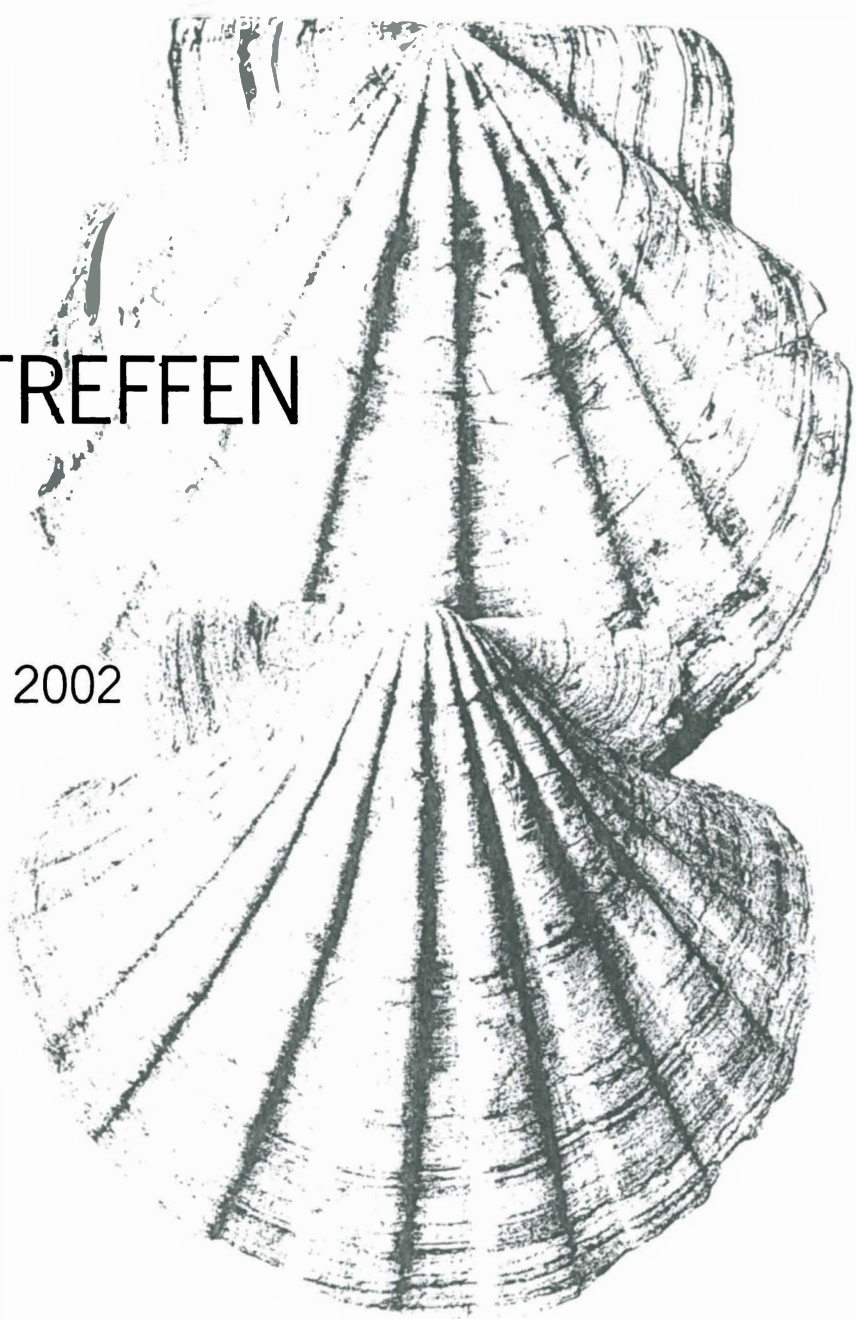
KURZFASSUNGEN ABSTRACTS



MOLASSE-TREFFEN 2002

MOLASSE MEETING 2002

WIEN • 5. – 7. APRIL 2002

GEOLOGISCHE BUNDESANSTALT WIEN

MOLASSE MEETING
PROGRAMM FÜR SAMSTAG DEN 06.04.2002

09.00–09.15: Begrüßung durch den Direktor der Geologischen Bundesanstalt Prof. Dr. H.-P. Schönlaub

09.15-09.30: Uhlig, U. (München, D): Paläoökologische und paläoklimatische Untersuchungen im Oligozän des süddeutschen Molassebeckens

09.30-09.45: Kowalke, T. (Hamburg, D): Frühontogenetische Entwicklung brackischer Mollusken im Miozän der Westlichen und Zentralen Paratethys: systematische und paläoökologische Implikationen

