly above the floor.

The content variations of microelements reflect both differences in composition of parent material and in bauxitization degree. Oscilations in vertical distribution of microelements are more visible in the lower quality bauxites, whereas in the high quality bauxites the microelements are concentrated in the floor. Such microelements as Ni, Co, Cu, Y, La and others are more mobile, thus forming the highest concentrations directly above the carbonate basement (Fig. 1.).

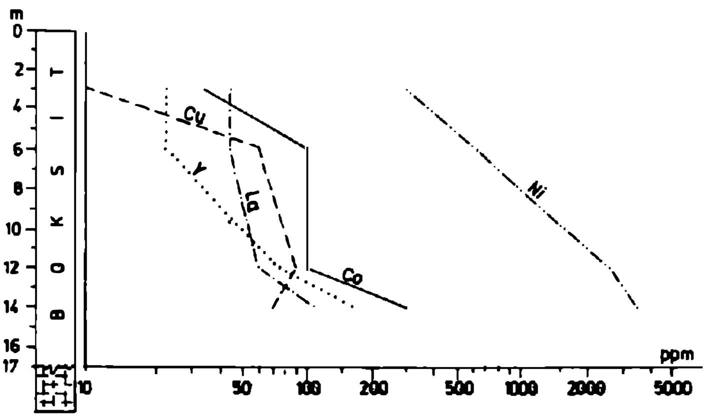

Fig. 1. - Vertical distribution of some microelements in the higher quality bauxites of the Trafostanica deposit

Bouxites of western Serbia bear the increased concentrations of radioactive elements in following quantities: uranium up to 12.11 ppm, and thorium to 57.79 ppm. The increased contents of these elements offer the possibility the bauxites to be clearly distinguished from the country rocks, as well as possibility the radiometric methods to be applied in explorations.

CONSERVATION OF GEOLOGICAL HERITAGE IN BULGARIA: PRESENT STATE AND FUTURE INITIATIVES

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Over 360 natural geological sites are selected and put under protection by the Bulgarian Legislation on Nature Protection. These are geological formations which are unique with respect to their shape, structure, texture, specific features and beauty. Usually are considered whole rock massifs and successions or individual beds, groups of picturesque layers and elements of these formations and rock bodies (earth and stone pyramids and stone rivers, rock windows and bridges, niches and caves in the rocks, karstic gorges, ponors, dams and all other karstic forms). Eroded alluvial formations and terraces, river valleys and tectonic grabens are also among them. Areas and sites of unique fossils and fossil accumulations, petrified trees and forests, extinct volcanoes and products of their activity are also presented. A variety of sand and sand dunes and stones, coastal banks and bands, lakes, bays, swamps, water falls, pits, localities of ancient mines, quarries and excavations are also included.

Besides of the protected natural geologic sites the classic geologic sections and outcrops known as natural geologic museums, as well as the deposits and occurrences of rare minerals and crystals and mineral individuals having beautiful and large crystal forms (natural mineralogical museums) and also different genetic or morphologic types of ore deposits are to be mentioned.

As a whole, all listed natural geologic phenomena are of great significance for the geology of Bulgaria since they provide valuable data and evidences for the regional geologic development of the area of the country and of the Balkan Peninsula during entire geologic history. As subjects of natural beauty they all are of great aesthetic and emotional impact.

The natural geologic sites well known and considered here and everywhere as a national geologic heritage are imposed, however, on immediate effect of different natural agents and geologic processes and could be under direct influence of men and of their behaviour. No doubt in this case that the natural features and phenomena could be damaged or destroyed in such a way and extent so that no natural or artificial restoration and cultivation can any longer be used to recover the natural beauty. The protection of the heritage requires quick building of state monitoring and watching system.

Additional sites and localities could be included into the natural geologic heritage of the country in order to be protected and left to the coming generations. Many of the existing and newly established sites could be forwarded for the inclusion to the Lists of the World, European and Balkan heritage. They all will meet the established international standards.

ECOGEOLOGY - WHAT DOES THAT MEAN ?

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Ecogeology (syn. Environmental Geology) is a new interdisciplinary sphere of knowledge, originating at the crossing point of geology and ecology. The subject of its research is the natural connection between the geological environment and the components of nature with estimation of the influence of man's activity in its various aspects. The following trends of ecogeology can be outlined:

- study of the geological environment and its conditions; the anthropogenic effect and the effective measures for environmental protection;
- rational and complex utilisation of the mineral resources; protection of the bowels of the Earth and of the Environment during geological explorations and mining activities;
- engineering geological aspects for protection of geological environment;
- protection of the surface waters, ground, mineral and thermal waters;
- estimation of the natural hygienic geological potential of different territories;
- ecogeological researches in respect with activities directed at getting the earth rid from radioactive and dangerous anthropogenic wastes;
- problems of the cryosphere with respect to its vulnerability from every possible angle;
- monitoring (the more precise term is "lithomonitoring") of geological environment including recent geological processes and phenomena and their activation under the effects of anthropogenic activity;
- ecogeological mapping and methods;
- problems of the regional ecogeology;
- problems of natural geological monuments and interesting geological sites (so-called geological heritage);

Ecogeology is interrelated with other sciences like biology, geography, hydrology, meteorology, protection of health and economy. The fact that many areas throughout the world are in critical position promotes the ecogeological studies which have recently become typical in many countries. The problems that these studies are trying to solve are included in the curriculum of many institutions and organisations all over the world.

ENDOGENIC GOLD-BEARING MINERALISATIONS IN BULGARIA

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On the basis of the geological features, hydrothermal alterations, mineral composition, content of gold and physics-chemical parameters of the ore formations in 44 different deposits and occurrences 15 geological-genetic types of gold mineralisation in Bulgaria, grouped into three genetical classes, are divided:

A. Hypothermal mineralisations: 1. Stratiform quartz-gold-pyrrhotite mineralisations in the Pre-Cambrian (?) metamorphites (Kamilski dol);

B. Mesothermal mineralisations: 2. Vein quartz-gold-sulphide deposits in granitoids and low-grade schists (Govezhda, Svishti plaz, Zlata); 3. Porphyry gold-molybdenum-copper mineralisations in Late Cretaceous hypo-abyssal intrusions and dykes, Paleozoic granitoids and schists (Medet, Elatsite, Prohorovo); 4. Vein gold-sulphide mineralisations in metamorphites, Paleozoic and Late Cretaceous granitoids (Sarnena Gora, Gorna Dikanya, Petrovo, Babyak, Polski Gradets, Dobroselets); 5. Vein and replacement gold-containing polymetallic mineralisations in high-grade metamorphites (Strashimir, Krushev dol, Pilevo);

C. Epithermal mineralisations: 6. Disseminated stratabound gold-sulphide mineralisations in Early Paleozoic black schists (Western Balkan, Kraishte); 7. Disseminated stratabound gold sulphide mineralisations in green schist rock complexes with a toleiitic magmatism or in metamorphosed "Sakar-type" Triassic (Mandritsa, Dolno Lukovo, Ustrem-Gramadite); 8. Massive sulphide gold-copper-pyrite mineralisations in intermediate acid volcanogenic rocks (Chelopech, Radka, Krassen); 9. Porphyry gold-copper-pyrite mineralisations in Late Cretaceous subvolcanic bodies, dykes and volcanites and Paleozoic granitoids (Assarel, Tzar Assen); 10. Disseminated gold-pyrite (oxidised) mineralisations silicificated volcanites (Petelovo); 11. Veinlet-disseminated gold-copper-polymetallic mineralisations in sedimentary, subvolcanic and metamorphic rocks (Vozdol); 12. Veinlet-disseminated gold-sulphide-barite mineralisations in andesite volcanites (Stara Zagora); 13. Vein gold-copper-polymetallic mineralisations in basic alkaline and subalkaline volcanites (Bakadzhik, Zidarovo); 14. Vein gold-silver-polymetallic mineralisations in intermediate acid volcanites and high-grade metamorphites (Madzharovo, Popsko); 15. Disseminated stratabound gold and silver-gold mineralisations in sedimentary, volcanic and metamorphic rocks (Sedefche, Rozino, Sarnak, Novakovo-east).

In regional aspect the gold mineralisations are grouped in 5 gold-bearing ore complexes:

A. Complex of Late Paleozoic gold mineralisations formed in collision environment of Paleobalkanides (Stara Planina Mts., Kraishte);

B. Complex of Late Cretaceous gold-copper-polymetallic mineralisations formed in subduction environment (ensialic magmatic arc) in Central Srednogorie; C. Complex of Late Cretaceous gold-copper-polymetallic mineralisations formed in subduction environment (ensialic magmatic arc with back-arc rift) in Eastern Srednogorie;

D. Complex of Tertiary gold and gold-polymetallic mineralisations formed in collision environment in Eastern Rhodopes;

E. Complex of Tertiary polymetallic mineralisations formed in collision environment in Western Rhodopes.

STRUCTURAL HISTORY OF A FLYSCH SEQUENCE: CASE STUDY FROM MAGURA NAPPE, OUTER CARPATHIANS (POLAND)

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This paper traces the structural development of a flysch sequence since its deposition up to post-orogenic collapse. A transect through the Magura nappe has been choosen as the study area due to good knowledge of tectonics of the area and excellent exposures. Field observations of map-scale and small-scale structures have been combined with microscopic analysis, including cathodoluminescence, X-ray analysis and fluid inclusion analysis.

The Polish segment of the Outer Carpathians is a north-verging thrust-and-fold belt. The Magura nappe assumes the innermost position within this belt. During Eocene times, the nappe was an accretionary wedge related to the southward subduction of the Outer Carpathians. The subduction in the Polish segment of the Outer Carpathians ceased during the Early Miocene. Later on, this segment of the Outer Carpathians was the locus of segment-parallel strike-slip faulting related to the eastward escape of the Eastern Alps. This was followed by a collapse marked by normal faulting.

The microscopic analysis of small-scale hydroplastic thrusts has shown that regional thrusting within the Magura nappe was initiated during Paleocene times or earlier. One of the regional thrusts is sealed by Upper Eocene strata containing olistostromal intercalations. This constrains the upper limit of the time of the thrusting. The results of meso- and microanalysis of deformation bands have shown that the Lower to Middle Eocene sequence of the Magura nappe was folded during deposition. The folding was completed by the Middle Eocene. The induration of folded strata increased during the folding, but even at the completion of the folding the strata were still poorly indurated. Results of analysis of diagenetic grade of claystones are compatible with the early age of the folding and thrusting. The orientation of cross-fold joints and sandstone dykes indicates that during the Early and Middle Eocene the overall stress regime remained constant.

Calcite mineralization is ubiquitous in the study area. It follows from microscopic analysis of joints, deformation bands and hydroplastic faults that bulk of this mineralization is of a post-folding age. Moreover, the results of microscopic analysis show that brittle faulting largely post-date calcite mineralization. The faulting occured in three successive stages during: (1) early collapse related to N-S extension, (2) strike-slip tectonics related to W-E compression and, (3) final collapse related to W-E extension. During the final collapse (3), the innermost part of the Magura nappe was heated up to 150-210^{0}C, as shown by advanced diagenesis and results of study of fluid inclusions in quarz-calcite veins. This heating occured during the late Early Miocene.

EVOLUTION OF THE VIENNA BASIN AT NORTHEASTERN CORNER OF THE EASTERN ALPS

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Vienna basin is regarded usually as classical example of a pull apart basin (Royden) in many textbook of structural geology. Even though some authors sec difficulties connected with this oversimplified evaluation (Fodor, Wessely), overwhelming majority of recent interpretations repete pull apart story defined by Royden in 1983.

I present here an evidence based on deep (14 s) and shallow (5 - 6 s) seismic profiles and geologic studies from numerous boreholes and surface that there were, in fact, three distinct periods of the development of the Vienna basin during Neogene.

The first one occurred during late Eggenburgian,
Ottnangian and Karpatian (20 - 16.5 Ma) of the Paratethyan scale. Piggy back basin development via transtension in the area of the shallow low-angle Alpine and steep high-angle Carpathian thrust boundary was present. Transtension lead to unusually rapid subsidence and sedimentation during counterclockwise rotation of the Carpathian subplate. Western Bulhary strike-slip fault is well evidenced. There is, however, no sign about its eastern counterpart. Transtension probably occurred via reactivation of previous subhorizontal Alpine thrust faults in the Limestone Alps. Only minor subsidence and sedimentation took place in Flysch belt. This first piggy back basin might be regarded as special example of a pull apart basin.

Second period brought the majority of sedimentation and also recent shape of the Vienna basin. It started in mid-Badenian (15.5 Ma) after short about 1 million years long time of docking and compression phase after transtension and end of thrusting. Several half graben were developed along high angle 50° major normal faults as Steinberg, Schrattenberg, Kuty and others. Pure extension was a leading tectonic regime and no strike-slip faulting was evidenced. Recent rhomboschsm shape of the basin is result of pure extension which ended at Pontian (7 - 6 Ma).

Following late Miocene, Pliocene and Quaternary development of the basin was mostly dominated by uplift and erosion. Sarmatian (12 Ma) marinc sediments has been sometimes elevated to a height of 400 m above sea level. Minor pull apart sedimentation has occured along the Mur - Muerz - Leitha - Male Karpaty fault.

Deep seismic and geologic studies of the Vienna basin and surrounding Alps and Carpathians result, however, in surprising conclusions valid for the whole Eastern Alps. The Alpine - Carpathian boundary was present along N - S trending passive margin of the Krosno - Tarcau ocean (which was subducted later between 20 - 10 Ma) also during the Oligocene and early Miocene. This boundary was subsequently shifted to the North without significant movement to the East. Late Jurassic black shales beneath the Vienna basin different from platform sediments beneath the Alps document the time of opening of the latest Carpathian ocean. Oligocene and early Miocene shallow thin-skinned thrusting of the Eastern Alps over the European platform was accompanied by Oligocene steep continental and early Miocene oceanic subduction of the Carpathians. At least 15 km thick pile of the Carpathian flysch and few km or nearly non existent Alpine flysch document large scale offscraping in the Carpathians and subduction or tectonic erosion of flysch and Helveticum in the Alps. Corollary of these observations is simple: Large scale Oligocene and Miocene escape movement of the East Alps to the East is excluded. Simple 2D sandbox modelling and structural studies of the East Alps are contra - evidenced by 3D seismic studies at the Alpine - Carpathian boundary. Other model for post - Eocene development of the East Alps has to be found.

STUDY ON THE DEPOSITIONAL ENVIRONMENT OF PALEOGENE SEDIMENTS IN DOLNA KAMCHIA DEPRESSION AREA USING GAMMA -RAY WELL LOG DATA

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Dolna Kamchia depression is situated as a narrow strip within the Bulgarian onshore and offshore area. Paleogene sediments are represented by Eocene and Oligocene. They are built by clays, marls and thin interbeds of sandstone. They are characterised by low electric resistivity and the apparent resistivity and the apparent resistivity diagrams cannot be used for segmentation of the drillhole sections.

Gamma-ray diagrams are considerably differentiated, which allows to confidently segment and correlate the rocks permeated by drilling. Ten packs with various values of gamma ray radioactivity can be differentiated on the gamma-ray diagrams of the Oligocene and Upper Eocene rocks.

The environment of deposition in the basin determines the type of sediments and their radioactive elements content. The study of gamma-ray radioactivity and the content of Uranium U, Thorium Th and Potassium K^{40} and their alteration throughout the area enable us to reconstruct the physical, geographic and paleo-environment of sedimentation.

The highest gamma-ray radioactivity in the Paleogene was measured in the marls and the clayey interbed of the Upper Eocene. The anomalous high radioactivity of pack IX is due to the increased content of K^{40} and Th which was presumably substantiated by a slower sinking rate of the basin's bottom and the dry atmosphere of the territory under consideration during that time. This contributed to the intensive evaporation of waters from the relatively illite reservoir. The sediments of pack VIII were formed in an analogous environment, but due to the increased supply of clayey material, which was characterised by an increased adsorption capacity - Uranium content increased as well.

During the deposition of the sediments of pack VII in the areas of increased velocity of absorption and sedimentation the Th and K^{40} content decreased as compared with the areas of slower sinking and sedimentation (Well R-74). Here it occurred under the conditions of a dryer climate and a deeper basin. Presumably, during that period the bottom started to sink more intensively, as well as the sediments of packs VI and V. These were deposited under the conditions of a non-compensated sedimentation.

ENVIRONMENT-PROCESS-PRODUCT RELATION IN THE RUDNIK POLYMETALLIC DEPOSIT, SERBIA

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The polymetallic deposit Rudnik was formed under complex genetic and geological conditions. When reconstructing the mineralization process of the Rudnik deposit, three significant geological aspects may be distinguished: (a) variety of environmental conditions, (b) diversity in formation processes and (c) heterogeneity of the obtained results, namely of the formed paragenetic mineral and elements associations.

Variety of environmental conditions. Under conditions of complex geological structure of the Rudnik deposit, three lithological media of essential importance for formation of mineralization may be distinguished as follows: (a) skarns accompanied by limestones and carbonaceous sandstones; (b) hornfels and (c) hydraulic breccias. These media greatly differ in mineralogical, physico-chemical, petrophysical and permeable properties.

Diversity in formation processes. Deposition of ore minerals was carried out from hydrothermal fluides by unstable differentiation of solutions and accompanying intraore tectonics. The main feature of the selected lithological media, from aspect of flow of these hydrothermal solutions, is diverse porosity and permeability, as well as chemical and mineralogical composition that influenced on both the course and intensity of metasomatic process. *Skarns and limestones*, as for composition, and carbonaceous sandstones regarding to composition and relatively advantageous porosity and permeability, represented a medium where metasomatic processes caused petrogenic minerals to be changed for ore minerals. Carbonaceous sandstones, containing limestone partings and lenses, are characterized by significantly greater mineralization that limestones, due to easier flow of hydrothermal solutions. Extremely large "stratiform" massive sulphide ore bodies were formed in carbonaceous sandstones occurring in the southeast part of deposit in form of relatively stable stratiform level. *Hornfelses,* characterized by small porosity compared to other lithological members of the Rudnik deposit, proved to be relatively impermeable for hydrothermal solutions. This led to formation of insignificant ore mineral concentrations in kornites in form of impregnations, rarely in form of small veins and thin veinlets within crack-fissure systems. *Hydraulic breccias* represented a medium that, owing to looseness and tectonic fissuration, enabled flow of solutions as well as precipitation of useful components caused by temperature drop, particularly abrupt pressure fall. In those-breccias, impregnation-nestlike type of mineralization was formed with greater ore mineral masses. Hydraulic breccias are the result of complex hydrothermal kinematic processes that provided impression of dacite-latite-quartzlatite dikes.

Hoterogenity of the obtained results. In skarn lithological medium, a skarn paragenetic association of minerals was formed being represented by galenite, sphalerite, chalcopyrite and pyrite as predominant ore minerals and a series of accompanying minerals, mostly sulphides. Pyrrhotite occurs in hornfels, pyrite rarely, chalcopyrite in form of impregnations and small veins and veinlets in fissures and cracks. In hydraulic breccias, with respect to pressure drop as one of the main factors of deposition and accompanying phenomenon of secondary boiling, greater quantities of sulphide minerals were formed with a somewhat different ration, predominantly chalcopyrite, sphalerite and galenite with pyrites accompanied by scheelite.

GENERAL METALLOGENIC CHARACTERISTICS OF AZNA MINERALIZATION, SERBIA

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The complex mineralization of Azna is located in the Rudnik ore field, within Šumadija metallogenic zone, being a part of the Serbian-Macedonian metallogenic province. Geological structure of terrain where this deposit was formed consists of rock of breccia, magmatic, contact-metamorphous-metasomatic and sedimentary complex. The breccia complex is represented by tectonic and hydraulic breccias, the magmatic complex is represented by dacites, latites and quartzlatites in form of dikes, the contact-metamorphous-metasomatic complex is represented by skarns and hornfels and the sedimentary complex is represented by sandstones and flysh formations. Particularly interesting is the occurrence of hydraulic breccias with fragments of millimetre to a meter length and variable composition: granodiorite, andesite, dacite, latite, quartzlatite, skarns, hornfels, quarzite, sandstones, limestones, flysch etc. The binding agent in those breccias is of magmatic origin only at individual locations, while it is mainly of non-magmatic origin. Those hydraulic breccias were formed in diatremas when breaking the overcritical fluids under extremely high explosive pressure within a highly complex hydromagmatic process.

When estimating a geological medium of Azna from aspect of mineral deposition the following parameters are of significant importance: composition, porosity and permeability of hydraulic breccias, dacites, latites and quartzlatites. Lithological and structural factors are in fact the control factors that are of great importance in determining the location of mineralization. Lithological factor of control indicates the presence of hydraulic breccias that were suitable for additional flow of hydrothermal solutions and deposition processes of mineralization. Structural factor of control is represented by fissures and crack-fissure systems in breccias and dikes being mechanically discontinuous and mineralized along those surfaces.

The Azna deposit has a shape of irregular cone and consists of three ore bodies: Azna, Z1 and A2. The contours of ore body are gradual and mineralization is of impregnation-spotty-massive type with uneven mineralization of Azna area. Ore minerals occur both in fragments and cement of hydraulic breccias. Depending on formation conditions, a complex paragenetic association of minerals and elements resulted. The main ore minerals are chalcopyrite, galenite, sphalerite, arsenopyrite, pyrites and schelite; pyrrhotite, gel-pyrite, bacterium pyrite, chalcopyrite occur as accompanying minerals as well as native Au, native Ag, native Bi and tetrahedrite, while zircon, anatase, rutile, marcasite, Bi-tetraedrite, leucoxene, coveline, bismuthinite, chilenite, crenerite, calaverite, cuptite, electrum etc. occurred as secondary minerals. The main non-ore minerals are garnets, epidote, amphiboles and quartz while accompanying ones are sericite, sphene and calcite.

SEQUENCE STRATIGRAPHY OF THE TRANSITION FROM CONTINENTAL TO MARINE LOWER TRIASSIC SEDIMENTS IN WESTERN BALKAN (NW BULGARIA)

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The most complete and representative outcrops of the Triassic system in Western Stara Planina are in the Iskar gorge area. The continental sediments on its bottom (Petrohan terrigenous group - Buntsandstein facial type) are built up by three fluvial mesocycles (MC-0, MC-1 and MC-2), from which just the upper one - MC-2, is developed completely and consists of three units MC-2/1, MC-2/2 and MC-2/3 (Tronkov and Ajdanlijsky, 1998). In the best outcrop of the transition from continental to marine Lower Triassic sediments - that near Sfrazen, following successions are observed. At the bottom is outcropped part of the topmost elementary fluvial cycle in the middle unit of MC-2 (interval MC-2/2), which is a product of anastigmosing fluvial setting. Elementary fluvial cycles from the completely outcropped upper unit of this mesocycle (MC-2/3 -18 m thick) are characterised by abundance of autochtonous (Brokelbank breccia type) in the bottom and allochtonous (violet colours and calcrete horizons) paleopedogenic products in their upper parts, as well as abundance of clay plug-abandoned channels. Unit MC-2/3 is formed in a highly sinuous fluvial environment and mark the final stage of an entirely continental Lower Triassic sedimentation.

The transitional sediments - the Svidol Fm (Fig. 1), begin with a transgressive system tract (TST). Its lower part (interval A - 8 m) is situated over a sequence boundary and consists of three distinct parasequences, each starting with a continental channel and overbank deposits and finishing with centimetre thick supratidal dolomitic marls and dolomites. The facies successions in them are asymmetrical. The middle part of the TST (interval B - 11,5 m) is built up of three parasequences similar to those in the above-mentioned interval, but here continental channel deposits are absent, the quantity of supratidal dolomites and marls in higher parasequences gradually increases and facies successions are symmetrical. In these two intervals of TST, terrigenous deposits are predominantly with red colour and are often bioturbated. Both intervals are formed in the coastal plane setting under the progressively increasing influence of supratidal processes. The upper part of TST (interval C - 10 m) begins with grey carbonate sandstones, which are covered by light beige-grey marls and carbonate silts, all produced in an intertidal flat setting. In this interval, which is capped by a bed of grey micritic limestone (mfs), parasequences from order four were not separated. The upper part of the Svidol Fm (interval D 10,5 m) highstand tract (HST), consists of four parasequences. They are built up of asymmetrical, shallowing-up facies successions, represented by intertidal intraclastic carbonates and marls on the bottom and supratidal dolomites in their upper parts. The quantity of the letter grows in higher parasequences. Intertidal deposits in intervals C and D consist of marine *Bivalves*. The upper boundary of interval D is an erosional, transgresive and sequence one. Entirely calcareous peritidal deposits of the Mogila Fm follow over it. Their cyclic character is described by Tronkov (1968). The same author suggested that the Svidol Fm was formed in the last Lower Triassic, draning upon the amonoidic fauna (*Beneckeia tenuis*) found at 10 m over that boundary.

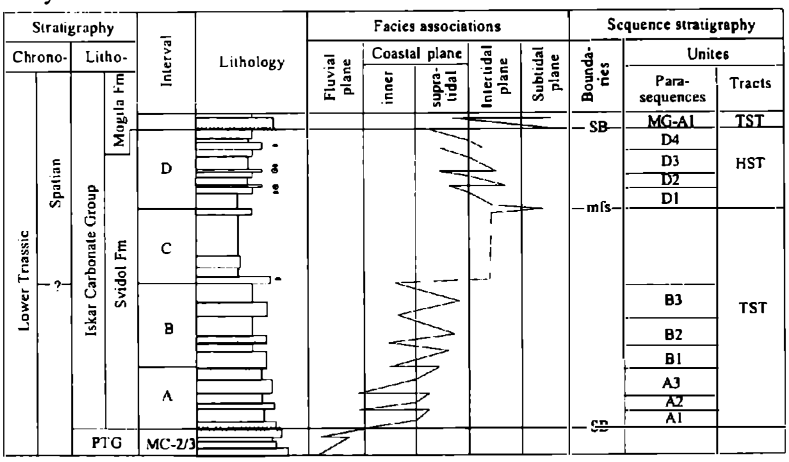

Fig. 1.

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FACIES AND ZONATION OF THE UKRAINIAN CARPATHIANS

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Though the Ukrainian Carpathians have been investigated for a long period of time, the question concerning structural subdivisions has not been solved yet. One can find the acknowledgment of it in a few versions of tectonic division into areas. There are some reasons of such statement. The principal of them is the presence of a big quantity of thrusts, among which one can hardly distinguish the main one, "cutting" a veneer or a nappe from below. The second reason consists in imperfection of the principles of division into areas, which, unfortunately, are not universal for the whole territory. And the third one consists in the structure peculiarities of the Ukrainian Carpathians, which are within the joint of the Eastern and Western branches.

The main conclusions the author arrives at by analyses of all the materials, consists in a "trough" development of all the available structural units. The author considers it possible to trace all the flysh nappe from east to west by means of changes which are manifested by gradual "reuvenation" of the nappes in this direction.

The whole flysh area of the Ukrainian Carpathians was a marginal part of Tethys in Cretaceous and Paleogene and had the common area, despite the presence of lengthwise cordillera. Both paleogeographic materials and observed at present and mapped intermediate facies, which uncover connections and decrease the differences between individual nappes testify this. Certainly, on the early stages of geosynclinal development the conditions of forming and sedimentation sources were different and that is revealed by means of facies analysis. The plan of development of each structural-facies unit in the Early and Late Cretaceous, in Eocene and Oligocene does not coincide and is different, though it is subordinated to the common process, Sedimentary lenses, deposited in individual troughs, were reworked later by Neogenic tectogenesis and they formed nappes of different significance, extension and hierarchy. Their role is discussed nowadays, and the results will have been represented by the meetings in Austria.

MINERALS OF THE CARPATHIANS: SPACE AND TIME DISTRIBUTION OF MINERAL SPECIES

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The Carpathians mountains range include numerous genetic types of mineral occurrences showing a fairly uniform distribution over an area of about 400,000 sq Km. However, the different parts of the Carpathians are characterized by peculiar occurrences assemblages, a fact primarily due to their belonging to different mega-protoliths, i.e. plates or microplates or cratons. The Phanerozoic evolution of the Carpathians was obviously gouverned by their position at the junction of three plates, i.e. East-European, Moesian and Preapulian.

Spatial distribution. The Austroalpine units (Dallmeyer et.al., 1996) or the Internal Dacides (Såndulescu, 1984), partly named Preapulian craton by Balintoni (1997) contain significant U mineral deposits in Hungary (Mecsek), Slovakia (Gemerides) and Romania (Apuseni Mts), with a large number of secondary minerals depicted especially in the Mecsek occurrences. Huge magnesite deposits are located in Gemerides and hydrothermal AuAgTe and CuPbZn deposits with numerous tellurides, Sb-sulphosalts and Hg minerals are known in all the Carpathians countries. Two "gold spots" are known within the Austroalpine units, i.e. the celebrated "Golden Quadrangle" in the Apuseni Mts. (RO) and the Kremnitza area (SLK). A Neogene "Sb-line" can be depicted in the northern part of the area, which can be traced from Slovakia through Ukraina to Romania. A Te-rich spot and a Hg spot can be noticed in the Apuseni Mts and in the Ukrainean Carpathians, respectively. The Median Dacides of Såndulescu, splitted by Balintoni into the Euxinic and Getic cratons include significant stratiform Pb-Zn-Mn and Cu-Pb-Zn ores especially in the East Carpathians, mostly in Romania, partly in Ukraina. Hereto belong also the Banat skarn deposits, in which the ore minerals are Bi-dominated. A N-S running "Bi-line" can here be traced (Udubasa, 1998), which can be followed also in the Apuseni Mts, over the "border" to the Austroalpine Units. The Major Tethysian Suture (MTS) of Såndulescu is twice important, both as a "direct bearer" of Fe-Ti-V- and Cu-pyrite ores within the ophiolitic rocks of the Mures zone and as a potential metal-rich protoliths during later tectonic processing. Such a role seems to be obvious in the Apuseni Mts and can be presumed in the Eastern Carpathians in relation to the Miocene volcanic activity.

Time-related distribution. Several epochs of main mineral forming processes are distributed over the whole Phanerozoic time in the Carpathians (Table), with a significant increase of mineral species number during the K_3-Pg_1 and Miocene events.

Cainozoic	PbZnCu, SbHgAs, AuAgTe	RO, SLK, H, UKR
	porphyry coppers	RO, H
	NaCl	RO, UKR
Mesozoic	Cu, Bi, Mo, Co, W, skarns	RO
	Al	H, RO
Paleozoic	U	H, SLK, RO
	Mg, Fe	SLK
	Mn, PbZnCu, Fe	RO, UKR
Proterozoic	PbZn	RO

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SHEAR ZONE RELATED GOLD ORES. AN EXAMPLE - VALEA LUI STAN, SOUTH CARPATHIANS, ROMANIA

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Small-scale shear zone related gold ores are quite widespread in Romania, especially in the medium grade metamorphics of the South Carpathians. The archetype of such ores was described as early as 1976 by Udubaşa at Valea lui Stan (Udubaşa, Hann, 1987), where gold was exploited since the beginning of the XXth Century. The following features led to the idea that the Valea lui Stan gold deposit is neither a hydrothermal, nor a stratabound ore deposition: (1) lack of hydrothermal alteration of the host metamorphics, (2) lack of lithostratigraphic control, (3) constant association of quartz gold ores with strongly retrogressed medium grade metamorphic rocks along long-lived shear zones, (4) a wide spread of sulfur isotope composition values, (5) a limited number of mineral species, i.e. pyrite, chalcopyrite, arsenopyrite, sphalerite, which with some variations occur also in other similar gold occurrences, (6) a constant association of gold ores with retrogressed amphibolites. The amphibolites of the so-called Sibişel Fm have shown the highest (geochemical) values of gold as against the other rocks in the South Carpathians, a fact enabling their characterization as gold protores (about 0.1 ppm Au). The geochemical reconnaissance of such potential gold protores in relation to structural recognition of suitable shear zones suggest the presence of shear zone related gold ore bodies, the main characteristic of which is the highly irregular distribution of gold gouverned by a similar distribution of "dilatant zones" within the shear planes. By comparison with other similar gold occurrences in the metamorphic rocks it became obvious the major role of protores and the type of shearing in the development of the shear zone related mineralizations. A further problem of this type of ores is related to the size of shear zones, a fact enabling the nature of the ore solutions to solve and the source of metal(s) as well. The bigger the shear zone the easier the connexion of shearing planes to the hydrothermal or hydrothermal-like channelways. In such a way the apparent conflict between the "pure", generally small-scale (SSSZ) and the mixed, larger-scale shear zone (LSSZ) related mineralizations can be greatly attenuated. For the SSZ no "matter importing" is or seems to be necessary whereas for the LSSZ clearly epigenetic overprints might be accepted or even foreseen.

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ACCESSORY NIOBIUM-TANTALUM MINERALS IN THE WEST-CARPATHIAN GRANITE-PEGMATITE SUITES, SLOVAKIA: COMPOSITION AND EVOLUTION.

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Since ca. 1990, a variety of Nb,Ta-bearing oxide minerals were described in Hercynian S/I-type orogenic leucogranites and mainly granitic pegmatites. Beside of tin-bearing Permian the Spiš-Gemer granites with disseminated Nb,Ta-mineralization, these rare-element minerals occur in three Lower Carboniferous granite-pegmatite rock-types of the Tatric Unit, Central Western Carpathians: (1) muscovite leucogranites, (2) pegmatites of S-type granites, and (3) pegmatites of I>S granodiorites-granites:

(1) Muscovite to biotite-muscovite S-type leucogranites near Kovarce (Tribeč Mts.) contain Nb,Ta-rich rutile, locally with exsolved Ti-rich ferrocolumbite or titanian ixiolite. Rutile contains ≤11 wt.% Nb_2O_5 ≤14 wt.% Ta_2O_5, ferrocolumbite/ixiolite shows at. Mn/(Mn+Ta) = 0.01-0.12; Ta/(Ta+Nb) = 0.13-0.17, ≤5 wt.% TiO_2 and ≤2 wt.% WO_3. The origin of Nb,Ta-minerals is due to advanced fractional crystallization of granitic magma without any transparent post-magmatic processes (e.g. greisenization, albitization).

(2) Nb,Ta-mineralization in zonal granitic pegmatites of S-type leucogranites is connected with albite-rich and coarse-grained K-feldspar-quartz-muscovite assemblages. The most fractionated pegmatite vein of beryl-columbite subtype occurs at Moravany nad Váhom (Považský Inovec Mts.), other bodies were found in the Bratislava area (Malé Karpaty Mts.) and Rázločno (Žiar Mts.). Accessory minerals comprise mainly almandine-spessartine, gahnite, Hf-rich zircon, beryl and Nb,Ta-oxides: several populations of Ti-poor ferrocolumbite to manganotantalite with Mn/(Mn+Fe) = 0.16-0.67 and Ta/(Ta+Nb) = 0.09-0.81, rarely ferrotapiolite, fersmite, microlite, uranmicrolite and pyrochlore.

(3) The most peculiar group is the Nb,Ta,(Ti, U, Sb, Pb)-mineralization in pegmatites of the Prašivá I>S-type biotite granodiorite-granite at Sopotnica Valley, Dúbrava mine and Veľká Chochuľa Hill, the Nízke Tatry Mts. Relatively poorly fractionated alkali feldspar-quartz-muscovite or biotite pegmatites, locally with beryl and uraninite, contain Ti-rich ferrocolumbite, titanian ixiolite and Nb,Ta-rich rutile (≤23 wt.% Nb_2O_5, ≤30 wt.% Ta_2O_5), locally with Nb,Ta-rich armalcolite + ilmenite exsolution lamellae. An external Sb,Pb-bearing hydrothermal overprint of these primary Nb,Ta,Ti-oxides originated a secondary mineralization with niobian-tantalian titanite, fersmite, stibiotantalite and a variety of pyrochlore-group minerals: microlite, pyrochlore, betafite, uranpyrochlore, uranmicrolite, stiboan-uranoan pyrochlore to microlite, stibiomicrolite, stibiobetafite and plumbomicrolite. Unusual Nb,Ta,U-rich romeite (≤9.5 wt.% Nb_2O_5, ≤4.2 wt.% Ta_2O_5, ≤8.3 wt.% UO_2) is the youngest cavity-filling mineral.

CHARACTERISTICS OF MALM-VALANGINIAN AQUIFER IN THE TRANSITIONAL ZONE (PLATFORM-PERIPLATFORM) FROM THE CENTRAL PARTS OF NORTHERN BULGARIA

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The main aquifer in Central North Bulgaria is the Upper Jurassic-Lower Cretaceous one and it is widely spread. The following main lithostratigraphic units are included in it: Pleven, Kaspichan and Salash Formations. The thickness of this aquifer reaches up to 1,500 m to the north of Beglezh. North-northwestward it decreases and near Lovetch it is only 237 m. This fact is due to the transition from carbonate to flysch facies. The aquifer sinks to southwest. The maximum depth of the aquifer is 3,000 m, near Cherven Bryag. The faults do not interrupt the continuity of the aquifer.

The reservoir properties of this aquifer are predetermined by karstification, fracturing and by primary porosity to an inconsiderable degree. According to the transmission coefficient the aquifer is characterized as abundant. Its transmissibility varies from 490 to 1,568 sq. m per day. The waters of the aquifer are pressure. Generally, the static water levels are beneath the surface. Near Pleven, Slavyanovo, Krushovitza and Alexandrovo the static water levels are established at the greatest depths - 105-121 m. The rest of the studied region is characterized by water levels at 20-60 m depth.

The waters of Upper Jurassic-Lower Cretaceous aquifer are thermal also. Their temperatures increase in NE-SW direction from 42° to 103°C. It is due to the sinking of the aquifer.

The water salinity ranges from 10 to 15 g/l. The waters are formed under the conditions of recent refreshment connected with the increasing of metamorphization. The specific microcompounds are indices for a medium hydrogeochemical assessment. The water-soluble organic compounds and gases are analogous indices but in some places they are favorable for oil accumulations mainly and rarely for gas accumulations (e.g. Devetaki, Gorsko Slivovo).

The Upper Jurassic-Lower Cretaceous aquifer furthers the preservation of hydrocarbon accumulations. It is very prospective for the utilization of its geothermal energy, too.

Lithospheric mantle beneath Bulgaria: evidence from ultramafic xenoliths in the Oligo-Miocene alkali basalts.

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The Oligo-Miocene alkali basalt volcanism in Bulgaria outcrops in a ≈250km long N-S alignment which cuts four tectonic units from North to South: Moesian Platform, Srednogorie, Balkan Zone and Rhodope Massif. Basaltic occurrences are mainly found as small monogenetic volcanic centers (Moesian platform), subvolcanic bodies (Srednogorie and Balkan Zone) and dyke swarms (Rhodope Massif).

The alkaline volcanic products host a large, although small in size (up to 10cm), variety of ultramafic rocks and megacrysts: spinel lherzolites, harzburgites, clino- and orthopyroxenites, dunites, wehrlites, websterites and clino- and orthopyroxene and amphibole megacrysts which indicates a relatively fast speed of the uprising magmas from the asthenospheric through the lithospheric mantle. Group I xenoliths prevails in the Moesian platform basalts whereas group II predominates in the Rhodope Massif basalts.

Textural features of the ultramafic xenoliths are prevalently protogranular to porphyroclastic although rare equigranular and secondary textured xenoliths occur. Rare grains of interstitial amphibole and phlogopite are present. The latter have been found in refractory xenoliths such as dunites.