09.45-10.00: Kroh A. (Graz, A): Palaeoecology of a Badenian echinoderm-brachiopod assemblage from the initial Leitha Platform ("Hartl-sands", Eisenstadt – Austria)

10.00-10.15: Mandic, O. (Wien, A): Middle Miocene mollusce bearing series of Gainfarn (SW-Vienna Basin, Austria)

10.15-10.30: Kaffepause

10.30-11.30: Posterpräsentationen

Bassler, B. (München, D): Mittelmiozäne Charophyten der Forschungsbohrung Nördlingen

Coric, S. & Spezzaferri, S. (Wien, A): Ecology of Karpatian (Early Miocene) foraminifera and calcareous nannofossils from Laa an der Thaya, Lower Austria: a statistical approach. Results from FWF Projekt P-13743-Bio

Grimm, K., Grimm, M., Gürs, K. ., Hiß, M., Lietzow, A., Reichenbacher, B., Ritzkowski, S., Standke, G. & Steininger, F.: Stratigraphische Übersichts-tabelle über das Paleogen und Neogen von Deutschland

Harzhauser, M., Mandic, O. & Böhm, M. (Wien, A; München, D): Palaeoecology of the Karpatian (Late Burdigalian) Korneuburg Basin

Kaiser, D.: Benthic Foraminifers in warm temperate carbonate sediments of The Gulf of Neaples, Italy

Kaiser, D., Rasser, M.W., Nebelsick, J.N. & Piller, W.E.(2001): Late Oligocene Algal Limestones on a mixed carbonate – siliciclastic ramp at the southern margin of the Bohemian Massif (Upper Austria)

Nehyba, S. (Brno, CZ): Lower Badenian coarse-grained deltas in the southern part of the Carpathian Foredeep (Czech Republic)

Pervesler, P. (Wien, A): Chemosymbiosis, fossil Lucinid bioturbations and the Chondrites aenigma

Pervesler, P. & Roetzel, R. (Wien, A): Enviromental significance of Bioturbations in the Grund Formation (Miocene/Lower Badenian) in northern Lower Austria

Roetzel, R., Krenmayr, H.G. & Moser, M. (Wien, A): Die Molasse auf der digitalen geologischen Karte 1:200.000 der Bundesländer Ober- und Niederösterreich

Rupp, Ch. & Haunold-Jenke, J. (Wien, A): Untermiozäne Foraminiferen-faunen aus dem Raum Wels

Schenk, B., Uhlig, U., Reichenbacher, B., Kowalke, T., Bassler, B. & Matzke-Karsz, R. (München, D): Das Sindelsdorf-Profil bei Penzberg in der bayrischen Faltenmolasse – Fossilinhalt und Biostratigraphie

Spezzaferri, S., Coric, S., Hohenegger, J, & Rögl, F. (Wien, A): The Molasse and Styrian Basins (Central Paratethys) show different paleoceanographic evolution during the Karpatian: Evidence from microfossil assemblages. Results from FWF Projekt P-13743-Bio

Wagreich, M., Schmid, H.-P. & Faber, R. (Wien, A): Karpatian to Early Badenian faulting in the central Vienna Basin (Austria)

Zuschin, M., Harzhauser, M. & Mandic, O. (Wien, A): The mollusc fauna of the tempestitic shell beds at Grund (Lower Badenian, Austria)

11.30-11.45: Hir, J. (Paszto, H): Middle Miocene rodent faunas from Hungary and Western Romania

11.45-12.00: Márton, V. (Oradea, RO): Middle Miocene Anurans from the Pannonian Basin

12.00-13.30: Mittagspause

13.30-13.45: Gregor, H.-J. (Olching, D): Fossile Hölzer und ihre geologisch-paläontologische Problematik

13.45-14.00: Kempf, O. (Tübingen, D): Post-Eocene evolution of the North Alpine Foreland Basin and its response to Alpine tectonics

14.00-14.15: Kälin, D. (Bern, CH): Der Wellenberg bei Frauenfeld - die jüngsten Anteile der oberen Süsswassermolasse der Ostschweiz: Biostratigraphische Daten und tektonische Implikationen

14.15-14.30: Nehyba, S. (Brno, CZ): Facies Architecture of the southern part of the Carpathian Foredeep (Subsurface Data)

14.30-15.30: Posterdiskussion / Kaffeepause

15.30-15.45: Tipper, J.C. (Freiburg, D): Loading fractures and Liesegang laminae: large-scale and small-scale sedimentary structures found in the northwestern part of the Molasse Basin in southwest Germany

15.45-16.00: Latal, C., Kroh, A. & Piller, W.E. (Graz, A): Stable isotope signatures at the Karpatian - Badenian boundary in the Styrian Neogene Basin

16.00-16.15: Janz, H. (Tübingen, D): Stable Isotope Composition (O and C) and Trace Element Ratios (Sr/Ca, Mg/Ca) of Miocene Marine and Brackish Ostracods from Northalpine Foreland Deposits (Germany and Austria) as indicators for Palaeoclimate

16.15-17.15: Berger, J.-P.(Fribourg, CH) & Reichenbacher, B.(München, D.): Workshop Paläogeographie der Molassezone

17.15-17.45: Berger, J.-P. (Fribourg, CH): Organisation

Mittelmiozäne Charophyten der Forschungsbohrung Nördlingen

Barbara Bassler

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Aus den Seesedimenten des Nördlinger Rieses, erkundet durch die Forschungsbohrung Nördlingen in den Jahren 1973 bis 1976, wurden zahlreiche Charophyten-Gyrogonite geborgen. Das Belegmaterial aus der Bayerischen Staatssammlung für Paläontologie und historische Geologie in München wurde jetzt einer Revision unterzogen, da der Bearbeitungsstand sich seit 1977 wesentlich verbessert hat. Vier Arten aus den Gattungen *Nitellopsis, Lychnothamnus* und *Chara* konnten aus den Teufen 32,6 m; 31,8 m und 27,1 m des Abschnittes IVb nachgewiesen werden. Dieser Abschnitt ist durch Schwankungen der Salinität gekennzeichnet, die mit charakteristischen Charophyten- Assoziationen korrelieren. Eine sukzessive Verlandung in den oberen Bereichen der Ablagerungen kann durch die Charophyten-Funde erwartungsgemäß nicht nachvollzogen werden.

Die Arten werden mit denen des Steinheimer Beckens verglichen, dessen Ablagerungen vermutlich nur wenig jünger sind (MN 7 im Vergleich zu MN 6).

Literatur:

Dehm, R. & al. (1977): Die Tier- und Pflanzenreste aus den obermiozänen Riessee-Ablagerungen in der Forschungsbohrung Nördlingen 1973. Geologica Bavarica; 75; 91-109; München.

Schudack, M.E. & Janz, H. (1997): Die Charophyten der miozänen *kleini*-Schichten. Sonderveröffentlichungen, Geologisches Institut der Universität zu Köln (Festschrift Eugen K. Kempf); 114; 427-449, Köln.

Ecology of Karpatian (Early Miocene) foraminifera and calcareous nannofossils from Laa an der Thaya, Lower Austria: a statistical approach. Results from FWF Project P-13743-Bio

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This research represent the first attempt of paleoecological reconstruction of part of the Laa Formation drilled and cored (Hole BL 503, Wienerberger) at Laa an der Thaya (type locality of the Laa Fm.) in the Molasse Basin, Lower Austria, spanning the Middle Karpatian (Latest Burdigalian). Sediments from Hole BL 503 consist of approximately 2 meters of Quaternary loess with sand passing to yellow brownish sand containing variable amount of silt down to approximately 6 m. They can be correlated to the upper part of the sequence outcropping in the brickyard and consisting of shallow-water deposits, discordantly overlying the calcareous shales. Karpatian homogeneous gray silt and marl with randomly distributed 1-cm thick fine sandy layers occur from 6 m down to 30 m. These sandy layers are interpreted to be distal fans.

In this study we present the paleoecological interpretation based on quantitative analysis of benthic and planktonic foraminifera and calcareous nannofossil.

Multivariate statistic based on the Bray-Curtis Similarity, non-metric MultiDimensional Scaling (nMDS) and Similarity and Dissimilarity Term Analyses is applied to raw data to identify the ecological gradients subtending the assemblages.

A paleoclimatic curve was obtained using the algebraic sum of planktonic foraminifera warm- and temperate-water indicators (positive) and cool-water indicators (negative) to highlight the paleoclimatic trend during the middle Karpatian.

Our data indicate that the sediments drilled at Laa Th. were deposited in water depth not exceeding 200 m, relatively "near shore" in an environment characterized by generally high concentration of organic matter, suboxic to dysoxic conditions, high nutrient availability, variable salinity and generally cool paleoclimate. Based on nannoplankton distribution we also suggest that nutrient availability and upwelling conditions, rather than other ecological factors, control the distribution of calcareous nannoplankton in the Molasse Basin.