Geothermometric and geobarometric calculations indicate equilibrium temperatures and pressures of 850°-1050°C and 13-17kb, the highest temparatures being related with the undeformed xenoliths.

Bulk-rock analyses of the northern Bulgaria xenoliths display typical contents of depleted mantle rocks with major and trace element trends possibly related to the extraction of mafic melts at different degree of partial melting. Sr and Nd isotopic ratios for the Moesian Platform xenolith suite range betwœn 0.70297 to 0.70330 and 0.512827 to 0.513199, respectively, and fall in the Depleted Mantle Field although they are more enriched than other texturally and chemically similar East European xenolith suites.

HFSE and REE chondritic-normalised spiderrams for selected clinopyroxenes from representative Bulgarian xenoliths show typical Ti and Zr troughs while La-Ce turn-ups for the most refractory rocks and LREE enrichments for some more fertile-textured spinel peridotites occur. Thus, cryptic metasomatism is the only witness of possible action (Iinfluence) of metasomatic processes. No evidence of subduction-related components were found and most probably the cryptic metasomatism is rather related to the passage of asthenospheric melts or fluids related to the alkaline magmatism.

MESOZOIC FORMATIONS OF THE EASTERN SERBIA DANUBICUM

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In the Danubicum (Poreč - Stara Planina terrain) the Mesozoic is represented with continual development of Jurassic and Lower Cretaceous, which lie discordantly over Pre-Cambrium and Paleozoic.

Using the tools of formation analysis Mesozoic of Danubicum is distiungished into three formations: **SILICICLASTICS AND LIMESTONE OF *PESAČA*, *BOLJETIN* LIMESTONE, AND *NOVOKORITSKI* LIMESTONE AND MARLSTONE (Fig. 1.).**

Siliciclastics and limestone of Pesača stratigraphically correspond to Lias and Lower Dogger. Within them, there are 5 members: 1. transgressive clastics; 2. sediments of barrier-lagoon complex; 3. transgressive sandstones and shallow-water limestones; 4. prograding coast clastics and shallow-water limestones; 5. shelf sandstones and limestones. According to the facies characteristics the formation Siliciclastics and limestone of Pesača has clastic-carbonaceous character with the tendency of decreasing clastic content upward through the column. Genetically, the formation was formed in the transitional and shallow-water marine environment and is associated with the Lias transgression.

Boljetin limestone stratigraphically belongs to Middle and Upper Dogger and Malmian. It consists of four members: 1. crionoidal limestones and Ammonitico rosso layer with hard ground; 2. red nodular limestones; 3. red thin-bedded limestones with cherts; 4. red nodular limestones with cherts. The formation is deep-water marine and is connected to the eastern margin of the Danube trough, i.e. to the narrow deep basin with swells which basically enabled the specific condense sedimentation. Two upper members of the formation contain siliceous sediments - concretional and bedded cherts, radiolarites and beds and thick layers of calcarenites and calcrudites made of material brought from shelf into the basin.

Novokoritski limestone and marlstone formation stratigraphically correspond to Lower Cretaceous. It consists of two members: limestones and clayey limestones with black cherts (Berriasian - Lower Hauterivian); 2. clayey limestones, marls and clayey sandstones (Upper Hauterivian - Albian). Deep-water sedimentation of red bedded and nodular limestones and siliceous sediments of Middle and Upper Jurassic is continued in the Lower Cretaceous, but with tendency of shallowing and change of geochemical regime which, at that time increased the deposition of gray limestones and clayey limestones with black cherts. The second member is characterised with gradual decreasing of carbonaceous content and increasing of pelitic to sandy component. Hence, the dominating lythotype in this member is marlstone.

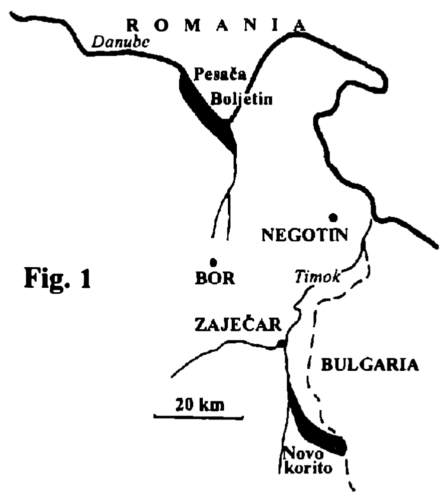

Fig. 1

NEW DATA ON THE OCCURRENCES OF THE LOWER CRETACEOUS AMMONITES (BERRIASIAN-HAUTERIVIAN) IN THE NORTHERN CALCAREOUS ALPS (AUSTRIA)

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In 1995-1997 I in co-operation with Prof. P. Faupl (University of Vienna, Geozentrum) devoted time to field biostratigraphic research of Lower Cretaceous sequences of strata east and west of the Weyerer Arc Structure (Bajuvarian Nappe Complex). Studied deposits provided rich ammonite assemblages that had not been, with some exceptions, known in the given area before.

In the vicinity of Grossraming, localities belonging both the Rossfeld Formation and the Schrambach Formation (Reichraming Nappe) were observed. Some results achieved have been already published (Vašíček & Faupl 1996, 1998) or are in the press. The ammonite assemblages from the Rossfeld Formation document the Upper Valanginian (about 20 species), those from the Schrambach Formation prove partly the Lower, but especially the Upper Valanginian to almost all the Hauterivian (about 30 species).

In the Lower Cretaceous outcrops situated on the Oisberg hill by Hollenstein a.d. Ybbs in the Schrambach Formation (Lunz Nappe), ammonites from the Upper Berriasian and the Lower Valanginian were found. As it follows from the present stage of processing, about 12 species of ammmonites can be seen here.

The ammonite assemblages represent merely the Mediterranean faunal province, including some zone species. They specify significantly the stratigraphic data hitherto known, or they supplement paleogeoraphic opinions and ideas of processes taking place in the sedimentary space in question. The composition of the ammonite association is influenced strongly by depth conditions and sedimentary factors as confirmed by ammonite assemblages from the Rossfeld Formation of the same age that represent the synorogenetic clastic succession and from the Schrambach Formation represented by light pelagic limestones.

Vašíček Z. & Faupl P. (1996): Die Cephalopoden aus den Ressfeldschichten der Reichraminger Decke (Obervalanginium; oberösterreichische Kalkalpen). - Jb. Geol. B. - A., 139, 101 - 125. Wien.
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Origin of the Danube Basin - heterogeneous lithosphere stretching

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The Danube Basin is one of the Pannonian basin system. The basin western margin is bordered by Malé Karpaty Mts. and by hills of Burgenland, the northern margin by Povazský Inovec Mts. and Tribec Mts., the eastern margin by Bakony Mts, Gerecse Mts, Pilis Mts, Štiavnicke vrchy, Mts. and Pohronský Inovec Mts. The valley of river Danube between towns Bratislava and Esztergom divides basin into the northern and southern part. The Northern Danube Basin (NDB) is an extensional thermal basin generated in consequence of the heterogeneous lithosphere stretching. It is proved by basin structure determined by:

- assymmetry in basin burial: the thickest syn-rift deposits are situated in its outer zone, meanwhile the thick sequences of post-rift deposits are in its inner zone,
  contrast in the thickness of both the syn- and post-rift deposits,
  contrast in subsidence rate of both the syn- and post-rift stages of the basin burial
  history,
- diference in the density and throw of normal faults active during the syn-rift stage in both outer and inner basin zones.

The geophysical data claim, that the lithosphere beneath the Danube Basin is attenuated. The lithosphere was termally thinned in the Late Oligocene, Early and Middle Miocenne by rise of the astenosphere. At the beginning of the asthenosphere upwelling the upper crust in the area of the Danube Basin as well as the whole Pannonian realm was rised above the sea level and eroded. In the basin history it can be classified as the stage of prerifting. Later on, at the beginning of the Middle Miocene the pre-rifting stage was relieved by the syn-rifting stage. In the NDB this stage was promoted by a strong volcanic activity. The lithosphere discharged a huge volume of andesite magmas, continued in rising, giving way to the mechanism of the heterogeneous lithosphere stretching. In the basin inner zone, where the volcanoes were distributed and the lower lithosphere was stretched, crust persisted above sea level and the syn-rift sedimentation was restricted as well as the faulting. Meanwhile in the basin outer zone the upper crust stretched and normal faults took control above the huge syn-rift sedimentation. After the cessation of the asthenosphere rise the volcanic activity died out and the attenuated lithosphere/asthenosphere system of the basin inner zone began to cool. The thinned lithosphere, after emptying out of magmatic chambres trying to achieve a new isostatic equilibrium, underwent a collapse. It gave way to the huge post-rift sedimentation in the basin inner zone.

The NDB is a particular case of the basin, originated by heterogeneous lithosphere stretching, where the thermal lithosphere stretching was multiplied by the volcanic activity.

SEQUENCE STRATIGRAPHY OF THE MIDDLE EOCENE-PLIOCENE TROUGH BASINS OF THE RHODOPE MASSIF

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The late Middle Eocene (1-1,5 km), Late Eocene (1,2-2 km), Oligocene-early Early Miocene (1-1,5 km), late Early Miocene-Pleistocene (1-1,5 km) supersequences and depositional sequences of the basins of the Rhodope Massif are an example of a mixed terrestrial-water-basin, transgressive-regressive sequences. Two middle supersequences contain and volcanic rock associations. The supersequences are second order regional depositional cycles and provide a record of depositional system, environmental and structural evolution. They are presented in trough basins, which have specific orientation and development in area and during the time. Their basal boundary is a regional unconformity. The supersequences are consisted of depositional sequences (300-800 m) which basal boundaries are an erosion unconformity. The depositional sequences are trough terrestrial-water-basin (lacustrine, gulf-lagoon, marine), transgressive-regressive. The marine basins were developed first in peripheral parts of massif and later had bigger areas. The base of the transgressive systems tract (TST) of depositional sequences is presented by syntectonic red and light-colored fluvial (proluvial) and alluvial breccia-conglomerate, conglomerate, sandstone and sandy shale. The upper part of TST is inundational-transgressive complex (unit) by coal-bearing band and water-basin sandstone, clayey sandstone and siltstone, sandy shale, bituminous shale, biogenic limestone. Maximum flooding surfaces (MFS) are thin units of bituminous and lime shale, clayey limestone as well as diatomite. The highstand systems tract (HST) is a sanding-upward complex of sandy shale, clayey sandstone, sandstone and pebble conglomerate, fluvial and alluvial by genesis.

The late Middle Eocene supersequence contains two depositional sequences in which upper parts dominate or typically are presented relatively deeper water facies, and many of the shallow-water facies form mosaics. The TST of the Late Eocene supersequence occurs two asymmetrical depositional sequences, which lower fluvial-alluvial units dominate. The third sequence is describe by more typical development of the transgressive parasequence sets and deeper water facies and biogenic limestone, but contains and volcanic rocks. The Oligocene-early Early Miocene supersequence is symmetric transgressive-regressive and consists two asymmetrical and one symmetrical depositional sequence. These sequences did not well develop in view of intensive volcanic activity and development of volcanic depression. Three depositional sequences occur in the late Early Miocene-Pleistocene supersequence. The first two - late Early-Middle Miocene and Late Miocene-Early Pliocene - sequences are transgressive-regressive, but third - Late Pliocene-Pleistocene - is cut. It marks the episode of inversion of the trough basins and uplift of the neighbour blocs and horsts in high mountains. That supersequence has more small area of development and does not contain volcanic rocks. It is formed in new trough basins, which are developed by the side of the Oligocene volcanic depression and plutonic zones. Later after downward of the temperature of the rocks, the Late Miocene basins and depositional sequences are developed and in their peripheral parts. The lithostatic pressure of sediments was developed during late transgressive episodes when the adjacent areas were subsided as well.

The episodes of development of the water basins were corelated to third order cycles of uplift of the level of World Ocean. The analysis of sequence stratigraphy of the Eocene-Pliocene trough basins of the Rhodope Massif has demonstrated the importance of not interpreting sequences only for eustasy or of basin tectonics. The complex analyze of the sequence stratigraphy and subsidence history shows that some sequence boundaries can be related to one mechanism, others to the other mechanism or to combination of both.

NEW HEAT FLOW DATA IN THE TRANSYLVANIAN BASIN AND SOME GEOTECTONIC IMPLICATIONS

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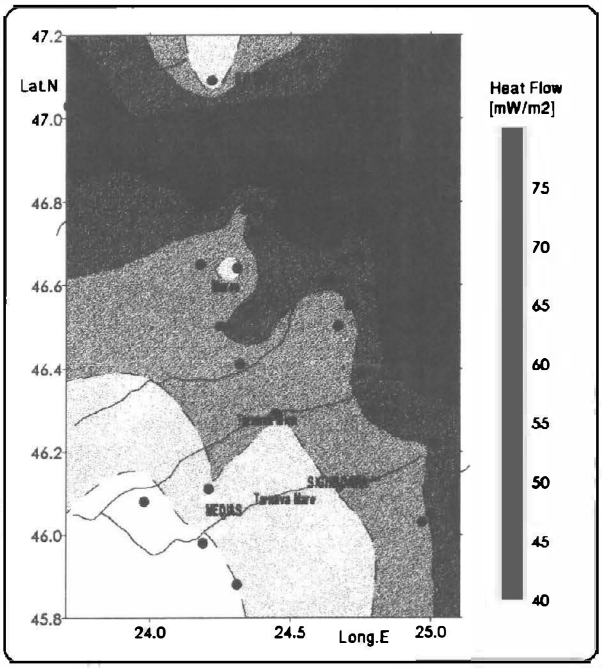
New heat flow data obtained from 55 deep wells are added to the previous 6 values reported for the Transylvanian Basin and incorporated into the Heat Flow Map of Europe (edition 1979 and 1993 respectively). The compiled contour map exhibits a more complex pattern of the heat flow geographic distribution within this major sedimentary basin of the south-eastern Europe. Two sectors could be separated on this map:

(1) A northern sector located between Somes and Mureş Valleys, characterised by higher values (60-70 mWm^{-2}) as compared with the mean heat flow calculated for the whole basin (approximately 55 mWm^{-2}). Maximum heat flow values (> 60 mWm^{-2}) are situated on a 10 to 30 km wide strip striking into the E-W direction. North and southward of this strip two minimums (< 55 mWm^{-2}) are located on areas where Middle Miocene-Pliocene sediments thicken out producing a "blanket effect". Temperature gradient for a depth interval of 3-5 km has been calculated from heat flow data by means of a computer-aided program, tacking into consideration the heat conductivity of the rocks encountered at these depths. Temperature gradient values range from 15 to 28 mKm^{-1} depending on location and rock type.

(2) Heat flow values determined in the area between Mureş and Tarnava Mare Valley range from less than 45 mWm^{-2} in the south-western part to more than 70 mWm^{-2} in the north-eastern part (nearby the Neogene-Quaternary volcanic zone of the Eastern Carpathians). Temperature gradient calculated for the depth interval of 3-5 km varies from 13-17 mKm^{-1} in the south-western half of this sector to 30-45 mKm^{-1} in the north-eastern part.



Heat Flow Map of the Transylvanian Basin
(points represent location of investigated wells for new data acquisition)

Heat flow distribution pattern seems to be sensible to the structural evolution of the Transylvanian Basin, from Upper Cretaceous to Pliocene. So, Upper Cretaceous sediments were mainly deposited along roughly N-S trending grabens and were subsequently folded before the end of the Paleocene. N-S tension and extension took place in the Oligocene and important thrusts are associated with this phase in north-western and south-eastern parts of the basin. Late Miocene E-W extension affected vast areas and caused some important normal faulting in the south-east.

Rifting process in the Middle-Upper Triassic in the Bükk Mts. (NE Hungary)

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Due to my study of Middle-Upper Triassic rocks in the Bükk Mts. (NE Hungary), we can reconstruct different stages of a rifting process.

The pre-rift stage is characterised by normal marine Anisian dolomite and limestone. The rifting begins with an emergence in the Lower Anisian. We can distinguish two rising events: a smaller one in the Lower Anisian, and a bigger one in the Illyrian. The first can be correlated with the Piz de Peres or with the Voltago Conglomerate, the second with the Richthofen Conglomerate in the Dolomites. The emergence is characterised by lake marls (borehole: Felsőtárkány-7) and fluviatile conglomerates and breccas (Sebesvízvölgy, borehole: Miskolc-10). The rising is followed by the first volcanic event at the Anisian/Ladinian boundary interval.

In the Ladinian, the area subsided first very rapidly: some hundred meters during a few million year. Later, in the post-rift stage, in the Upper Ladinian, Lower Carnian, the subsidence slowed down. I could prove this tendency of the subsidence in two sections (boreholes: Felsőtárkány-7, Sebesvízvölgy). In the Ladinian-Carnian, the coeval platform-basin evolution can be reconstructed. On the platforms, Wetterstein and Dachstein reefs flourish, and lagunal sediments can be found. Between the platforms, intraplatform basins exist, some of which were restricted in the Ladinian. Chemical character of the second volcanic event of the Upper Ladinian is similar to that of the volcanic of extension areas.

The evolution of the platforms kept pace with the subsidence of the basement for a while, but later the platforms (or parts of the platforms) were drowned. So, the platform carbonates are followed by deep marine cherty limestone.

The Middle-Upper Triassic evolution of the Bükk Mts. can be correlated very well with that of other rifting areas, connected with it in the Triassic. According to my investigation, the Bükk Mts. was the updoming part of a rising area, while the Aggtelek Mts. was at the opposite (break away) side of the ocean. Pieces of the Middle-Upper Triassic ocean (Neo-Tethys) are the ophiolites of Bódva Valley and the ophiolites of Darnó Hill. The evolution of this three parts of a rifting ocean can be correlated very well. The Anisian Steinalm Limestone is present in all the three units. After the sedimentation of the Steinalm Limestone, the Bükk Mts. arises, the Aggtelek Mts. and the Bódva Unit subside. In the oceanic unit (Bódva Valley, Darnó Hill), the oceanic crust appears in the Middle Ladinian.

The updoming part (Bükk Mts.) is characterised by bimodal volcanic activity and by continental sediments, which are missing at the opposite side of the rifting ocean. Due to gradual thinning of the continental crust, the extension of the platforms decrease, while the basins conquer bigger and bigger areas.

REDEPOSITED OPHIOLITIC MATERIAL IN LOWER CRETACEOUS PELITIC ROCKS OF GERECSE MTS., HUNGARY

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The Lower Cretaceous clastic sequence at *Bersek hill*, Gerecse Mts., N. Transdanubia (Fig. 1), is composed of various products of sediment gravity flows (turbidites, debris flow deposits and slumps) formed in deep marine depositional environment (Árgyelán et al. 1997). In the Bersek Marl Formation muddy and silty sediments predominate over sands. The overlying Lábatlan Formation is composed of sandstone with intercalated marly layers. Coarse-grained clastic rocks occur at the outcrop *Köszörûkõ-bánya*, which are interpreted as sediments deposited in a submarine channel of a deep-sea fan (Sztanó 1990a,b). According to the previous petrographic studies carried out in the *Bersek hill* section and at *Köszörûkõ-bánya* (B. Árgyelán 1995) in the sandstone layers of both Bersek and Lábatlan Formations basic volcanic rock components predominate.