Fossile Hölzer und ihre geologisch-paläontologische Problematik

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Fossile Hölzer gehören zu den häufigsten und interessantesten Fossilobjekten weltweit. Häufig sind aber die Bestimmungen eher dürftig und meist nur rezenten Gattungen oder Familien zuordenbar – dies im Gegensatz zu Fruktifikationen (z.B. SELMEIER 1958, 2000). Daß dabei ökologische oder klimatologische Aspekte bei den fossilen Hölzernproblematisch werden können, läßt sich anhand einiger Beispiele zeigen:

1. *Castanoxylon* ist ein Holztyp, das ähnlich dem Holz der Gattung *Castanea* oder *Castanopsis* ist – beidemale Fagaceen. Während *Castanea* weder durch eindeutige Früchte noch Blätter im Tertiär vertreten ist, hat *Castanopsis* beides vorzuweisen und ist Leitfossil für die Oligozän-Molasse. *Castanopsis* ist wärmer-temperiert als *Castanea* und paßt besser in die tertiären Kompositionen als Castanea.
2. Viele ältere Bestimmungen von Hölzern sind heute definitiv falsch und sollten auch so zitiert werden. Wenn eine Mangrove in der USM postuliert und sich u.a. auf die von HOFMANN (1944, 1952) bestimmten Mangrove-Hölzer vom Typ *Shoreoxylon* etc. beruft, ist das ganz einfach falsch (mündl. Mit Prof. GOTTWALD, Reinbek). Eine Überprüfung alter Bestimmungen wäre dringend notwendig, da man sonst zu irreführenden ökologischen Daten kommt.

3. Es fällt auf, daß sehr viele bestimmte Taxa in der Gesamtkomposition einer tertiären Landschaft wie Fremdkörper wirken. GOTTWALD hat (1997) aus den Ortenburger Schottern eine Komposition von Hölzern bearbeitet, die so nicht in den Molassesedimenten vorkommen kann. Es handelt sich nämlich um Fossilien verschiedener ökologischer und klimatologischer Bereiche. Wir haben z.B. warm-gemäßigte (immer sensu KÖPPEN) Cfa- und tropische Af-Klimate in der Holztypen vertreten. Erstere passen in die Molasse, *Bombacoxylon* und andere Typen eben nicht. GOTTWALD hat soeben Kieselhölzer von der Alb bei Neuburg und Ingolstadt bearbeitet und ebenfalls wieder eine seltsame Mischung verschiedener Typen feststellt, darunter z.B. tropische Icacinaceen (vgl. auch LANG 2001, SELMEIER 1987). Hinzu kommt, daß alle tropischen Hölzer und deren Vergleichsgattungen im Eozän Europas weitverbreitet sind, aber nicht mehr im Neogen. Daß z.B. Juglandaceen, Lauraceen oder Platanaceen durchaus Jungtertiären Alters sein können und mit den anderen gemischt erscheinen, ist gut möglich und sogar wahrscheinlich. Haben wir doch im Delsberger Becken zwei bis drei verschieden alte Holzfloren zusammen gefunden (SELMEIER 1982).
4. Zur Transportproblematik bei großen und schweren fossilen Hölzern sei eigentlich nur kurz erwähnt, daß Hochwässer nach eigener Anschauung durchaus riesige Lasten transportieren können – unabhängig davon wie schwer sie sind. Gerade gut gerundete Kiese wie der Ortenburger Schotter oder die Grimmelfinger Graupensande sind gute Gleitmittel für Objekte aller Art – abhängig vom Gefälle. Da wir mit sporadischen Regenfällen und oft auch sicher langdauernden Überschwemmungen im Jungtertiär rechnen können (Cfa-Klima), ist auch die Wassermenge und damit die Durchfeuchtung des Sediments voll vorhanden (evtl. thixotrophes Verhalten). Aus diesen Gründen fehlt auch durchgehend eine echte Rinde.
5. Über die vermutlichen Herkunftsgebiete der umgelagerten Hölzer kann im Moment nur spekuliert werden. Liefergebiete im Osten, z.B. in Ungarn usw. sind wahrscheinlich, da dort häufig Eozän anzutreffen ist und ähnliche Holztypen auftreten wie in der Molasse. HOLLEIS & GREGOR haben bereits 1986 auf die Verteilung der Fundorte auf der Alb, die taxonomischen Bestimmungen der einzelnen Holztypen und die Umlagerung der Hölzer hingewiesen.

Zusammenfassend läßt sich also sagen, daß Kieselhölzer in Molassesedimenten nur bedingt zu palökologischen, paläoklimatologischen oder stratigraphischen Aussagen herangezogen werden können, aber als geologische „Problematika" sehr gute Indikatoren für Umlagerung und Rekonstruktion älterer Systeme gelten können (GREGOR & HOLLEIS 2002).

Literatur:

GOTTWALD, H.P.J. (1997): Alttertiäre Kieselhölzer aus miozänen Schottern der ostbayerischen Molasse bei Ortenburg.- Documenta naturae, 109: 1-83, 24 Abb., 4 Tab., 11 Taf., München. GOTTWALD, H.P.J. (2002): Kieselhölzer der Südlichen Frankenalb bei Neuburg/D. mit Kommentaren.- Documenta naturae, in. Vorb. GREGOR, H.-J. & HOLLEIS, P (2002): Kieselhölzer aus Bayern, ihre ökologisch-klimatologische Problematik, ihre Systematik und ihre geographische Verbreitung.- Documenta naturae (in. Vorb.). HOFMANN, E. (1944): Pflanzenreste aus den Phosphoritvorkommen von Prambachkirchen in Oberdonau, I. Teil.– Palaeontographica, Abt. B, **88**: 1-86, 11 Taf., Stuttgart. HOFMANN, E. (1952): Pflanzenreste aus dem Phosphoritvorkommen von Prambachkirchen in Oberösterreich, II. Teil. Palaeontographica, Abt. B., **92**: 122-183, 5 Taf., Stuttgart. HOLLEIS, P. & GREGOR, H.-J. (1986): Ein Beitrag zum Problem der Herkunft von Kieselhölzern auf der Südlichen Frankenalb und der Neufund einer Tepskya ebenda.- Archaeopteryx, 1986: 51-60, 2 Tab., 6 Abb., Eichstätt LANG,L. (2001): Lagerungsverhältnisse versteinerter Hölzer südlich Neuburg a.d.Donau.- Neuburger Kollektaneenblatt (Hrsg. Hist. Ver. Neubg.), Jahrbuch 149/2001: 183-196, 6 Abb., Neuburg. SELMEIER, A. (1958): Die Kieselhölzer des bayerischen Miozäns. - Ber.naturwiss.Ver. Landshut, 23: 24-95, 11 Taf., 1 Textabb., Landshut. SELMEIER, A. (1982): Verkieselte Holzreste aus den pontischen Vogesenschottern des Delsberger Beckens (Schweiz). -Cour. Forsch.-Inst.Senckenberg, 56: 33-41, 6 Abb., Frankfurt a.M. SELMEIER, A. (1987): Aufsammlung von Kieselhöl-zern der Südlichen Frankenalb. - Archaeopteryx 1985: 14-24, 9 Abb., Eichstätt.

Stratigraphische Übersichtstabelle des Paleogen und Neogen von Deutschland

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Die stratigraphische Kommission von Deutschland gibt zur Geotagung 2002 in Würzburg das Poster „Stratigraphische Übersichtstabelle von Deutschland" heraus. In dieser Tabelle sind die lithostratigraphischen Einheiten Deutschlands (Formationen) in Bezug zur Zeitgliederung dargestellt. Der paleogene und neogene Anteil auf diesem Poster wird hier vorgestellt.

Die deutschen Gebiete mit tertiären Ablagerungen wurden in vier (paläo)geographische Regionen (Norddeutschland, Rheingrabensystem, Molassebecken und Helvetikum) zusammengefasst. Norddeutschland wurde nochmals in Westen, Mitte und Osten dreigeteilt. Das Rheingrabensystem wurde in Mainzer Becken, Oberrheingraben und Hessische Senke unterteilt. Das Molassebecken wurde in die Spalten Westen inklusive Subalpin und Osten untergliedert, das Helvetikum nimmt lediglich eine Spalte ein.

In jeder Spalte sind die Formationen nach ihren Faziesbedingungen farblich gekennzeichnet. Folgende Fazies wurden unterschieden: Vollmarin, randmarin bis brackisch, limnisch-fluviatil und terrestrisch. Salzbildungen, Kohleflöze und Vulkanite wurden separat ausgehalten.

Palaeoecology of the Karpatian (Late Burdigalian) Korneuburg Basin

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The Korneuburg Basin is a SSE-NNE elongated basin of about 20 km length and attains a maximum width of 7 km. Its protected position - strongly cut off from the open Paratethys Sea in the south but variously connected in the north - caused a complex interplay of marine and coastal-terrestrial conditions. Rapid shifts in facies were triggered by short-termed sea-level oscillations, local, synsedimentary tectonics along the western margin of the basin and the changing courses of rivers and rivulets. Composition and distribution of the mollusc fauna and the lower vertebrates reflect various palaeoenvironments which formed in this late Early Miocene basin.