The mineralogical composition of the clay fraction of marly rocks was determined by X-ray diffraction (Viczián & Kovács-Pálffy 1998). The most abundant clay minerals are *non-ideal, corrensite-like regular interstratifications* of chlorite, vermiculite and smectite layers. Their d(001) spacing is about 29 Å in untreated specimens. On treatment with ethylene glycol the 001 basal reflection moves toward 31 Å. Also the higher order basal reflections 002, 004, 006 and 008 reflections shift towards higher *d*-values. The proportion of the expandable (=smectitic) component in the regular mixed-layer phase was determined considering the shift of the 001 and 002 basal reflections in the ethylene glycol treated specimens (Thorez 1976). Generally 1/3 of the components proved to be expandable (S=30-40 %) in the Lábatlan Sandstone Fm. In the underlying Bersek Marl Fm. the regularly mixed-layer phase is less expandable (S=10-20 %). A similar material was described as *"corrensite with limited expandability"* by Lippmann & Rothfuss (1980, Abb. 7). In some cases, in the Bersek Marl Formation, the 002 basal reflection of corrensite does not collapse upon heating, it only moves to about 13.8 Å and its intensity does not decrease. It may be interpreted as *mixed-layer corrensite/chlorite*. For similar non-ideal alteration products of ophiolite rocks in the Northern Appenines, Italy, the less strict term *'corrensite-like minerals'* was used by Brigatti and Poppi (1984).

The corrensite-like phase and hematite are interpreted as alteration products of basic volcanic rocks. The decrease of the basic-ultrabasic volcanogenic components in the sandy grains of the Lábatlan Fm. (B. Árgyelán 1995) cannot be observed in the composition of the neighbouring marly rocks. The reason may be that in pelagic conditions the distribution of suspended material is more uniform than that of the coarser-grained sediments transported by various gravity flow processes. Illite, illite/smectite, kaolinite and probably a part of chlorite can be of terrigeneous clastic origin.

The proportion of the smectite component of *mixed-layer illite/smectites* is S<~30 %, mostly <~20 %, as determined by the shift of the basal reflections upon ethylene glycol treatment indicating medium strong diagenesis. Similarly, regular corrensite-like phases indicate medium strong diagenetic transformation of basic igneous source material corresponding to a burial temperature of slightly above 100 °C.

Analogous occurrences in volcanogenic sedimentary formations of the Alp-Carpathian-Dinaric area: The Lower Oligocene Taveyannaz Sandstone in the Helvetic nappes of the Western Alps (Lippmann & Rothfuss 1980). The Senonian "Bor pelites" occurring around the copper deposit of Bor, Eastern Serbia (Obradović & Pavlović 1975, Lippmann & Rothfuss 1980). Greywackes derived from ophiolitic material in the Upper Oligocene flysch of Levočské vrchy Mts., Slovakia (Biroň et al. 1996).

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METALLOGENY OF THE GOLD QUADRILATER (SOUTH APUSENI MOUNTAINS, ROMANIA)

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The Romanian territory contains numerous ore deposits known and mined since Roman times. Such an area of economic importance is the famous "Gold Quadrilater" of the South Apuseni Mountains. Its metallic ressouces,i.e. Au, Ag,Pb,Zn and Cu, have been intensively extracted, especially high-grade ores of world-class deposits such as Barza and Rosia Montana.Various metallic minerals have been described as "locus tipicus" occurrences in this ore region.

The geological setting of the "Gold Quadrilater" is represented by Tertiary calc-alkaline volcano-plutonic complexes of intermediate character (14.7±1.7 Ma to 7.4±o.4 Ma) in sedimentary basins of molasse type controlled by NW-SE lineation across early Alpine magmatic products, i.e. subduction-related Jurassic-Lower Cretaceous igneous associations (island arc ophiolites and granitoide) and Upper Cretaceous-Paleocene igneous associations(Banatites).The Tertiary magmatism is associated with extensional tectonics caused by NE escape of the Pannonian region during Upper Oligocene-Lower Miocene times. The magmatism was determined by the melting of thinned and metasomatised continental margin of the Pre-Apulian craton in back-arc rift position with respect to the subduction-related volcanic arc of the East Carpathians.

From metallogenetic point of view the upper part of Tertiary volcano-plutonic complexes represent a preferential site of precious metals ± base metals epithermal systems and Cu± Mo, Au porphyry systems. As a result of tectono-magmatic and mineralization-alteration characteristics, the following petro-metallogenetic districts have been delineated in the "Gold Quadrilater": Brad -Sacaramb, Zlatna – Stanija, Rosia Montana-Bucium and Baia de Aries.

The Brad- Sacaramb district is the most important and contains two types of environment:
- non-porphyry environment of epithermal-low sulfidation character represented by Pb-Zn and Au-Ag-Te veins and stockworks at Sacaramb and Hondol-Baiaga and major Au-Ag veins at Barza;
-porphyry environment with epithermal-low sulfidation vein halo at Bolcana, Musariu, Voia, Valea Morii and Rovina (Cu-Au porphyry and Au-Ag,Pb-Zn veins).

The Zlatna-Stanija district is similar with Au-Ag-Te-Pb-Zn veins at Hanes,Larga,Fata Baii and Cu-Au porphyries with associated Au-Ag,Pb-Zn veins and stockworks at Muncaceasca-Stanija.

The Rosia Montana-Bucium district is more elaborate in term of porphyry-epithermal relation: mineralization at Rosia Montana is a composite (breccia pipe+ vein) epithermal –low sulfidation sistem whereas the porphyry environment is represented by Rosia Poieni high-sulfidation epithermal-porphyry Cu-Mo assemblage and Bucium-Tarnita low sulfidation epithermal-porphyry Cu-Au association.

The Baia de Aries district is definitely non-porphyry environment with Au-Ag in breccia pipe and adjacent Pb-Zn replacement ores in marbles.

MIDDLE TRIASSIC AMMONOIDS AND STRATIGRAPHY OF THE BALATON HIGHLAND HUNGARY

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GEOLOGICAL - GEOPHYSICAL CRITERIA OF INDIVIDUALIZATION OF THE ORE-BEARING OBJECTS OF DIFFERENT RANGE

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Ore province, ore area, ore field, ore body - arc the ore-bearing objects of different range. Systems analysis of the geological objects ierarchy makcs possible to detennine their geological-geophysical position. We carried it out on the examples of the Eastern Transbaikalian and the Carpathian regions. In the latter we singled out Carpathian ore provincc, in it - ore areas, for example Beregove, Vyshkove and so on. In their turn the ore areas contain ore fields. So Beregove ore area consists of Beregove, Began, Kvasove ore fields, which are connected with geological-structural blocks of lower ranges. Elementary blocks contain ore bodies. Their whole complexes form the geological-structural elements of higher orders.

Geophysical methods give the information as to disjunctive dislocations, which limit the geological-structural clements of different sizes. It is more difficult to obtain the data about their spatial location. The easiest way to do it is when the disjunctive dislocations are filled with dikes with the noticable magnetization.

Ore fields form very often the areal anomalies of induced polarization and of self potential field. Rather often they are characterized by high meanings of summary information - complex gcophysical parameter.

The most important problem is the ore bodies mapping. It can be successfully done at relatively not deep bedding and at using the special modifications of the method of induced polarization and high-precise magnetic survey with a dctailed step of observation.

The most significant geological criteria of dividing the ierarchial order of geological-structural elements are "the areals of magmatism" - the structurally stipulated spatial associations of magmatic rocks, change of thicknesses and lithofacies of sedimentary rocks, and also the breaks, which divide the structural blocks.

RIFT-RELATED VOLCANICS IN THE PERMIAN OF THE WESTERN CARPATHIANS

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Abstract

In the current interpretation of the geological structure of the Western Carpathians the Late Paleozoic is preserved in a mosaic of blocks developed through Alpine-type tectonics As part of the defined tectonic units of the Central and Inner Carpathians Alpine nappe units were influenced by post-Alpine Tertiary faulting. The degree of preservation of Late Paleozoic sequences was conditioned by development in original sedimentation basins (areal extent, thickness, lithostratigraphic extent and content); their fate in the Alpine orogenic cycle was determined by Cenozoic uncovering during an extensional regime.

The products of Permian volcanism in the tectonic units of the Western Carpathians are variously represented, depending on the tectogenetic character of original sedimentation basins and the intensity and geotectonic nature of volcanic activity. The development of Permian basins, the filling of which has preserved fragmentally as part of the defined Alpine units of the Western Carpathians, represents a post-collisional stage of the Variscan Orogen. This stage is characterized by a transtensional/transpressional and extensional (to rifting) regime. Permian volcanics document and complete the picture of geotectonic development of the Upper Paleozoic in the Western Carpathians.

Rift-related volcanism in the Late Paleozoic of the Western Carpathians was active between the Upper Stephanian and Upper Permian epochs. The volcanic rocks indicate post-collision stage of the Variscan orogeny, related to the formation of basins on the continental crust. An extensional to rifting regime with acid to intermediate calc-alkaline volcanism is a characteristic feature of the Tatra terrain. Its presence is indicated by volcanic rocks in the Tatricum, Northern and Southern Veporicum. We rank into this group also the limnofluvial basin with calc-alkaline volcanics founded on the Byšta terrain (Zemplinicum). The sequences that originated in the regional rift basin with continental tholeiites, which was founded on a hypothetical Ipoltica terrain, are preserved in the basal parts of a multinappe unit the Hronicum. A transpressional/transtensional to extensional regime was a characteristic feature of the basin founded on the substratum preserved in the Northern Gemeric Unit. Acid to intermediate volcanics with calc-alkaline magmatic affinity are predominate here. A characteristic feature of the Southern Gemeric Unit during the Permian time was an extensional continental basin with typical Verrucano facies in the basal part of the development. There is the only occurrence of typical Veruccano facies in the whole Western Carpathians. The volcanics are acid with calc-alkaline to transitional alkaline magmatic affinity. This zone is correlated with analogous developments of the South Alpine-Dinaride type.

PALEOZOIC SEDIMENTARY FORMATIONS OF THE WESTERN CARPATHIANS: SEDIMENTARY AND GEODYNAMIC EVOLUTION

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The Western Carpathians Paleozoic sedimentary formations can be classified in the terms of general criteria: the type of crust on which primary depositional basin rested, the position of this basin relative to plate margin as well as the type of plate interaction occurring during sedimentation. Most of the Early Paleozoic sedimentary formations have been strongly metamorphosed during Variscan orogenic events and without some exceptions lost their diagnostic sedimentary features. A relative good preservation of the sedimentary structures as well as the primary detrital modes in coarser clastic sediments is characteristic in the area of the Inner Western Carpathians (IWC). The IWC Early Paleozoic sedimentary formations originated in episutural basins located and contained in compressional regime. Basins can be divided to following categories: 1. forearc basin, floored by attenuated continental crust or fragment of oceanic crust and subduction complex. A filling of this basin is represented by huge flysch volcano-sedimentary formations; 2. backarc basin floored by oceanic and transitional crust and filled mostly by fine-grained, deep-marine sediments mixed with huge masses of basic volcanoclastic material. The Late Paleozoic Western Carpathians sedimentary formations reflect continuation of convergent tectonic regime associated with formation of Variscan compressional megasuture. They originated in the epi- and perisutural sedimentary basins located mostly along compressional suture on rigid litosphere, related to episutural megashear system or as graben and rift type extensional basins. A characteristic feature of a filling of these basins is gradual progradation of deep-marine and shallow-water to continental red-beds sediments in time and space (from the Lower Carboniferous to Upper Permian as well as from the IWC to Central Western Carpathians).

It has long been recognized that the detrital composition of clastic rocks is significantly related to the tectonic setting of their source area (Dickinson and Suczek 1979; Dickinson et al. 1983). A brief discussion on the tectonic control of mineral composition of Paleozoic Western Carpathian clastic sediments, mainly sandstones, is presented. The detrital mineral composition of Late Paleozoic sandstone associations proved two main tectonic settings of source areas: 1. continental block provenances; 2. collision orogen provenances. The Early Paleozoic forearc suite is characteristic mixed sources, with prevailing undissected magmatic arc provenance, associated with material derived from continental block and subduction complex.

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METAMORPHIC EVOLUTION OF THE TATRIC AND VEPORIC BASEMENT UNITS IN THE EASTERN SECTOR OF THE WESTERN CARPATHIANS

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The crystalline basement of the Alpine Tatric and Veporic Units originated by a composite process of gradual amalgamation of different terranes and lithotectonic units during Variscan and probably also during Pre-Variscan orogenic events. Their consolidation to rigid continental crust occurred at end of the Variscan orogenic cycle. The new epi-Variscan crust became a substratum of the Upper Carboniferous/Permian transpression/transtension sedimentary basins in the first stage and of extensional basins in the second stage. The basins were filled up with sedimentary or volcanic-sedimentary continental formations. The fragments of this crust were involved into the Alpine nappe structure together with their Carboniferous/Permian envelope. In the eastern sector of the Western Carpathians they are exposed in the Branisko Mts., Cierna Hora Mts. as well as in the Zemplínske vrchy Hills (Zemplinic Unit). All these basement fragments were covered by lithologically similar Mesozoic cover sequences which reflect the same tectonic setting during Alpine geodynamic development.

The main feature of the basement units is the presence of high-grade metamorphic rocks of different lithologies (gneisses, amphibolites and migmatites) which were affected by intensive magmatic activity. Representative mineral assemblages of high-grade assemblages are Gt+Bt+Kfs+Pl±Sil/Ky. Amphibolites are characterized by the presence of hornblende and plagioclase, but some amphibolites may contain also garnet. Geothermobarometric calculations indicated high-grade regional metamorphism with P-T conditions of high-temperature amphibolite facies. A relative broad range of temperatures and pressures (675-770°C, 630-870 MPa) was obtained for core compositions of garnet in gneisses. The retrograde P-T path is inferred by temperature and pressure decrease (590-650°C, 260-420 MPa) which was calculated for rim compositions of garnet and by retrograde net transfer reactions involving Sil, Bt, Qtz as well as by transformation of kyanite to sillimanite. Thermodynamic stabilization of the whole basement complex is indicated by appearance of muscovite after reaction Sil+Kfs=Mus+Qtz. Relatively higher pressures of 1000 MPa at 700°C and 800 MPa at 600°C were obtained for core and rim compositions of garnet, respectively in amphibolites. The character of garnet zonation that has mostly a flat diffusion profile of Ca from core to rim suggest a P-T path with isothermal uplift followed by isobaric cooling. The decompression stage was associated with partial melting, migmatitization and granitoid magmatism.

In addition to high-grade metamorphic rocks, some low-grade gneisses with intercalation of graphitic varieties are also present in the basement units. They are represented by muscovite, biotite and rarely also by staurolite and have tectonic contact with high-grade rocks. Considering a geotherm similar to that for high-grade rocks, the mineral assemblage, mainly the presence of staurolite indicate metamorphic temperature and pressure of 600-650°C and 550-650 MPa for these relatively low-grade metamorphic rocks of the Tatric and Veporic Unit in the eastern part of the Western Carpathians. According to metamorphic conditions and lithology, the basement rocks of the Zemplinic Unit can be compared with that from the Tatric and Veporic Units of the Central West Carpathians.

THE VARISCAN TERRANE COLLAGE IN THE WESTERN CARPATHIAN DOMAIN

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The geodynamic interpretation of the Western Carpathian, pre-Alpine basement development bases on the new results of petrological-geochemical studies of the crystalline rock assemblages and on the lithostratigraphic-petrological research into the post-Variscan sequences. The fragments of Variscan basement and of its Late Paleozoic envelope, incorporated in the Alpine tectonic units, have a distinctly different character in the Central and Inner Western Carpathians. Their analysis has shown that the Variscan Orogeny was of a subductional-collisional type and that it paved the way to the Alpine Orogeny. The sequence of collisional events is recorded in the chronological and spatial development of the Late Variscan Basins. Two chronologically differing zones of the flysch sedimentation in the accretional prisms indicate a close-down of two collisional sutures - an Early Carboniferous one, composed of the Tournaisian-Visean flysch and a Late Carboniferous one, composed of the Bashkirian to Lower Moscovian flysch

THE INFLUENCE OF γ-RADIATION ON HYDROCARBON INCLUSIONS IN QUARTZ FROM NYZHNI VOROTA (UKRAINIAN CARPATHIANS)

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Fluid inclusions, influenced by natural radiation, change their chemical composition. Study of such transformations in the most effective when an artificial radiation is used.

The results of cryometric investigation of hydrocarbon inclusions in quartz crystals of "marmarosh diamonds" type from Ukrainian Carpathians before and after γ-radiation are compiled in the table. Dosage uses is $1 \cdot 10^{10}$ rad, the source is ^{60}Co.

Table. Temperatures of phase transitions in the primary fluid inclusions in quartz from Ukrainian Carpathians before and after γ-radiation.

N	Phase composition on 20°C, %	Th CH_4-rich solution, ± 0,2°C/Phase	Tm solid CO_2, ± 0,2°C,	Th, ±1°C, /Phase
		Before radiation		
1	$20L_1+80L_2$	-85,5/liquid	-	$+95/L_2$
2	$50L_1+50L_2$	-61,8/liquid	-	+62/L2
3*	$40L+60L_2$	-82,2/C.D.	-	-
		After radiation		
1	$20L_1+80G$	-82,0/gas	-	>+95G
2	$50L_1+50G$	-84,4/gas	-	>+95/?
3*	40L+60G	-95,7/gas	-	-

L- water solution; L_1 - liquid oil hydrocarbons; L_2- liquid methane solution; G - gas methane solution; C.D. - critical density methane solution. *- inclusion of heterogeneous capture.

After the irradiation the temperatures of homogenization of CH_4-enriched solution ($ThCH_4$) may eigther increase (inclusion 1) or decrease (inclusions 2,3).

The liquid phase of CH_4-enriched solution becomes gaseous (inclusions 1,2) whereas the gaseous ones does not change (inclusion 3). After the irradiation the temperatures of complete homogenization (Th) rises (inclusions 1,2) and homogenization scheme changes (inclusion 1).

Such the irradiation induced changes are caused by change of chemical composition of the inclusions. From the radiation-chemical experiment it follows that H_2, C_2H_4, C_2H_6, C_3H_6, C_3H_8, n- C_4H_{10}, i- C_4H_{10}, i- C_5H_{10} are formed due to radiolys of pure CH_4. The saturated liquid hydrocarbons having at least from 6 to 27 carbon atoms are synthesized when higher dosages of radiation are implyed. Therefore, it is reasonable to assume that after γ-radiation of the inclusions the quantity of heavier hydrocarbons increases and the quantity of methane as well as its density strongly decreases.

The quantity of methane in inclusion after irradiation indicates $ThCH_4$ and phase changes in CH_4-enriched solution. This may be illustrated by monocomponent system diagram. When irradiation dosage increases, $ThCH_4$ of liquid methane solutions increases up to the critical level then followed by further decrease. In gaseous inclusions the increase of the dosage will only lead to $ThCH_4$ decrease.

The ability of the hydrocarbon solution of inclusions to react on ionizing radiations may be used as dosameters in a wide range of dosages of radiation including very high ones. As faras we ave aware such method of dose estimation has not yet been used anywhere.

STRUCTURAL-TECTONIC EVOLUTION OF OIL-GAS STRUCTURES IN THE TERRITORY OF VOJVODINA AT THE SW PART OF PANNONIAN BASIN

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Oil deposits are predominantly located at uplifted parts of paleorelief of the Tertiary base, in the form of ridge. Reservoir rock is mainly formed either of decomposed area of the base or of Miocene sediments.

Tertiary base is made of Paleosoic schists and Mesozoic sediments. In the footwall of Paleozoic structures, a stable Tertiary formations development with corelating relation of shallower and deeper structures is existent. In the footwall of Mesozoic structures with hydrocarbon accumulation, Quaternary and Paludine sediments are of enlarged thickness, Upper Pontian sediments are of uniform thickness, while Lower Pontian and Paludine sediments are present with gradual increase of thickness to the structure edges.

The structures are followed by visible tectonic dislocation o regional character. During Tertiary, the fault was active with different intensity and character, influencing onto hydrocarbon accumulation. During period of depositing Panonian and Lower Pannonian sediments it was active with singenetic character. Period of depositing Quaternary and Panonian formations is characteristed by the footwall consolidation. Apex part of the structure with hydrocarbon accumulation is sinking gradually with the fault reactivating with opposite direction of the sediments movement. This causes a new hydrocarbon migration, particularly of gas component towards newly formed shallower structures, non-correlating with the deeper structure and the main deposit.

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URANIUM OCCURRENCES IN THE WESTERNMOST PART OF CARPATHIAN-BALKAN ARCH

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Investigation of uranium in western, marginal belt of Serbian part of Carpathian-Balkan arch, in last 10 years, are related to the uranium occurrences in Ridnaj-Krepoljin ore zone. They were mostly discovered by ground prospection while some were detected by gammaspectrometric airborne survey. Investigations of uranium occurrences started by phase of field identification, through phase of selection and preliminary checking into phase of detailed checking (radioactive anomalies). Methods of geological-radiometric prospection were applied, as well as trenching, geophysical investigations, exploration drilling and laboratory investigations.

The marginal part of Ridanj-Krepoljin ore zone with uranium occurrences is 10-15 km wide, extending from Danube on the north to Nisava on the south (Fig. 1.).

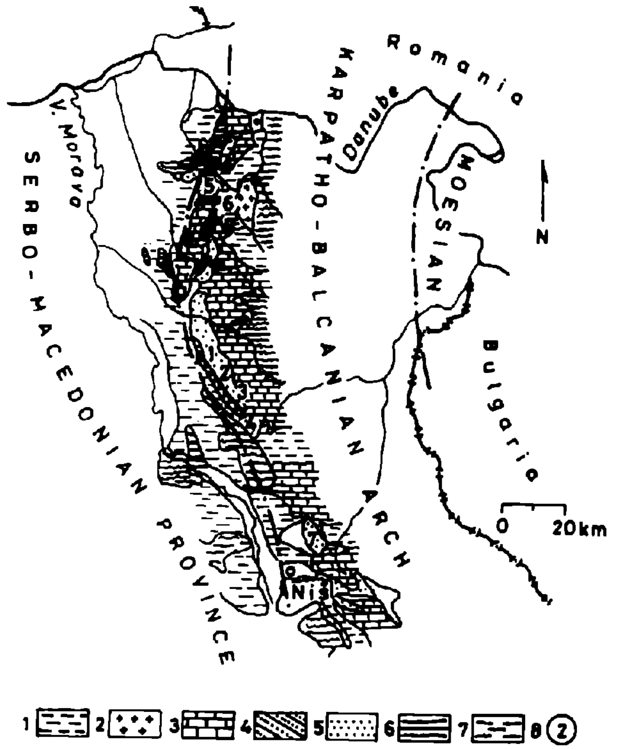

Fig. 1. Uranium occurrences in the westernmost part of Carpathian-Balkan arch
1.Tertiary clastics, 2. Older granitoids, 3. Cretaceous, Jurassic and Triassic limestones and dolomites, 4. Lower Triassic clastics, 5. Permian-Triassic terrigene sediments, 6. Older Palaeozoic to Riphean metamorphic rocks, 7. Proterozoic gneisses and mica schists, 8. Uranium occurrences.

Uranium occurrences are unevenly ivestigated, so that some are in the phase of prospection-investigation while others are in a phase of semi detailed investigations. Most of the works were performed in the middle part of the belt, on uranium occurrences 1, 2, 3 and 4. Uranium occureneces 1, 2 and 3 are connected with structural control origin while on occurrence 4 lithofacial factor had most influence. In this part of the belt deposits and ore bodies can be expected within them, of infiltrational (4) and possibly hydrothermal (1, 2 and 3) type. The following uranium minerals were established: pitchblende, powder pitchblende, cophinite and decloasite. Indicator elements are fluorite and barite. Alongside uranium there are Cu and Sb occurrences as ewll as Ag, B_2O_5, V, As, Pb and Zn which give basic metallogenic features of the investigated area. The most northern part of the belt yealds occurrences 5 and 6. They are connected with pre-Baikalian and Baikalian metamorphic rocks, and their origin is connected by structural control factor. On these no radioactive minerals nor indicator elements were established.

On the southern part of the belt there is uranium occurrence 7. It is basically of same geological-economic features as occurrence 4. This means that in this part also there could be expected deposits of same genetic type.

PARTIAL RESULTS OF SLOPE DEFORMATION MONITORING IN SLOVAKIA

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Slope deformations as the most serious geological hazards in Slovakia cover more than 3 % of its total territory Because of the very heterogeneous geological structure of the country, the distribution of slope deformations is very uneven (in some areas they disturb about 60 % of the total area). Therefore, the slope deformations are a serious phenomenon which must be taken into consideration in any people activities.

The information about the conditions of slope deformation activation can be obtained by long-term monitoring of the slope deformation development. Therefore the monitoring of landslides and other slope deformations has been included as an important part in the project entitled "Partial monitoring system of geological factors of the environment of Slovak Republic" which has been appointed to the Geological Survey of Slovak Republic at present.

Complex slope failure monitoring includes all basic types of slope deformations (sliding, creeping or falling at the rock cuts), distributed in all main geological structures. Besides, the selection of localities was based on their economic importance (including the evaluation of corrective measures effectivity in active slides).

The system of monitoring of various slope failures types is variable. The monitoring of the rock cuts stability is based on the methods of detailed documentation of the joint parameters, graphical methods of the slope stability analysis and methods of photogrammetry. A new simple apparatus, registering a small movements of rock blocks was developed, as well. Using these methods, four localities of rock cuts have been monitored since 1994. According to partial results of monitoring, the technical corrective measures had to be realized in one locality.

Slow creeping slope failures are monitored by crack gauges. These instruments (type TM-71) are situated on three localities on the border of Neogene Volcanites (Eastern Slovakia) and on one locality in Core Mountains (near a contact of tectonic nappes). Despite of short period of observation, the partial results of measurement in Neogene Volcanites indicate probable a gravitational-tectonic movement of the mountains.

The monitoring of landslides utilize a wide scale of methods - surface measurements of landslide activity (which include detailed mapping, measuring of movements of geodetic points and measuring of surface residual stresses), subsurface measurements in various depth of landslide body (inclinometric drill logging and various types of geophysical logging) and regime measurements and observation. Different level of monitoring is used in fifteen localities of landslides. The partial results of monitoring led to recommendation of supplemental corrective measures on two localities and confirmated correctivity and effectivity of corrective measures on seven landslide localities.

INTEGRATED NANNOFOSSIL, PLANKTONIC FORAMINIFERA AND AMMONITE STRATIGRAPHY OF SOME EUROPEAN KEY SECTIONS: SANTONIAN-CAMPANIAN AND CAMPANIAN-MAASTRICHTIAN BOUNDARIES

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Several sections in Austria, Hungary and northern Spain were investigated for an integration of nannofossil, planktonic foraminifera and ammonite zonations across the Santonian-Campanian and the Campanian-Maastrichtian boundaries. All these sections are situated along the northern margin of the Tethyan realm.
Although the proposed boundary criterion, the LO of *Marsupites testudinarius*, due to the lack of the species can not be applied in Austria, ammonite data allow a recognition of the S/C-boundary interval in the Gosau area. There, *Placenticeras* cf. *bidorsatum*, used as a lower Campanian marker succeeds Late Santonian ammonites such as *Boehmoceras* and *Placenticeras polyopsis*. Nannofossil data indicate, that the S/C-boundary lies within the Calculites obscurus zone (CC17) above the FO of curved *Lucianorhabdus cayeuxii* (subzone CC17b). *Broinsonia* (*Aspidolithus*) *parca*, defining the base of CC18, has its FO about 20 metres above the LOs of Santonian ammonites, at about the same level as the LO of the planktonic foraminifera genus *Dicarinella*. *Globotruncanita elevata* appears for the first time a few meters above this level. Correlation to magnetostratigraphy has been achieved within the Hungarian borehole Bakonyjákó 528, where the base of the reversed chron C33r was found within nannofossil subzone CC17b. Sections in northern Spain provide some additional data for the S/C-boundary. In the Sarasate section (Navarra) the FO of the ammonite *Scaphites hippocrepis* III, an Early Campanian index species, lies also within nannofossil subzone CC17b.
In northern Spain, the taken boundary marker for the base of the Maastrichtian, the FO of the ammonite *Pachydiscus neubergicus*, was found at Erro, succeeding a Late Campanian *Nostoceras* bed in the Nostoceras hyatti Zone. Both events are within nannofossil subzone CC23a, characterized by the presence of *Ceratholithoides aculeus*, *Broinsonia (A.) parca constricta* and *Quadrum (Uniplanarius) trifidum* and the absence of both *Reinhardtites anthophorus* and *Eiffellithus eximius*. Data from other Spanish sections (Imiscoz, Juandechaco I and Erice II) indicate that the FO of *P. neubergicus* can be correlated consistently to a level within subzone CC23a However, correlations to other European sections indicate considerable diachroneity in local first occurrences of *P. neubergicus*. Within its type locality near Neuberg (Austria), *P. neubergicus* appears in a transgressive series as late as CC25b, suggesting a Late Maastrichtian age. Occurrences of *P. neubergicus* within the Ukrainian Nagoryany area were correlated to nannofossil subzone CC23b. Compared to Tethyan planktonic foraminiferal zonations the LO of *Globotruncanita calcarata* is considerably older than the base of the Maastrichtian defined by *P. neubergicus*. As a consequence of the rather long range of *P. neubergicus* a calibration of local FOs of *P. neubergicus* against other fossil groups, e.g. calcareous nannoplankton, seems to be necessary.

THE NEW METALLOGENETIC MAP OF AUSTRIA

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The new *"Metallogenetic Map of Austria 1. 500 000 Including Industrial Minerals and Mineral Fuels"* has been compiled by the Committee for Mineral Deposits Research of the Austrian Mining Association (BVÖ, Bergmännischer Verband Österreichs) in close cooperation with the Austrian Academy of Sciences (WEBER, L. ed. 1997 a). The extremly complicated preparation of the map, which has been drawn digitally, has been carried out by the Geological Survey of Austria. An explanatory text ("Handbuch der Lagerstätten der Erze, Industrieminerale und Energierohstoffe Österreichs" WEBER, L. 1997 b) was also printed by the Geological Survey of Austria.

This metallogenetic map is the first of its kind in Austria. When the available maps proved to be insufficient it was inevitable to draw an up to date geologic-tectonic base map. Furthermore the numerous information concerning mineral deposits had to be checked carefully to build a reliable data base. For compiling this map the results both nationwide aeromagnetic survey and streamsediment geochemistry have been used.

Metallogenetic maps should emphasize connections between geology, tectonic and mineral deposits. Mineral deposits of similar metal content, similar genesis, which show a strong link to a particular geologic and or/tectonic unit, are defined as a metallogenetic district. As a matter of fact such maps may be of main interest for the mining industry as a decision basis for prospecting or exploration programs, for geoscientists to clarify various problems as well.

In the map the particular mineral deposits/occurrences are documented as followed:

- shape of deposit in symbols (without any genetic interpretation):
  stratiform/lenticular - veins/lodes - disseminated/stockwork - irregular.
- orientation:
  symbols of stratiform and vein deposits are arranged in the map in respect to the strike direction.
- mineral commodity:
  the deposits were classified in respect to their major contents and distributed to iron and steel alloying metals - base metals - special metals - precious metals - industrial minerals - mineral fuels.
- dimension:
  is only indicated as "major" (= actually or until last time mined) or "minor" deposits.
- minerogenetic districts:
  frequency of deposits/occurrences is an important additional information to define particular minerogentic districts. Therefore in contrast to other international metallogenetic maps it was attempted to include not only some important deposits in the map but also to define optically the about 150 minerogenetic districts by the frequency of their mineral occurrences. Contour lines were only drawn where it was required for a good readability of the map.
- position and name of deposits/occurrences:
  a list of the nearly 3000 mineral occurrences, tabulated alphabethically and by map sheets of the official maps (ÖK), allowing to identify the locations on the map is added in pocket together with the maps.

The preparation of a CD-Rom is the next stage in the documentation of Austrian mineral deposits/occurrences. This electronic information system should be available at the beginning of 1999. It will provide the metallogenetic map, the entire data base for approx. 3000 mineral deposits/occurrences which can be read back by mouse click, and 28.000 sample sites and values of 35 analyzed elements of Austrian streamsediment geochemistry.

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New data on the North-Tethyan Tithonian Nerineaceans
(the Ernstbrunn Limestone fauna, Austria)

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The nerineacean assemblage, described lately (Wieczorek, 1998) from the Ernstbrunn Limestone cropping out in the environs of Dörfles near Ernstbrunn (Waschberg Zone, Lower Austria), consists of: *Eunerinea hoheneggeri* (PETERS), *Eunerinea posthuma* (ZITTEL), *Euerinea* cf. *sculpta* (ETALLON), *Cryptoplocus* cf. *picteti* GEMMELLARO, *Cryptoplocus* sp., *Ptygmatis pseudobruntrutana* (GEMMELLARO), *Ptygmatis carpathica* (ZEUSCHNER), *Endoplocus staszycii* (ZEUSCHNER), *Endoplocus obtusiceps* (ZITTEL), *Phaneroptyxis rugifera* (ZITTEL), *Itieria globosa* FAVRE, *Aphanotaenia strigillata* (CREDNER), *Aptyxiella* (?) *rustica* FAVRE, and three species of *Diptyxis.*
Eunerinea hoheneggeri and *P pseudobruntrutana* occur most frequently. *Diptyxis* specimens are also not rare.
These species form a significant component of the diceras-coral- nerineacean assemblage which is typical for the shallow-water carbonate platform of the northern Tethys during the Tithonian time.
However, the nerineaceans from the Ernstbrunn Limestone show similarities not only to the nerineaceans from other localities situated along the European margin, but also to the nerineaceans from Vardar zone and the Adria margin (Table 1).

Table 1

EUROPEAN MARGIN								Vardar zone	ADRIA MARGIN		
Dörfles **Wieczorek,1998**	Stram-berg	Inwałd	Kruhel	Kelheim	Saleve	Herault	Wimmis		Plassen	Friuli	Sicily
Eunerinea hoheneggeri	+	+	+	+	+	+	+	+	+		+
Cryptoplocus cf. *picteti*											+
Diptyxis								+	+		
Ptygmatis pseudo-bruntrutana		+			+		+	+			
P. carpathica		+		+				+		+	+
Phaneroptyxis rugifera								+			
Endoplocus staszycii	+	+	+		+	+		+		+	+
Endoplocus obtusiceps			+					+			
Itieria globosa	+					+				+	
Aphanotaenia strigillata											

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DIFFERENCES IN WEATHERING OF THE CARPATHIAN FLYSCH SANDSTONES RELATED TO THE CONCENTRATION OF ATMOSPHERIC POLLUTION

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This study deals with weathering phenomena of the most frequent types of sandstones from the Polish part of the Flysch Carpathians. The processes of destruction of the rocks in the presence of the anthropogenic pollution of the atmosphere differs from the „natural" weathering. Different parts of the Beskidy Mountains (the northern part of the Beskid Makowski Mts., Beskid Niski Mts., Pogórze Dynowskie, Bieszczady Mts.) have been chosen due to differences in composition and concentration of dust and gases (SO_2, NO_x, CO, CO_2) in the atmosphere. Samples were collected from surface layers of natural outcrops and buildings in which sandstones of local origin had been used as building material.

The occurrence of variously shaped sandstone tors is a typical feature of the Carpathians mountain ridges and near ridges areas. Tors of the Carpathians flysch sandstones shaped by various weathering processes often form picturesque groupings termed „rock towns" e.g. Prządki near Krosno, Skamieniałe Miasto at Ciężkowice. Numerous isolated tors and their groupings are protected as natural reserves.

Sandstones represent a wide spectrum of petrographic types. There are fine- and medium-grained varieties, calcite-rich and calcite-poor. The content of clayey matrix also differs in different sandstones.

Because of the increasing concentration of atmospheric pollution in the Carpathians, an attempt was undertaken to recognize an influence of pollutants on weathering processes. Several features have been considered as indicators of the influence of air pollution on the rocks: occurrence of gypsum crusts on the surface of the rock or occurrence of dispersed single gypsum crystals, presence of numerous anthropogenic dusts on the surface, occurrence of the layer of amorphic or poorly crystalline aluminosilicates with relatively high concentration of sulphur, chlorine and phosphorus.

Gypsum crust, gypsum efflorescences, and anthropogenic dust particles (of industrial origin) on the surfaces of the Carpathian flysch sandstones are directly correlatable with a high concentration of atmospheric pollution. All the above mentioned features have been noted on the surfaces of sandstones from the highly polluted area of Kalwaria Zebrzydowska. Dispersed efflorescences, individual gypsum crystals, and dust particles occur in the Beskid Niski Mts. (e.g. Diabli Kamień Tor) where the level of pollution is relatively low. In the Bieszczady Mts. gypsum efflorescences on sandstones have not been found, and anthropogenic dusts have been noted only on some samples. Rock surfaces in the Bieszczady Mts. area are often covered by layers of microbiological origin.

Although the presence of atmospheric pollution is marked on the surfaces of the rocks (gypsum crust, gypsum efflorescences, anthropogenic dusts) the intensity and mechanism of natural weathering processes is not significantly changed.

Subsidence versus exhumation: Vertical movements in the Alpine-Carpathian-Pannonian region during the Late Cretaceous

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Vertical movements within orogenic belts with respect to a reference level (e.g. surface, sealevel) are documented by P-T-t and/or T-t paths, which give informations on the exhumation and cooling path of rocks as well as subsidence curves, which portray the evolution of sedimentary basins quantitatively. Contemporaneous exhumation of metamorphic domes and subsidence within adjacent basins is a characteristic feature, observed all over the Alpine-Carpathian mountain belt during the Late Cretaceous. Subsidence curves (own calculations and compiled from literature) and cooling age data (compiled) are presented from the Alpine-Carpathian-Pannonian region in order to document spatial and temporal variations of Late Cretaceous vertical movements.

The formation of synorogenic Late Cretaceous "Gosau" basins, all over the Alpine-Carpathian-Pannonian area, is a key feature for that time and gives hints for the operating subsurface processes and the geodynamic evolution of the whole mountain belt(s). The characteristic features of Gosau basins are: (1) Gosau sequences post-date Mid-Early Late Cretaceous thick-skinned thrust imbrications. (2) A combination of strike-slip and normal faults, typical for transtensional settings, plays an important role during initial basin formation. (3) The subsidence pattern commonly indicate a two step subsidence history with a moderate initial subsidence (Uppermost Turonian- Campanian) followed by a distinct subsidence pulse during the Campanian to Early Maastrichtian. (4) The sedimentary record displays an evolution from an alluvial to lacustrine/shallow marine to deep marine depositional environment. Accordingly, coarse-grained clastics, shallow water limestones, locally coal bearing marls, sandstones, turbiditic sequences and shales are observed. The major facies change from shallow to deep water is associated with the Campanian to Maastrichtian subsidence pulse.

Isotopic studies clearly show, that post-metamorphic exhumation and cooling of basement series occurs contemporaneous with basin subsidence and started first in the E-Carpathians and Apuseni Mountains during the Aptian to Albian, whereas younger cooling ages (ca. Cenomanian onward) are known from the Eastern Alps and Western Carpathians. Additionally, structural investigations revealed ductile to semi-ductile extensional structures, which are related to the tectonic unroofing of previously thickened crust. Rapid exhumation of metamorphic domes results in thermally and subsequently mechanically unstable conditions with large lateral and vertical gradients. Lithospheric strength is reduced in these thermally active regions and subsequent collapse of the mechanically very weak crust, which can not support large stresses provides a plausible trigger for Gosau basin formation in internal positions of the orogen.