Hierarchical Cluster Analysis and non-metric Multi-Dimensional Scaling have been carried out in order to investigate the similarities of the faunas. The analysis shows clearly the presence of two distinct groups. The first cluster includes samples from three Teritzberg sites in marine-estuarine beds characterized by *Crassostrea gryphoides*/*Crenomytilus aquitanicus* accumulations, coal lenses and occurrence of terrestrial snails. The second group includes fully marine sites from the northern Korneuburg Basin and Kreuzstetten Bay. Typical stenohaline organisms like *Macrochlamis*, *Pecten* or *Aporrhais* are all absent in the first, southern Korneuburg Basin group. The gastropod fauna is strongly predominated by sublittoral, carnivorous and infaunal taxa. A complex marine ecosystem with sponges, corals, and various echinoderms can be predicted from the predators *Triphora perversa, Architectonica simplex, Zonaria dertamygdaloides, Ficopsis burdigalensis, Ficus cingulata* and *Phalium miolaevigata*. The bivalve assemblage of the northern Korneuburg Basin, too, hints at the predominance of fully marine, shallow water environments, although occasional salinity fluctuations might have affected the littoral zone.

In the southern basin especially the gastropods display several taxa which have modern counterparts in mangroves and the adjacent environments. These taxa are the ubiquitous *Terebralia bidendata, Nerita plutonis*, and probably also *Ptychopotamides papveraceus* and some of the exceptional diverse elobiids. Most potamidid, neritid, and elobiid gastropods dwell between the mean tide level and the mean high water level of neap tides, whereas the barnacles are restricted to the seaward fringe. An important ecosystem of the southern Korneuburg Basin has been established in the mixohaline shallow subtidal zone of an estuarine bay through extensive *Crassostrea gryphoides* biostromes. The giant euryhaline oyster formed extensive reefs adjoining the lower intertidal zone and giving shelter to numerous species which depended directly or indirectly on this ecosystem. Hardground dwelling species such as *Balanus amphitrite*, *Polydora* and clionid sponges are commonly found associated with the giant bivalves. Among the gastropods, *Thais* and *Ocenebra* preyed on the juvenile oysters and balanids. *Terebralia bidendata* and *Granulolabium plicatum* formed large populations on wide intertidal mudflats extending between mangroves and the subtidal zone, where they were associated with masses of hydrobiid gastropods. Subsequently vast *Crenomytilus aquitanicus* (=*Mytilus haidingeri*) colonies characterised the lower zone of those flats extending possibly into the shallow subtidal zone.

Fluvial influx is also well documented in the southern part of the basin. *Tinnyea escheri* and *Theodoxus crenulatus* which probably preferred swift estuarine-riverine environments as well as taxa of less agitated fresh water settings as *Lymnaea, Stagnicola* and *Planorbarius* are frequently found. Aside from Obergänserndorf, terrestrial through limnic environments and a strong fresh water influence is best documented at the western sections of Teiritzberg. Due to the Oberndorf-Mollmannsdorf Swell in the middle of the basin slightly drier habitats might have developed along the elevation. Close to Obergänserndorf a rather open, probably abandoned floodplain environment above the groundwater level developed.

Thus the wetland system of the southern Korneuburg Basin may best be interpreted as a small, narrow estuary which was bordered by rather abrupt tectonic margins. Typically, in estuaries the fresh river water discharge is blocked from streaming into the open sea by either surrounding mainland, peninsulas, barrier islands, or fringing salt marshes. In the Korneuburg Basin the eastern ridge of the Flysch Zone might have acted as such a barrier. The Obergänserndorf-Mollmannsdorf swell seems to have divided this estuarine southern part from a predominately marine northern part. In the vicinity of Obergänserndorf a small peninsula or a chain of barrier islands formed which was connected to the eastern margin of the basin. In the north a normal marine embayment formed, which hardly exceeded 20-30 m water depth. In respect to the diverse, normal marine fauna of the northern basin, the brackish influence in its northernmost tip, and the estuarine facies in the southern basin, a marine connection was most likely established along the north-eastern coast.