FOLDED MIOCENE IN THE WESTERN PART OF THE POLISH CARPATHIANS - A NEW TECTONIC UNIT

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TECTONIC DEFORMATIONS OF THE QUATERNARY DEPOSITS IN POLISH CARPATHIANS

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CENTENARY OF VICTOR UHLIG'S MONOGRAPH ON THE GEOLOGY OF THE TATRA MOUNTAINS

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ABSTRACT

In the years 1897-98 Victor Uhlig, a Viennese geologist, published a monograph entitled "Die Geologie des Tatragebirges". (Vol.I: Stratigraphy, Vol.II: Tectonics). The attached geological map (in colours, scale 1:75.000) was partly based on data collected earlier by an other Viennese geologist, Guido Stache. The 2nd revised edition (1911) was one of the sheets of the Geological Atlas of Galicia.

The state of knowledge about the geology of the Tatra Mts was presented by V. Uhlig to the International Geological Congress held in Vienna, 1903, during a field trip to the Tatras, the Beskides and the Pieniny Klippen belt. Uhlig's ideas are contained in the Guidebook "Exkursionen in die pieninische Klippenzopne und in das Tatragebirge". It was on the basis of Uhlig s monograph of 1897-98, that Maurie Lugeon, a Swiss geologist who had never visited the Tatra Mts, evidenced in his papers "Analogies entre les Carpathes et les Alpes" (1902) and "Les nappes de recouvrement de la Tatra et l'origine des Klippes des Carpathes" (1903). These ideas have developed into an "ultranappistic" theory.

Nowadays it is an almost general opinion that from among the tectonic units of the Western Carpathians distinguished by Uhlig and his successors only the High Tatric and the Subtatric Nappes have derived from a root area south of the crystalline core of the Tatra Mountains.

The Geological Society of Poland organised its annual meeting in 1997 in Zakopane, devoted to the geology of the Tatras and the Podhale region, to celebrate the centenary of publication of the first volume of Uhlig's monograph.

MINERALOGY AND DIAGENESIS OF THE PALEOGEN BEDS OF DUKLA UNIT (EASTEN POLISH CARPATHIANS)

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The Dukla Unit is the most eastern nappe of the Polish Carpathians Flysch of late Cretaceaus - Paleogene age.

The aim of the investigation was to compare the mineralogy of shales and mudstones from two lithostratigraphic units: midle - Paleocene Majdan Beds and Paleocene- Eocene Lower Hieroglyphic Beds.

The two lithostratigraphic units differ in colour: black and dark grey shales dominate in the Majdan Beds, while in the Lower Hieroglyphic Beds contain green to greenish grey shales and mudstones.

XRD, SEM-EDS and optical microscopy analyses show that the mineral assemblage of the two lithostratigraphic units is similar. Besides dominant minerals, those of the mica group (illite, muscovite, biotite), quartz and chlorite they also contain minor amounts of plagioclase, calcite, gypsum and pyrite.

The distribution of minerals is the same within the lithostratigraphic units and as well as at their boundaries, suggesting similar provenance for both units.

The composition of the pelitic fraction (<2μm) is similar in both lithostratigraphic units. Clay minerals are mainly represented by illite, mixed-layer illite/smectites with R3 type ordering, chlorite and mixed-layer chlorite/smectites. In the illites the smectite content does not exceed 20%. The Lower Hieroglyphic Beds contain mixed-layer chlorite/smectite minerals. The results were confirmed by XRD and EDS analyses of single flakes of those minerals, the smektites containing significant K^+ In the Majdan Beds chlorite is well crystallised. This can be a result of more advanced diagenesis, which is also suggested by greater illitization of smectite.

The shales and mudstones are characterised by a high degree of diagenesis (intensive illitization of smectite). Other diagenetic processes visible in the mudstones and fine-grained sandstones are the solution of feldspars and quartz, chloritization of biotite, albitization of plagioclase, crystallization of calcite with an admixture of Fe and Mg and the crystallization of autigenic quartz and albite.

The chemical composition of minerals in the rocks imply a geochemical complexity of the diagenetical enviroment (Środoń, 1996). The dominant geochemical enviroment of diagenesis is that of Si-Al-K activity related to fine-grained clastic rocks (of primary composition quartz-mica-feldspar) with a lesser influence of Si-Al-K-Fe-Mg activity affecting clast from a possible distal pyroclastic source.

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PRIMARY AND SECONDARY ACCESSORY MINERALS IN THE HIGH TATRA GRANITOIDS (POLAND)

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Accessory minerals in igneous rocks act as the scavengers of some trace elements important in petrogenetic studies. Because of this reason, it is very important to distinguish accessory minerals of primary and secondary origin and, in the case of secondary origin, to determine the source of fluids. Accessory minerals in the High granitoids are as following: apatite, monazite, zircon, magnetite, hematite, ilmenite, epidote, allanite, sulphides and others.

Apatite is the most frequent accessory mineral in the High Tatra granitoids. Two types of apatites can be distinguished. Bigger ones are rounded, almost isometric and greyish. Smaller apatite crystals which form euhedral prisms or rods are colourless or yellowish. All apatites are fluorapatites; chlorine is present in some of them. In numerous apatite crystals very low content (<0.1 wt%) of Mn was determined. REE were noted in a few crystals of apatite which form intergrowths with monazite. Apatite occurs in association with biotite and opaque minerals.

Monazites are rounded or euhedral. The content of Th, Si, and Ca differs in different grains, which suggests the compositional gradation monazite - cheralite and monazite - huttonitic monazite. Determination of Th, U and Pb indicates that probably several generations of monazites are present. Most monazites are present in close association with biotite and Fe-Ti-oxides. Some monazite-apatite (and REE-apatite) intergrowths suggest that some monazites grew in the reaction of apatite with REE-rich solutions.

Zircon is present as euhedral grains which dominate, subhedral (slightly rounded), and rounded ones. Euhedral grains are colourless or yellowish. Most of them represent S_2 type in Pupin's classification. Internal chemical zonation in the sections of zircons is absent or only slightly marked. Zircons occur in biotite, in Fe-Ti-oxide grains or at their margins, in apatites or feldspars.

Magnetite grains differ in morphology (among others skeletal crystals). Most of them are partly or completely transformed to hematite (maghemite, martite).

Hematite is present in few samples and forms intergrowths with ilmenite.

Sphene occurs rarely as discrete grains. It was noted in the form of tiny lamellae in chloritized biotite.

Ilmenite (beside ilmenite which is a by-product of biotite chloritization) forms intergrowths with other oxides. The intergrowths are complicated in chemical composition (mainly different Fe-Ti-oxides) and structure. They are often mantled by rutile. Usually ilmenite contains a significant amount of Mn.

Rutile resulted from the chloritization of biotite. It forms elongated, often porous, lamellae between chlorite plates. Some rutile needles were noted in quartz crystals.

Pyrite occurrence is scarce in granitoids studied. Few grains were noted in association with monazite.

Epidote and allanite are wide-spread secondary minerals in granitoids. Epidote was formed chloritized biotite or occurs together with albitized feldspars. Allanite is less common than epidote. It was noted in association with chloritized biotite and with monazite and REE-rich apatite. The structure of epidote-allanite intergrowths indicates that allanite was formed later than epidote.

Accessory minerals in the High Tatra granites crystallized from magma or were formed as secondary minerals. Numerous examples of them represent both groups. Some accessory minerals are xenocrysts from wall-rocks or were derived from a source area of granitic melt.

COMPOSITION, GENESIS AND POSTSEDIMENTARY EVOLUTION OF THE PALEOZOIC PELITIC ROCKS IN BULGARIA

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A 153 probe of Paleozoic pelitic rocks from Stara Planina Mountain, Kraishte area, Northern Bulgaria, Shipka Balkan, Sout-Eastern Bulgaria, Western Sredna Gora Mountain and other regions have been examined by X-ray diffractometrical study. The nonhydrated varieties of the dioctahedral micas (illite-muscovite) and chlorite are predominated, but also kaolinite, paragonite, smectite, pyrophillite, hematite, goethite, feldspar and quartz are represented. The dioctahedral micas are mainly of the 2M1 polytype and chlorites are trioctahedral, mainly polytype IIb. The kaolinite and smectites have been determined in the coal-bearing sediments of the Carboniferous system. On the basis of the qualitative and quantitative relationships of the components 18 mineral association have been differenciated: I - illite-muscovite + quartz; II - illite-muscovite + chlorite - + quartz; III - illite-muscovite + chlorite + feldspar + quartz; IV - illite-muscovite + geothite ± quartz; V - illite-muscovite + geothite; VI - illite-muscovite + chlorite + geothite + feldspar + quartz; VII - chlorite + illite-muscovite + geothite + quartz; VIII - illite-muscovite + chlorite + hematite + quartz; IX - illite-muscovite + hematite ± quartz ± feldspar; X - illite-muscovite + chlorite + hematite + feldspar ± quartz; XI - illite-muscovite + feldspar + quartz; XII - illite-muscovite + kaolinite ± quartz; XIII - illite-muscovite + kaolinite + chlorite; XIV - illite-muscovite + chlorite + paragonite + quartz + feldspar; XV - illite-muscovite + chlorite + paragonite + hematite + quartz + feldspar; XVI - smectite + kaolinite + quartz; XVII - smectite + illite-muscovite + hematite ; XVIII - chlorite. The lateral and vertical distribution of the 18 mineral association in the different Paleozoic systems and regions have been studied.

After their indices of illite-muscovite crystallinity the Paleozoic pellites are afected with respect to their postsedimentary evolution from diagenesis to early metamorphism (anci- and epizone). In Northern Bulgaria (Devonian-Permian) ICmed.=0,57; in Western Stara planina and Shipka Balkan Mts. (Ordovician-Carboniferous) ICmed. =0.27; in Kraishte area (Devonian-Permian) ICmed. =0,30; in SE Bulgaria - Dervent Hills (Ordoviciad-Devonian) ICmed. =0,21.

On the basis of the geochemical pecularities of the Paleozoic pelitic rocks five intervals have been distinguished: 1 Pre-Cambrian - Cambrian (?); 2 - Lower Ordovician; 3 - Middle Ordovician-Lowest Silurian; 4 - Lower Silurian - Upper Devonian (= Lowest Carboniferous); 5 - Upper Carboniferous - Permian.

Paleozoic pelitic rocks in Bulgaria are from different genesis (marine - from Ordovician to Lower Carboniferous and continental - in the Upper Paleozoic sections), polyfacial and formed in variaded climatic conditions. Formation of this sediments is realized in subarctic and temperate humid zone (during the Ordovician-Devonian), in equatorial humid zone (Upper Carboniferous) and arid climatic zone (Permian, part of Middle Devonian in North Bulgaria).

LACUSTRINE CARBONATE SEDIMENTATION IN NEOGENE SOFIA BASIN, BULGARIA

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The Neogene Sofia Basin is filled in with alluvial, lacustrine and paludal sediments. Four lithostratigraphic units were determined in there by Kamenov & Kojumdgieva (1983): variegated terrigeneous formation (irregular alternation of clayshales, siltshales, sands and sandstones), Gniljane Formation (pebble to cobble conglomerate, sands and sandstones, siltstones and silty clayshales.with lacustrine chalk and lignite interbeds in the upper part (Balsha Member), Novi Iskar Formation (clays, clayshales, mudshales enriched in diatoms and ostracods and rarely siltshales) and Lozenec Formation (clays, siltshales, mudshales, sands, and pebble to cobble conglomerate with lignite interbeds (Novi Han Member) in the lowermost part of the formation). The last three Formations form the Sofia Group and represent a full sedimentological cycle.

Resent studies find few limestone beds in the lower part of the Gniljane formation. In Novi Iskar Formation there are clayey limestones and marl interbeds in the central and northern patr of the basin. Micrite limestones between sediments of Lozenec Formation were find at the northern boundary and in some boreholes in the central part of the basin. These limestones form two to six beds with thickness from 0,5 up to 1 m each.

Lacustrine chalk was deposited in northern and north-western parts of Sofia basin during the Early Pontian, when the environment changed from aluvial to lacustrine. Chalk is composed generally of Mg-calcite (~68%), clay minerals (illite) and fine disspersed organic matter. The bed thickness is 0,5-1 m. Chalk beds lie over alternation of sands and shales and are covered by lignite coal beds. Chalk beds outcrop in the coal quarries nedr the villages of Katina and Balsha, and are found in boreholes in the northern Sofia Basin.

The microscopic observations show that limestones are silty and sandy fossiliferous micrite limestones. They are composed mainly of micrite with 10% charophites and ostracods as well as 18-25% terrigeneous grains (monocrystaline quartz grains, less composite quartz grains, potassium feldspars, plagioclase as albite-oligoclase and single muscovite and biotite flakes, the last slightly bleached and chloritized). Calcite crystals are 0.002-0.005 mm in size but there are small sections (0.5 x 0.7 mm) with irregular shape where micrite is recrystalized and the crystals' size is up to 0,015-0,020 mm. Ostracod shells are oriented subparalel to bedding and are well preserved. Only single shells are crashed. According to Dunham (1962) it is a wackstone (mud supported texture). The clay minerals are in insignificant amount near 6-7%. They are represented of smectite and illite. According to energy classification of Plumley (1962) these limestones can be referred to EI type II_1 formed in slightly agitated water and consisting less than 15% clay, less than 50% detritial quartz and more than 50% micrite matrix.

All sedimentological features lead to conclusion that limestones and chalk were formed in shallow littoral zone with slightly agitated water. The mudsupported texture and well preserved ostracode shells proved that these limestones were deposited in quite and probably shallow bay. The primary deposition of $CaCO_3$ was favored by rising of pH during the photosynthesis of macrophites (i.e. Chara) and/or diatoms. The presence of limestones in the lower levels of the Neogene suppose that similar conditions existed during the early stage of the Sofia Basin evolution.

Chalk beds were preserved from further transformation by organic compounds. A number of dissolved organic species like amino acids and humic matter have a strong tendency to become absorbed on the surface of calcite crystals and these organic coatings reduce the solubility of the carbonates and contribute to their preservation in the sediment.

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PHANEROZOIC VOLCANISM IN THE WESTERN SLOPES OF THE UKRAINIAN SHIELD

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On the territory eastward from to the Carpathian folded system, in contrast to the regions situated westward, it is assumed the active magmatism has finished in Late Precambrian (Vendian). However, new records and the reconnaissance analysis of the existed data suggest for numerous explosive volcanism appearance eastward from Carpathians in Phanerozoic times too up to Neogenian. Respective rocks formation stages and these rocks composition are correlated in some extent to the Back-Carpathian occurrences.

The distinct patterns of the region between the Carpathians and the Ukrainian Shield appear to be characterized by Phanerozoic volcanism resembling those of the stable structures like the Siberian Platform. However, most of flood-basalt occurrences at the Shield western slopes are considered as Riphean and Vendian units (Stratigraphy of the UkSSR, 1971). Nevertheless, such the rocks, mainly of explosive mode, have been described in Volyn and Fore-Dobrudzha areas in the cross-sections of Lower Paleozoic and Late Paleozoic (Triassic), and as basalts and tuffs are known from Upper Cretaceous units.

According to data obtained, well-exposed in quarries basalts of Volyn Series belong to Upper Cretaceous age despite of their previous assignment as Vendian. Young age has been early postulated by St.Malkovsky (1951 etc.) and now is proven by paleontology. In Berestovets quarry # 9, in tuffs overlayed by "Vendian" basalts, limestone clasts have been found, containing Campanian foraminifera: Neoflabelina rugosa leptodisca (Wedekind), Palmula inversa (Beissel), Vaginulinopsis trilobata (Orb.), Lenticulina aff. comptoni (Sowerbi), Globorotalites michelinianus (Orb.).

Foraminifera complex of the same age is also described in limestones filling the space between basalt "pillows" in the upper flow part, Raphalovka quarry. Limestones adjacent to the basalts, are marble-like, silicified. Contact alteration of the limestones is the reason why the basalts are considered as young units.

In the tuffs and tuffaceous sandstones of the Volyn Series, in the sections located at the Shield margin, Mesozoic-Cenozoic (Tashki village) and Miocene-Upper Sarmatian (Putrentsy village) foraminifera have been found, and these records are consistent to the palinology data. Neogene volcanism of extrusive mode is not found. Organic remnants-containing tuffs and tuffaceous sandstones are rather widespread (Volyn, Dnister region), have sufficient thickness, and their nature cannot be explained by explosive matter transfer from Back-Carpathians volcanic vents.

The stages of volcanic activity are well correlated between Carpathian and Back-Carpathian regions (Paleovolcanism..., 1984) and in the western slopes of the Ukrainian Shield. Cretaceous andesite-basalt lavas and tuffs of increased potassium content are known from Penninian, Marmarosh and Dukla Zones of the Carpathians. Sarmatian near-surface basalt to liparite extrusive and sedimentary-volcanogenic units are widespread in Back-Carpathian region.

In general, Phanerozoic volcanism apparently has been caused by deep-seated faults activization. Establishment of its new stages in the western slopes of the Ukrainian shield could essentially change the perspectives of this region in term of magmatism, stratigraphy, mineragenу and geological history studies as well as in respect of geological records correlation between neighbour areas of Belarus, Moldova and Poland.

ISOTOPE GEOCHEMISTRY OF UKRAINIAN CARPATHIANS

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In spite of rapid development of recent isotope researches all over the world including Ukraine, many problems on isotope age and genesis of various magmatic, sedimentary, metamorphic and ore associations still remain obscure being therefore a subject of stormy discussions.

The first K-Ar datings of igneous and metasedimentary rocks of East Carpathians have indicated the Precambrian age of the base of the Ukrainian part of Marmarosh massif. The further geochronological researches have however not confirmed these data, though from time to time in literature there still appears information of even older ages, i.e. up to 2.2 b. y. But again this was not confirmed by further investigations.

Nowadays by a variety of all modern geochronological data, the metamorphic rocks of Bilopotic series of 540 m.y. of age as well as Delovetzka series (455 m. y.) should be considered as the oldest ones in Carpathian region. During Caledonide stage of tectono-magmatic activation all these rocks have been broken through by various granitoids of both crust and mantle origin. By isotope ratios of strontium and oxygen the granitoids of Yavornykovy type may be attributed to the crust type ($^{87}Sr/^{86}Sr$ = 0.739, $\delta^{18}O$ = 12-13.2 ‰), whereas the Bilipotic complex was formed from mantle substratum ($^{87}Sr/^{86}Sr$ = 0.704, $\delta^{18}O$ = 8.5-9.4‰).

Although the ore deposits of the Ukrainian Carpathians were not yet investigated by isotope methods well enough, an available information allows to assume that gold-bearing deposits, for instance, which are related to carbonaceous sediments, have been formed at low temperatures at the expense of redistribution of ore substance in nearly surface conditions. Isotope composition of carbonates ($\delta^{13}\tilde{N}$ = -3-5 ‰, $\delta^{18}O$ = 14-18 ‰) indicates a presence of a depth substance in the ore-forming fluids, but the ore sedimentation conditions, as it follows from isotope composition of gold, associated with quartz ($\delta^{18}O$ = 10-13 ‰), were not deep.

THE RHODOPE REGION: EVIDENCE, IDEAS AND MAJOR CONTROVERSIES

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Controversies in the interpretation of the geological evidence on the Rhodope region come mostly from restricted field and laboratory data. The interpretations are deeply influenced by dominant tectonic hypotheses rather than by the newly acquired information. The problems may be solved through concerted efforts of the interested geological communities, with complex implementation of modern methods and techniques.

The classical views from the beginning of this century followed traditionally two principal lines. Fixistic hypotheses regarded the region as a median massif built up exclusively of high-grade metamorphic rocks of Precambrian age surrounded by envelopes of younger low-grade metamorphic and sedimentary sequences. The mobilistic hypotheses considered the high-grade metamorphics as "Metamorphiden", i. e., products of Alpine metamorphism of Palaeozoic and Mesozoic rocks from the root zones of huge nappe structures.