Middle Miocene rodent faunas from Hungary and Western Romania

Janos Hir

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The pre -Pannonian Miocene sediments were sadly neglected by the Hungarian vertebrate paleontologists up to 1980. In this year the locality Hasznos was excavated by László Kordos. The field activity was continued by the present author from 1995. During this campaign some new microvertebrate localities were intensively sampled. All of them come under the Sajó Valley Formation described as "Sarmatian terrestrial sequence" by the earlier scholars. The localities produced rich mollusc materials serve correlation between the MN -zones and the Central Paratethys stages. The lists of the rodents from the new faunas are the following.

1. Sámsonháza (Middle Badenian, MN6)
Spermophilinus bredai, Muscardinus sansaniensis, Microdyromys koenigswladi, Miodyromys aegercii, M. cf. aegercii, Megacricetodon minor, Democricetodon sp., Cricetodon cf. hungaricus, Eumyarion medius.

2. Mátraszőlős 1 -2 (Late Badenian, MN 7/8)
Eurolagus fontannessi, Spermophilinus bredai, Muscardinus aff. sansaniensis, Eliomys truci, Bransatoglis sp. (?), Eomyops oppligeri, Keramidomys mohleri, Democricetodon mutilus, D. cf. freisingensis, Megacricetodon minor, Cricetodon cf. hungaricus, Eumyarion latior, Anomalomys gaudryi.

3. Felsőtárkány 1. (Late Sarmatian, MN 7/8)
Paraglirulus sp., Myoglis meini, Eomyops oppligeri, Keramidomys cf. mohleri, Megacricetodon sp., Anomalomys gaudryi.

4. Felsőtárkány 3/2 (Late Sarmatian, MN 7/8)
Spermophilinus bredai, Miopetaurista sp., Blackia miocaenica, Muscardinus aff. sansaniensis, Microdyromys miocaenicus, Paraglirulus sp., Myoglis meini, Eomyops oppligeri, Keramidomys mohleri, Megacricetodon aff. minor, Eumyarion medius, Collimys sp., Anomalomys gaudryi.

5. Egerbocs (uncertain stratigraphic position)
Palaeosciurus sp., Forsythia gaudryi, Megacricetodon sp., Democricetodon sp.

From the Middle Miocene of Romania only Comanesti was published by Costin Radulescu and Petre Samson. In 2000 Marton Venczel and Janos Hir excavated the locality Tasad (Early Sarmatian, Volchynian, MN 7/8).

Spermophilinus bredai, Muscardinus aff. sansaniensis, Eliomys sp., Demo-cricetodon brevis, Megacricetodon cf. minor, Eumyarion medius, Cricetodon sp.

Der Wellenberg bei Frauenfeld - die jüngsten Anteile der Oberen Süsswassermolasse der Ostschweiz: biostratigraphische Daten und tektonische Implikationen

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CH-3003 Bern-Ittigen

Die in den letzten Jahren in der Oberen Süsswassermolasse (OSM) der Ostschweiz getätigten säugetierstratigraphischen Untersuchungen ergaben Resultate sowohl bezüglich der Altersfrage und der Korrelation verschiedener OSM-Profile als auch zur Molassetektonik südwestlich des Bodensees:

Der östlich von Frauenfeld gelegene Wellenberg stellt innerhalb der Oberen Süsswassermolasse (OSM) der Ostschweiz einen distalen Faziesbereich der Hörnli-Schüttung dar. Deren lithologische Entwicklung wird im ca. 180 m mächtigen Profil Chräzerentobel auf der Nordseite des Wellenberges dokumentiert. Drei in diesem Profil gelegene und zwei benachbarte Säugetier-Fundstellen erlauben eine Einstufung des Profils in den basalen und mittleren Bereich der Säugetiereinheit MN 7+8 (Oberes Mittelmiozän). Die Säugetierfunde zeigen auf, dass die höchsten Anteile des Wellenberges die bisher jüngsten datierbaren OSM-Sedimente der Ostschweiz darstellen. Speziell hervorzuheben ist die höchstgelegene, gut dokumentierte und faunistisch diverse Fundstelle Chräzerentobel 655m (BOLLIGER 1998), die aufgrund ihrer Kleinsäugerfauna jünger einzustufen ist als die ehemalige europäische Referenzfauna für MN 8, Anwil. Chräzerentobel 655m repräsentiert ein intermediäres Niveau zwischen den schweizerischen Referenzlokalitäten Anwil (MN 8, hohes Mittelmiozän) und Nebelbergweg (basale MN 9, tiefes Obermiozän).