New information confirmed the presence both of Precambrian protoliths that suffered Precambrian metamorphism and intrusion of Palaeozoic granites, and of Alpine metamorphism of post-Triassic age reaching locally amphibolite-facies conditions and followed by Late Cretaceous and Palaeogene granitoid complexes. However, some of these data are being systematically neglected on ideological rather than on real scientific basis.

Serious controversies exist on the age and origin of diabase-phyllitoid complexes at the periphery of the Rhodope massif, and their relations to the amphibolite-facies basement. These relations are interpreted in different manner depending on more general geodynamic considerations. Relations to surrounding and covering Mesozoic sedimentary formations are also discussed in an equivocal manner.

The neotectonic stage began with formation of the principal peneplain in Early - Middle Miocene time, after the last important compression event in earliest Neogene time. Correlations of denudation (planation) surfaces in the neotectonic horsts with sedimentary formations in the adjacent grabens point at conditions of generalized extension with rifting, block tilting and considerable vertical displacements. According to another viewpoint, the Rhodope metamorphic rocks represented a "Rhodope metamorphic core complex" that underwent Cretaceous to Tertiary folding and amphibolite-facies metamorphism, and has been exhumed very rapidly in Miocene time along a detachment surface. Several aspects of this hypothesis are inconsistent with the existing evidence.

LATE TRIASSIC EVENTS ON THE BALKAN PENINSULA

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Considerable sedimentation changes occurred in Late Triassic times due to important geodynamic events commonly known as Early Cimmerian orogeny. In the Peri-Tethyan realm palaeogeographic and sedimentation changes began in Carnian (and locally, even in late Ladinian time), with the break-up of the second carbonate platform, and gradual establishment of a dry land regime with lateritic weathering. Rifting and differential vertical movements resulted in the deposition of thick terrigenous red beds (e. g., the Vetroushka Formation, the newly introduced Chelyustnitsa Formation, and parts of the Ambaritsa and Borima Formations) in grabens adjacent to source areas. However, the marine regime persisted, as witnessed by foraminifers, gastropods, echinids and algae, up to Norian, and only in exceptional cases, to Rhaetian time, with diachronous marine regression. Products of lateritic weathering have been locally redeposited. Phosphate-bearing beds have been recently found, too. Folding ("Early Cimmerian phase") produced open normal folds, and only locally more intense compression within strain concentration zones resulted in formation of isoclinal folds, imbrication and thrusting.

In the Northern Tethys basin, uplift and erosion of Cimmerian mountains (Cimmerides) supplied terrigenous material for the Norian flysch of the Kotel strip although carbonate (marl and reefal limestone) sedimentation persisted in adjacent areas of restricted terrigenous supply. Flysch with olistostromes formed not only during Late Triassic time but also in the Early Jurassic, and was recorded as well in several younger episodes.

In the southern edge of the Southern Tethys basin (External Dinarides, Kruja Zone, Gavrovo Zone), sedimentation break with karstification and lateritic weathering with bauxites occurred at the end of Ladinian time, and was followed by Carnian shale and dolomite. In the pelagic environments (Pindos - Olonos), sedimentation of pelagic limestones and radiolarites in late Norian to Rhaetian time was abruptly replaced by red siltstones, sandstones and shales of Early Jurassic age. Obviously, the Cimmerian events deeply influenced even the open Tethyan environments. However, uncertainties still exist in respect to the exact age of Tethyan ophiolites and melange sealed by Upper Jurassic conglomerate, sandstone and limestone.

Within the Peri-Tethyan environment between the Northern and the Southern Tethys basins (Evvia, Subpelagonian), a carbonate platform is traditionally considered as developing through Late Triassic to Middle Jurassic times. However, the fossil record is lacking in the time interval from Norian (and even Carnian) to the Pliensbachian Age. Therefore, a latest Triassic sedimentation break is possible also here, and might have favoured karstification and bauxite formation in latest Triassic - earliest Jurassic time.

NEWLY RECOGNIZED UPPER TRIASSIC AND JURASSIC FORMATIONS IN SOUTHWEST BULGARIA: PALAEOGEOGRAPHIC AND PALAEOGEODYNAMIC IMPLICATIONS

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The allochthonous masses of the Morava superunit have been thrusted over the Strouma superunit in Mid Cretaceous time. Recently found considerable differences in the Upper Triassic and Jurassic lithologies allow the introduction of several new lithostratigraphic units that bear also considerable palaeogeographic and palaeogeodynamic implications.

The Upper Triassic Kobile Formation is situated at the top of the Triassic section (over the red beds of the Norian Komshtitsa Formation). It consists of phosphate- and sulphate-bearing yellowish sandstones and siltstones interbedded with grey dolomitic limestones. Occasionally, they contain echinids, gastropods and crinoid ossicles. A reappraisal of the Peri-Tethyan Triassic geodynamics, and especially, in respect of the possible source of the phosphate material and conditions of its deposition, should be made on the basis of this new evidence.

The Metohiya Formation (basal conglomerate built up of quartz and lydite pebbles; quartz sandstone; loose yellowish sandstone with carbonate cement interbedded by occasional limestone layers) covers the Upper Triassic Kobile and Komshtitsa formations with unconformable depositional contact. Only few specimens of ostracods and *Nodosaria* sp. have been found, and the age is considered as upper Lower Jurassic - Middle Jurassic on the basis of regional correlations. The other two newly introduced Jurassic formations belong to the Treklyano Group, and are of Middle Jurassic age. The Momchil Formation is built up of shales and siltstones interbedded with limestones. They yielded the foraminifers *Bolivina liassica*, *Discorbis scutiliformis*, *Protopeneroplis* cf. *striata* and *Lenticulina* cf. *quenstedti* as well as scarce calcareous nannofossils. The Sredorek Formation (limestones and marls with shaly interbeds) contains *Trocholina palastinensis* and *Ophthalmidium carinatum*. Lateral correlations with the deep marine sequence (shales and radiolarites) of the Dobridol and Rayantsi formations makes possible the reconstruction of a Jurassic narrow and deep submarine canyon within the Peri-Tethyan shallow sea. The formations of the Treklyano Group are covered by the Tithonian - Berriasian flysch of the Kostel Formation.

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RECOGNITION AND IDENTIFICATION OF PALAEOVOLCANIC STRUCTURES IN HUNGARY BY SPACE PHOTOGRAPHS

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The recognition of active volcanos by aerial and space photographs is well known since long time in the international literature.

To recognize *palaeovolcanic structures* there were made several attempts in Hungary. In the frame of the university training program Remote Sensing at Miskolc University, Department of Geology & Mineral Deposits, it succeeded by regular investigations to identify the most important palaeovolcanic structure forms, first of all on leaf-free photographs of the scale 1:50 000. For the identification we used the available data of aerial photographs, of aerogeophysical measurements and of mineralogical-petrographical-volcanological field observations of the respective areas. It could be proved, that all forms listed below can be identified by the means of surface-near morphological remains: eroded former eruption centres (volcanic calderas, necks, domes, shield volcanos); remnants of long lavaflows; stratovolcanic structures; remnants of somma of palaeovolcanos; outcrops of fissure volcanos and dykes.

Beyond the above-mentioned, by the help of digital images we demonstrate promising attempts for the boundering of some rock alteration zones (silification, argillitization); determinating the extention of postvolcanic activity zones (geyzers, hot spring lakes). All these may indirectly contribute to a better research of ore and non-ore raw materials connected with the volcanic activity.

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WHERE IS MINERALOGY EXPECTED TO GO IN THE NEXT DECADES ?

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Scientific prognoses are based either (a) on the detailed knowledge of the present situation and predictions on the basis of general laws of Nature, or (b) on trials to give a probable future scenario derived from the known present situation combined with a series of known situations in the past. In our problem we will have to use method (b), or even more vague ones.

Let us begin with a very simple partial problem: the number of new minerals described per year. We can learn this number for 1997 and for a number of preceding years by a search of the literature, and it is clear that we can extrapolate it to the future. We can do this either by a simple linear extrapolation or by a more complicated one, and mathematical tools for the probability limits of the prediction are available. Although at first sight such a procedure seems to be quite satisfactory, it bears in practice serious pitfalls. In our case one of them is the coming of new experimental methods. This was quite evidently the case with the invention of the electron microprobe analysis in the second half of our century which has brought an enormous progress in the analysis of tiny minerals, as well as with new developments in X-ray crystallography which allow now to investigate much smaller crystals than half a century ago. Such events cause (quasi) discontinuous developments: in our case to a rapid increase in the number of new minerals described per year. Such phenomena hold for some period of time, and then the development flattens again to a more "normal" trend.

Of considerably greater interest are, of course, more general questions on the future of mineralogy, - and those are much more difficult to answer. As minerals are homogenous grains found in Nature, it is clear that mineralogy *sensu stricto* will continue have its place with the earth sciences. But within this frame it will continue to have its identity, quite apart from questions of organization. Mineralogy was always more allied with physics and chemistry than e.g. tectonics and stratigraphy. When we look where there are the great progresses in mineralogy at present, we have to expect that in addition to field work and the ever more sophisticated investigation of the natural minerals (including extra-terrestrial ones) in the laboratory, synthetic experimental work up to very high temperatures and pressures will play an important role in our science. Here mineralogy (with petrology) has brought important impetus to the earth sciences and to science in general. Other probably important working fields in future mineralogy will be theoretical work in connection of the application of thermodynamics and lattice energies, and the investigation of the history of single mineral grains. - As to the applied side, in addition to the old bonds to the mining of ores and industrial minerals, ore dressing etc., new bonds to several fields of material science, e.g. ceramics and zeolite research, are becoming increasingly important and will help to let find mineralogists jobs not only in science, but also in industry.

GEOCHEMICAL MAPPING BY MOBILE FORMS OF CHEMICAL ELEMENTS

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There is no reliable information up to now on content of toxic elements and their mobile forms in the objects of environment of various landscape - geochemical (including reserve regions) zones of Ukraine.

Under the term mobile forms of chemical elements we mean those one, which are stabile thermodynamically in aqueous solution under definite physical - chemical conditions of medium and form which are easily extracted from minerals, rocks and soils into aqueous solutions and can easily migrate for long distances.

Mobile forms of toxic elements are responsible for normal functioning of biogeozenoses, they determine the state of soils (stability to physical - chemical processes, ability to selfpurification), they permit to estimate the degree of fertility of soils, their productivity and possibility to grow ecologically pure production, these forms make possible to find out the sources and character of natural and technogenic pollution.

Establishing of regularities of distribution of mobile forms of toxic elements in soils will permit to clarify their background and anomalous values, that will be the base for estimation of the state of pollution of the environment and for creation of the complex of ecological - geochemical mape of soils of Ukraine.

Mapping of mobile forms of chemical elements permits to establish background and anomalous values of pollutions and give their ecological estimation.

For geochemical mapping of soils it is reasonable to take into account some relative values. For example the ratio of bulk amounts and content of mobile forms of polluting agents into soils or the ratio of bulk amounts of elements in soils and plants.

The index of accumulation of polluting agents e.g. by soil is ratio of their content in it to their background quantity. For geochemical mapping the following additional coefficients could be used: coefficient of sinergetic loading (Ks), coefficient of mobility of chemical elements (Km), coefficient of assimilability by plants (Kp) and many others.

The basis for such geochemical maps may be some indexes of matter composition of soils and physical - chemical conditions of environment.

For geochemical mapping the following points should be taken into account:

-regularities of distribution in soils of chemical elements and their mobile forms reflect long-term effect of anthropogenic factors;

-simultaneous geochemical mapping of soils, surface waters and plants determins conditions of equilibrium in natural chain soil - water - plant;

- complex study and mapping on the base of a set of factors determins the direction of geochemical processes and can be the basis for predictional environmental geochemical mapping.

FLUORINE IN WATER OF LVIV REGION AND RELATION WITH BONE DISEASES

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Many endemic diseases depend on receipt in organism of the man toxic of elements. Among such toxic of elements the special role belongs fluorine and his components. The high contents fluorine and his mobile forms in objects of an environment cause various endemic of disease fluorosis, aging bones and many others. 17 areas in the Ukraine have been defined where there is a prevalence of high contents of fluorine water. The health risk comes from the presence in such waters of a fluorine-ion. Therefore fluorine reduction of water is one of most important problems today in the Ukraine. It is important also to look at the combined effects of fluorine with radioactive elements, nitrate and other toxic compounds. In these cases a fluorine content of 1.2 - 1.5 mg / l can cause fluorosis.

Many areas of Ukraine are characterized by the high contents fluorine in objects of an environment. The Lvov region there is territory mining - industrial agglomeration establishes the high contents fluorine in soils, rocks, superficial and underground waters. In soils and rocks of the contents fluorine exceeds the background contents in 5 - 10 and more occasions. However, the most precise correlation communication with endemic diseases is established only for potable waters. The contents fluorine in a number of areas of Lvov region changes within the limits of 1 - 3.5 mg / l.

Effects of an increased water fluoride content on the bone tissue, the rate of its aging, prevalence of osteoporosis were studied in 109 women (gr.I) aged 20-69 years residing in the areas of Lviv Region with a high fluoride content of drinking water. The control subjects (gr.II) included women of the same age from the areas in which there was a normal water fluoride content, standardized according to the body mass index and peculiarities of nutrition. The bone tissue was examined using an ultrasound densitometer "Achilles+" (Lunar Corp.). The speed of the sound (SOS, m/s), broadband ultrasound attenuation (BUA, db/MHz) and an estimated "stiffness" index (SI, %) were measured. The results of studies show the negative influence of the high fluoride content in the drinking water on the structural-functional bone tissue state, that leads to the accelerated aging, decrease of the bone density characteristics, development of osteoporosis. The most sensitive turned out to be the female population of age groups 20-29 years (the period of bone peak formation) and 50-59 years (postmenopausal period). In the I^{st} group women, there was a significant decrease in SOS, BUA and SI (20-29 yrs - 1550±5,8 m/s, 105,4±2,62 dB/MHz and 85,2±3,3%; 50-59 yrs - 1521±6,8 m/s, 98,2±2,65 dB/MHz and 71,2±3,8%) in comparison with control group (20-29 yrs - 1592±6,5 m/s, 119,2±3,31 dB/MHz and 92,4±1,6%; 50-59 yrs 1552±5,8 m/s, 106,1±2,51dB/MHz and 83,8±2,3%). The essential difference between indexes characterizing bone tissue state among the age groups 30-39 years and 40-49 years weren't revealed. Structural-functional age of bone tissue in the I^{st} group women exceeded the population standard among the age groups of 20-29 years (by 5,8 years) and 50-59 years (by 6,3 years). Among the group aged 50-59 years in the women I^{st} group osteoporosis was revealed in 26,3%, osteopenia - in 63,2%, while among the women of the II group of the appropriate age osteoporosis was revealed only in 12,5%, osteopenia - in 35,4%.

In summary, the high fluoride content of drinking water promote the worsening of structural-functional bone tissue state among the women during the period of bone peak formation and the postmenopausal period.

NEW EVIDENCES ON MAGMATIC EVOLUTION OF THE ORE BEARING ROCKS OF THE ČOKA MARIN AREA (EAST SERBIA)

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During the past decade the ore bearing rocks of the Čoka Marin (ČM) volcanic structure, situated within the northern part of the Timok Magmatic Complex (TMC) have been subjected to numerous investigations (e.g. Đorđević et al., 1990; Živković, et al., 1996). IN this study emphasis is on new evidences of their petrogenesis.

The volcanism in the ČM area started about 85 Ma ago when hornblende-biotite volcanic and volcaniclastic originated, followed dykes of pyroxene and hornblende andesites. Ore-hosting dacite-andesites formed about 72 Ma ago and today build central part of the ČM volcanic structure; the volcanism ceased by intrusion of various diorite and quartzdioriteporphyrite dykes. Most of the rocks of the ČM area follow calc-alkaline trend exept some diorite and quartzdioriteporphyrite dykes which show tholeiitic character. All the rocks correspond to orogenic andesitic association (e.g. FeO-MgO-Al_2O_3; Pearce, 1976). Volcanic arc affinity has been revealed for the volcanic rocks of the entire TMC, but some genetic aspects, first of all the role of low-pressure fractionation during the single eruptive periods have been underestimated and poorly known.

From the Harker variation diagrams appears consaguinity between two first phases of volcanism in the ČM area, namely hornblende-biotite and hornblende-pyroxene andesites. Although there is considerable data scattering, which probably results from crystal accumulation, it could be pointed out that all major oxides behave more or less compatible except K_2O which is moderately compatible; P_2O_5 content slightly increases until silica content reach values between 50 and 55 %, then turn to be compatible indicating apatite precipitation. Regarding trace element contents Y and Nb show compatible trend, Rb, Zr and Ba are all incompatible while Sr show great scattering. It is obvious that plagioclase, pyroxene, hornblende, magnetite and apatite (after 50% of silica) are all fractionated respectively. Compatible trend of K_2O as well as of Rb is not consistent with the presence of biotite, which is ubiquitos phenocryst phase in many andesite varieties. Hence we have to take into consideration contribution of crustal component, i.e. AFC instead of single fractionation processes. It is the geochemical modelling that could eventually provide further information.

On the contrary ore-bearing dacite-andesites show different oxide and especially trace element variation pattern. They are not spatially remote from the previous volcanic products but temporally they are, consequently representing a completely new volcanic phase. The youngest volcanic rocks in the ČM area appear as dioritporphyrite, augite dioritporphyrite, quartzdioriteporphyrite and rarely diorite dykes, and some of them probably represent less fractionated dacitoandesite magma. Due to rather heterogenic group of rocks there were no coherent geochemical picture to appear.

Lacking of isotopic data, which will be extremely important approach in the future studies, interpretation of the primary magma composition which evolved the ČM eruptives as well as of crustal contamination are by no means simple tasks. For the first approximation eight fresh samples of the less fractionated younger volcanics have been analysed by mass spectrometer (Mining Company of Bor) and average trace element contents were normalized to MORB (Pearce, 1982). It became again apparent that subduction component greatly influenced primary magma composition, since the mobile incompatible elements are highly enriched.

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BIOSTRATIGRAPHY OF THE BADENIAN SEDIMENTS IN THE EAST SLOVAKIAN BASIN ON THE FORAMINIFERA STUDY BASIS

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Approximately 700 microfaunal assemblages have been elaborated in the East Slovakia Basin. The age of the studied specimen is the Badenian (Langhian to Early Serravalian). On the basis of foraminifera content it was possible to identify following lithostratigraphic formations:

1. Nizný Hrabovec Formation consists of calcareous sandstones, siltstones and claystones with rhyodacite tuffs and tuffite laminae. The formation is assigned to Early Badenian lithostratigraphic member.

2. The Vranov Formation consists of the gray calcareous siltstones, claystones and sandstones. Unlike of Nizný Hrabovec formation it doesnot content zeolitized and rhyolite tuffs, with exception of the Trebišov area. Mentioned formation is the Middle Badenian.

3. Zbudza Formation consists of salty clays and evaporites halite, gypsum and anhydrite. Similarly to the Vranov Formation the Zbudza Formation does not crop out on the surface. The formation is of Middle Badenian age. Palaeoecological environment was not suitable for microfauna.

4. Mirkovce Formation is of Early to Middle Badenian age. It occurs in the Košice Depression. It consists of gray, green-gray calcareous claystones to silty claystones. In contrast to Nizný Hrabovec and Vranov Formations deposits of Mirkovce Formation have more pelitic character and contains Hrabov tuffs.

5. Lastomír Formation represents the lower part of the Late Badenian and consists of monotonous sequence of claystones and siltstones with coal fyto detritus. Lastomír Formation does not occur in the Košice Depression where middle and upper part of deposits laterally pass into

6. Klcovo Formation of Late Badenian to the Early Sarmatian.

Moravian (Early Badenian) can be correlated with the Praeorbulina Orbulina suturalis planktonic foraminiferal biozone and with the Lenticulina echinata bentic foraminiferal biozone (Cicha 1975). It is consistent with the Lagenide biozone sensu Grill (1941).

Vielician can be correlated with the Globigerina decoraperta G. druryi planktonic foraminiferal biozone and the Uvigerina semiornata brunensis Pseudotriplasia elongata (Cicha 1975) benthic foraminiferal biozone. Sensu Grill (1941) it is Spiroplectammina carinata = (Spiroplectinella) biozone. Kosovian can be correlated with the Velapertina planktonic foraminiferal biozone and the Pavonitina - Uvigerina hispidocostata bentic foraminiferal biozone (Cicha 1975). Sensu Grill (1941) this is the Bulimina - Bolivina biozone, which passes into the Ammonia beccarii biozone.

Formations divided in the East Slovakian lowland Vass and Cvercko (1985) were used for lithostratigraphic characteristics. This division is valid also in the Košice Depression. In this area are developed some specific members and formations defined by Karoli and Zlinská (1988).

MICROBIOSTRATIGRAPHIC EVALUATION OF MIOCENE SEDIMENTS FROM THE EAST SLOVAKIAN BASIN

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82 samples from the drill holes VDM, VSM, VLM, VBM, situated in the East Slovakian basin, were investigated in order to stratify the sediments.

On the basis of Foraminiral studies we can distinguish two stratigraphic stages in them, the first corresponding to Badenian and the second to Sarmatian stage (Table 1).

1. The Badenian stage is represented by two substages, the middle one and the upper one. The Middle Badenian stage, represented by the Vranov Formation, was intersected by the drill hole BB-1, SE of the Byšta spa (Zlinská 1996a). Ecologically, an autochthonous association of benthic agglutinated Foraminifera, belonging to the *Spiroplectammina carinata* (Grill, 1941, Table 1) biozone, are bound to a water with the total mineralization of 30-45 ‰ (euhaline water). The Foraminifera lived in a neritic to a shallow bathyal enviroment (Kovác-Zlinská, 1997). Similar agglutinances occur in the Upper Badenian Lastomír Formation, where they are accompanied by a calcareous benthos of the Bulimina-Bolivina biozone (Grill, 1941, Table 1). The genera *Bulimina, Bolivina* and *Praeglobobulimina, Fursenkoina* indicate that this formation sedimented in a marine, neritic environment. In marginal parts of the Bulimína-Bolivína biozone an Ammonia biozone developed (Grill, 1941, Table 1) represented by a marine-brackish microfauna. Lithostratigraphically, it represents the Klcov Formation that encroaches upon the base of the Lower Sarmatian. In this area, the Upper Badenian stage is represented by samples from the surroundings of Byšta and Breziny.
2. The Lower Sarmatian Stretava Formation crops out in the surroundings of Skároš, Slanská Huta, Kalša, Slivník and Dancov potok. Microfaunistically, it represents the biozone *Elphidium reginum* (Grill, 1941, Table 1). In contrast to the previously studied samples (Zlinská, 1996b), the new ones are lacking the typical species *Elphidium reginum* (Orb.). Its only occurrence is in the drill hole VTK-40. The Foraminiferal microfauna indicates a shallow water, brackish, sedimentary environment.

Table 1 Correlation table of the Foraminiferal biozones and of the lithostratigraphic units of the East Slovakian Basin (Badenian and Sarmatian)

STAGE		FORAMINIFERAL BIOZONES	LITHOSTRATIGRAPHICAL UNITS
		Grill ,1941,1943	Vass - Everèko,1985
SARMATIAN	upper	Nonion granosum	Kochanovce Formation
	middle	Elphidium hauerinum	
	lower	Elphidium reginum	Stretava Formation
		Ammonia Zone	Klèovo Formation
BADENIAN	upper	Bolivina-Bulimina Zone	Lastomír Formation
	middle	Spiroplectammina carinata	Zbudza Formation
			Vranov Formation
	lower	Lagenida Zone	Ni ný Hrabovec Formation

ABSTRACT
session S2 (PANCARDI-EUROPROBE)

3D-FLEXURAL MODELLING OF THE WEST- AND EAST CARPATHIAN TRANSITION ZONE

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The transition zone between the West- and East-Carpathian mountain belt and foredeep is characterized by the change in strike from W-E to NW-SE and by widening of the foredeep at this transition in S.E. Poland. The transition is probably controlled by the differential strength of the West- and East-European lithosphere and shape of the plate margins. Especially the contrasts between the fixed and rigid Russian Platform and the weak highly differentiated West European plate are dominant in controlling the shape of the belt and foredeep.
With 3D-modelling we analyzed the flexural expression of the obliquely interacting subducting /under-thrusting processes acting on the West- and East- European lithosphere. The differences in strength of the European lithosphere are represented by lateral variations in the effective elastic thickness (eet). The weak zones, expressed in low eet-values, control the main flexural bending of the lithosphere and the stronger zones, expressed in the higher eet-values, are able to transfer the flexural intra-plate stresses.
The behavior of the lithosphere under the Transition zone, however, can not be explained solely by lateral variations in eet. Profiles through the belt and foredeep give clear indications for both strong and weak lithosphere: the small radius of curvature of the autochthonous basement under the Carpathian belt indicates weak lithosphere, whereas the pronounced peripheral bulge indicates transfer of intra-plate stresses in relatively strong lithosphere. This apparent contradiction is explained by the role of normal faults, which enforce the deepening of the basement under the Carpathians. The NW-SE oriented pre-existing structures are associated with basement discontinuities of the Tornquist-Teisseyre Zone and were also involved in Mesozoic rifting.
By introducing crustal-scale planar faults in our 3D-flexural model we can explain the shape and deepening of the foredeep and maintain a relatively rigid surrounding domain to explain the shape and location of the peripheral bulge.

PARTIAL OCEANIZATIONS IN THE ATLANTIC AND ALPINE AREAS, and POSSIBLE APPLICATIONS In THE CARPATHIC DOMAIN.

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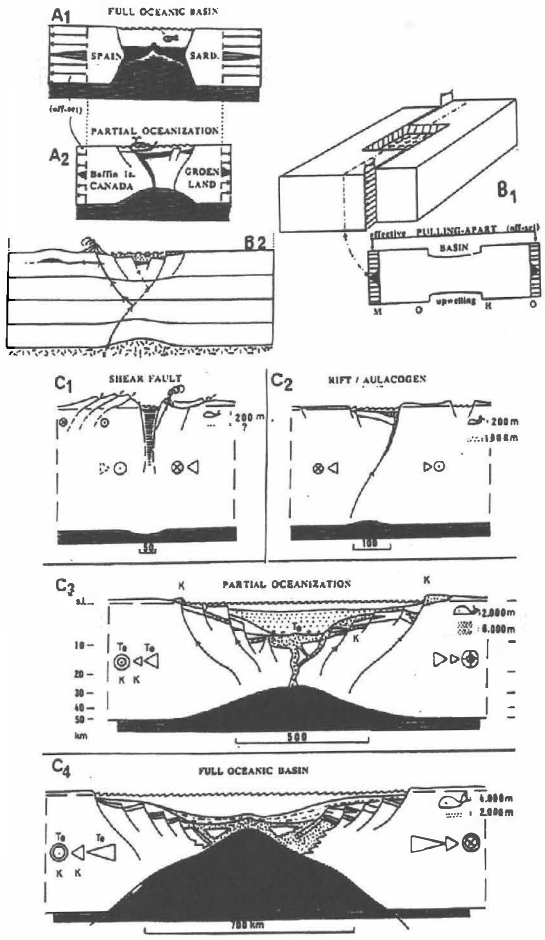
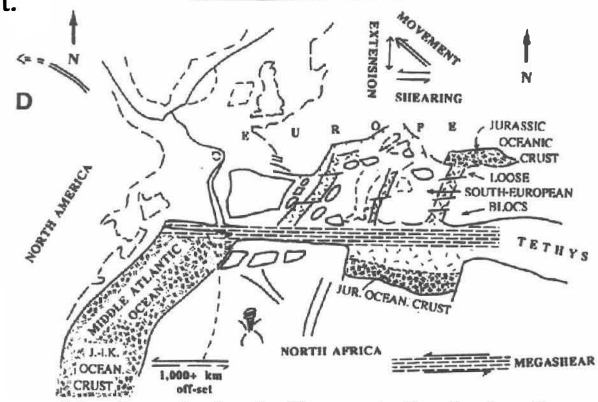
Basic volcanic activity frequently occurs at the opening of continental rifts, graben, aulacogens and pull-apart basins, especially in presence of strike-slip movements, which is most often the case. The process can issue true ocean arms (**A1**) or partially oceanized domains (**A2**): long furrows/rifts with thinned but still present continental crust, where volcanic "carpets" alternate with sediments.



The stretching (off-set) in such cases is not very great (**B1**), much less than the width of the basin itself. If the crust is thick, pulling-aparts of a few, or a few tens of kilometers may result in basins several hundreds kilometers wide and thousands of meters deep (since the stretching affects the crust on its full thickness). Tilted and disjoint basement blocks allow to the (mostly basic) magma to rise (**B2**), to overlap and eventually to englobe and "digest" the loosened cratonic blocs. All stages between simple dykes and fully oceanized domains can be evidenced (**C1-4**). It may be misleading to search for vast, and later subducted oceanic basins, each time one meets ophites, pillow lavas etc of limited extent, scattered within a continental interior.

In the case of the *Bay of Baffin*, (between Canada and Groenland: **C3**), a 400km wide pull-apart basin was formed, with less than 30kms of observed off-set. The *Midcontinent Rift System* (USA), the *Fitzroy Trough* (Australia), the *Takutu basin* (Brasil), the *Aquitaine Basin* and the *Rhine-Rhône-Valencia ("SW. European") Rift System* among others, are all due to failed rifting and/or limited-extent, wrench-related intracontinental pulling apart. All are accompanied by volcanism(s).



Southern Europe was dominated during early Mesozoic (till mid-Cretaceous) by a large sinistral transform system (**D**). Only part of the 1000+km displacement, (due to the Mid-Atlantic opening), was needed to generate the set of basins of the future Alpine system. A larger part extended into the Tethys embayment open to the East, since the Permian (Pangea).

The concept of truly Oceanic Basins in the Carpathic domain is challenged, for lack of direct evidence, and for lack of space for large-scale displacements, in that basement-dominated area (important role of the heritage).
The proposed *alternative interpretation* requires only limited internal adjustmens.

Key-words: Continental rifting, ocean openings, pull-aparts, basic volcanism, wrenching.

PLANKTONIC GASTROPODS (PTEROPODS) FROM THE MIOCENE OF THE SUBCARPATHIAN FOREDEEP AND THE ZDANICE UNIT IN MORAVIA (CZECH REPUBLIC)

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The paper by Ctyroky et al. (1968) is the most recent summarising the distribution of Czech pteropods. Now new finds of Miocene (Eggenburgian-Badenian) pteropods from the Subcarpathian Foredeep and the Zdanice unit in Moravia (Czech Republic) are evaluated systematically, biostratigraphically and paleobiogeographically. The material studied originates mainly from recent outcrops and boreholes (donated by P. Ctyroky, Prague) but includes also parts of the old pteropod collection of Kittl (1886), which is housed in the Museum of Natural History in Vienna. Some samples from the Czech localities of this collection were already discussed in Janssen & Zorn (1993). A study on Oligocene pteropods from Moravia is in progress.

The Eggenburgian pteropods originate from the Sakvice Marls of Zajeci and Valtice belonging to the Zdanice unit in Southern Moravia. The presence of *Clio triplicata* Audenino, 1897, which is the most typical pteropod in the Eggenburgian of the Central Paratethys, and *Vaginella* cf. *depressa* Daudin, 1800 could be established. It is one of the northernmost occurrences of *Clio triplicata*, which is common in the Molassezone of Upper Austria (Zorn, 1991). A study on the time setting of the "*Clio*-horizon" is in progress (cooperation Prague/Hodonin/Vienna). The next younger occurrence of pteropods is that of *Vaginella austriaca* (Kittl, 1886) and *Limacina* sp. in the Karpatian of the Subcarpathian Foredeep, documented in the boreholes Novy Prérov-1 and Nosislav-3.

In the Early Badenian of the Subcarpathian Foredeep *Vaginella austriaca* (Kittl, 1886), *Limacina* cf. *miorostralis* (Kautsky, 1925), *Clio fallauxi* (Kittl, 1886) and *Diacrolinia aurita* (Bellardi, 1873) have been found. The boreholes HJ-303 Tucapy, HJ-309 Nové Dvory and Drazovice, as well as the material from Kittl's localities of the surroundings of Ostrava have been studied. For the first time a protoconch of *C. fallauxi* could be isolated. *Clio fallauxi* and *Diacrolinia aurita* are stratigraphically restricted to the Early Badenian within the Central Paratethys and therefore are index fossils.

The pteropod assemblage from the Late Badenian deposits of the Subcarpathian Foredeep originates from boreholes in Northern Moravia (surroundings of Opava). They yielded *Limacina valvatina* (Reuss, 1867), *L. gramensis* (Rasmussen, 1968) and *Creseis spina* (Reuss, 1867). Within the Paratethys realm *Limacina gramensis* is restricted to the Late Badenian of the Subcarpathian Foredeep, known also from Southern Poland, Rumania and the Ukraine (Janssen & Zorn, 1993). Otherwise it is known only from the Langenfeldian of the North Sea Basin. The occurrence of *Creseis spina* during the Late Badenian agrees with that of the Austrian deposits, whereas in other parts of the Central Paratethys it occurs in the Middle and/or Early Badenian. Besides *Vaginella austriaca*, *Limacina valvatina* is the most characteristic pteropod species of the Badenian.

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CLIMATOSTRATIGRAPHIC SUBDIVISION OF QUATERNARY FLUVIAL DEPOSITS IN THE OUTER WEST CARPATHIANS, POLAND

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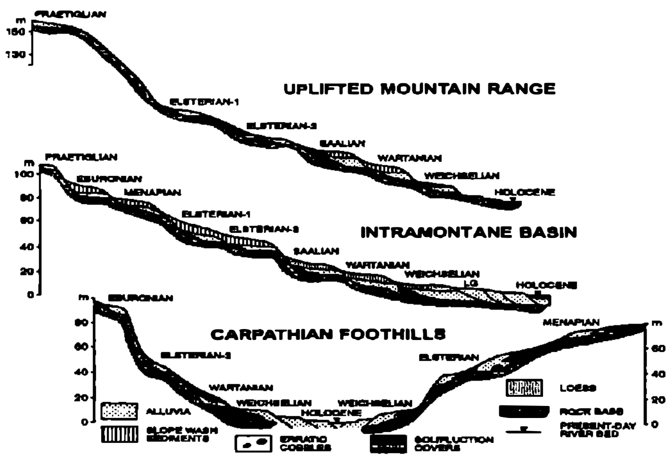
Main valleys of the Outer Carpathian rivers in Poland bear traces of 8 to 9 terrace steps dating from the Pleistocene, and two to four terraces of Holocene age. Most are either strath or complex-response terraces. The Weichselian and Holocene terraces, however, are cut-and-fill depositional landforms, except for some that are located in neotectonically uplifted regions. The exact dating of fluvial sediments laid down before the last glacial stage is difficult due to the lack of suitable datable material. Therefore, morphostratigraphic, climatostratigraphic or allostratigraphic procedures have to be applied. As far as climatostratigraphy is concerned, the best way of assigning fluvial sediments of a given terrace step to a "glacial" Quaternary stage is to check for "intertonguing" of solifluction covers with the alluvial series, a feature pointing to simultaneous deposition of both types of sediments. Basing on this criterion, the following, tentative climatostratigraphic chronology has been established and correlated with stratigraphic schemes used in the Polish Lowlands and NW Europe: T_1 - Różce stage (Praetiglian?), T_2 - Otwock stage (Eburonian?), T_3 - Narewian stage (Menapian?), T_4 - Nidanian stage (Elsterian-1), T_5 - Sanian stage (Elsterian-2), T_6 - Odranian stage (Saalian, Drenthe), T_7 - Wartanian stage (Warthe), T_8 - Vistulian stage (Weichselian), T_9 - Late Glacial of Weichselian stage, and T_{10-13} - Holocene terrace steps.

The scheme presented below shows few examples of Quaternary fluvial and slope sediments exposed on valley sides of one of the main valleys in the medial segment of the Polish Outer Carpathians, i.e. the Dunajec river valley. This valley truncates a number of physiographic units, from those affected by mountaineous glaciation in the Tatra Mts., through unglaciated Beskidy Mts., representing a periglacial zone during successive glacial stages, to the Carpathian Foothills, located at the margin of the most extensive continental, Elsterian-2, icesheet.



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Zlinska, A.: MICROBIOSTRATIGRAPHIC EVALUATION OF MIOCENE SEDIMENTS FROM THE EAST SLOVAKIAN BASIN

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Zoetemeijer, R., J.D. van Wees, A. Slaczka, N. Oszczypko, I. Bubniak: 3D-FLEXURAL MODELLING OF THE WEST- AND EAST CARPATHIAN TRANSITION ZONE

Zolnai, G.: PARTIAL OCEANIZATIONS IN THE ATLANTIC AND ALPINE AREAS, AND POSSIBLE APPLICATIONS IN THE CARPATHIC DOMAIN

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Zuchiewicz, W., A. Tokarski, L. Mastella, J. Rubinkiewicz, R. Szczesny, P. Leonowicz: STRUCTURAL HISTORY OF THE OUTER WEST CARPATHIANS, POLAND, INFERRED FROM CROSS-FOLD JOINT STUDIES

Zuchiewicz, W.: CLIMATOSTRATIGRAPHIC SUBDIVISION OF QUATERNARY FLUVIAL DEPOSITS IN THE OUTER WEST CARPATHIANS, POLAND

STRUCTURAL HISTORY OF THE OUTER WEST CARPATHIANS, POLAND, INFERRED FROM CROSS-FOLD JOINT STUDIES

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Cross-fold joints have been studied at nearly 300 stations located within Tertiary flysch strata of the Magura, Dukla, and Silesian nappes along the 320-km-long Polish segment of the Outer Carpathians. The nappes display different orientation of map-scale folds when proceeding from the west eastwards: SW-NE, W-E and NW-SE in the Magura nappe, NW-SE in the Dukla nappe, and W-E and WNW-ESE in the Silesian nappe. The episode of principal folding and thrusting in the Outer Carpathians of Poland began in Eocene times in the Magura nappe, then it migrated progressively northwards until the late Sarmatian. The Dukla and Silesian nappes were folded only once, during late Oligocene through Miocene times, whereas the strata of the Magura nappe were folded twice, both during the Eocene and in the Miocene.

Joints are represented by one or two systems, each of them composed of a single set of extensional T joints and two conjugated sets of D_1 and D_2 shear joints. In all the nappes studied, cross-fold joints of all the sets are symmetrically arranged within the map-scale folds. Both the T joints and the acute bisector between D_1 and D_2 joints trend subperpendicular to the map-scale fold axes, pointing to mutual relationships between the cross-fold joints and the map-scale folds, as well as to the relation of cross-fold joints to far-field stresses. The D_1 and D_2 joints are of pre-folding or early folding age. They were formed when poorly lithified country strata were still in horizontal position.

The following aspects of structural history of the Outer Carpathian nappes can be deduced from the study of jointing: (1) the Palaeogene stress history of all the nappes was dominated by strike-slip stress regime, with more or less constant orientation of the maximum principal stress. This stress regime has been active throughout the area since the Paleocene and, at least in the eastern segment of the Silesian nappe, since the early Cretaceous; (2) the post-Palaeogene structural development of the Silesian nappe was different from that of the Magura nappe. Within the latter, the Palaeogene joint pattern was disturbed by an episode of younger, superimposed drape folding, by post-folding cross-fold strike-slip faults, and by differentiated isostatic uplift, amounting to >1 km in the western part of the nappe.

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