Mit Hilfe der vorliegenden Kleinsäugerfunde kann aufgezeigt werden, dass die Untergrenze der sg. "Konglomeratstufe" (sensu HOFMANN 1951) im Gebiet Bischofszell - Wil - Frauenfeld von proximal nach distal jünger (diachron) ist und zudem teilweise auf falschen lithostratigraphischen Korrelationen beruht. Beckenparallel scheint das Einsetzen einzelner markanter Konglomeratschübe hingegen ± isochron ausgebildet zu sein. Mehrere neue Säugetierfundstellen erlauben eine Klarstellung und Vereinfachung der Stratigraphie der OSM im Querschnitt Tannenberg – Wellenberg. Im wesentlichen zeigt sich eine weitgehende Übereinstimmung der Schichtmächtigkeiten mit vergleichbaren OSM-Abfolgen im westlichen und nördlichen Hörnli-Schuttfächer (Zürichsee-Gebiet und Umgebung südöstlich Winterthur). Die einander entsprechenden Bentonitvorkommen von Bischofszell und Waldkirch/Mollen werden als ein neues, stratigrapisch höchstgelegenes Bentonitniveau der Ostschweiz erkannt.

Die topographisch tiefe Lage der jüngsten OSM des Wellenbergs bedingt die Existenz von bedeutenden Längs- und Querbrüchen in der Molasse südwestlich des Bodensees. Mit den hier vorliegenden biostratigraphischen Daten können die Lage und die Versetzungsbeträge einiger Bruchsysteme ermittelt werden. Eine Mehrzahl der von früheren Autoren postulierten Brüche und Horst-Graben-Strukturen muss hingegen negiert werden. Insbesondere der von SCHMIDLE (1931) und HOFMANN (1951) postulierte „Thurgraben“ kann nicht bestätigt werden. Insgesamt ergibt sich für den Querschnitt Tannenberg – Seerücken das Bild einer durch abgesunkene Schollen geprägten Extensionstektonik, die sich in einer senkenähnlichen Struktur mit Tiefpunkt auf der Höhe des Wellenbergs äussert.

Late Oligocene algal limestones on a mixed carbonate-siliciclastic ramp at the south margin of the Bohemian Massif (Upper Austria)

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The Upper Oligocene (Chattian, Lower Egerian) Linz Sands of the sand pit 'Treul' in Steyregg (near Linz, Upper Austria) contain a >40 m thick succession of siliciclastic and carbonate sediments. They are characterized by a low diversity of facies and components. Microfacies and granulometric analyses allowed the designation of four facies: coralline algal rudstone facies, terrigenous - coralline algal rudstone facies, miogypsinid facies, and siliciclastic facies. Siliciclastics derive from the crystalline basement and show a wide range of grain sizes from arenites to boulders. Main carbonate components are coralline algae, benthic foraminifers (especially miogypsinids) and oysters. The identification of *Miogypsina formosensis* YABE et HANZAWA and its delimitation from *M. complanata* SCHLUMBERGER and *M. banthamensis* TAN SIN HOK revealed that the studied sequence was deposited between 25 and 24 million years b. p. Granulometric and paleoecological studies, as well as actualistic comparisons allowed the interpretation of the sedimentary environment. The studied sediments were deposited on a mixed carbonate-siliciclastic ramp above fair weather wave base. Vertical and lateral transitions from siliciclastics to carbonates suggest trends from proximal to distal environments and thus backstepping of the ramp. These frequent transitions are probably caused by sea level changes due to local tectonics. Erosion of the crystalline underground and formation of submarine dunes by wave agitation took place during sea level low stands. Sea level high stands caused settling of coralline algae on the dunes, which led to the formation of wide '*Maerl*' fields. The following sea level low stand either caused the transport of siliciclastic dunes over the '*Maerl*' fields or erosion due to absent accommodation space.

Benthic Foraminifers in warm temperate carbonate sediments of the Gulf of Naples

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The Mediterranean area is nowadays a small rest of the formerly global Tethys after neogene cooling and narrowing by the north drifting Africa. During the Tertiary temporary a southern remaining Tethys and a northern Paratethys developed and climate changed from tropical into warm temperate nowadays. The system of today warm temperate biocenoses In the Mediterranean was first described from PERES & PICARD. Seagrass meadows and coralline algae (*Maerl*) play a most important role in shallow water carbonate production. Seagrass reached their extended distribution during the Oligocene and Miocene times and were found well present in the Paratethys area (Sirens/seagrass in Oligocene Linz Sands). A unique example of Oligocene *Maerl* is presented on the Poster next to this. The geological history of seagrass communities was reconstructed because seagrass communities and associated animals (foraminifers and sirens) radiated equitemporal. The geological history of seagrass communities was substantially reconstructed with foraminifers. The geological history of sirens through the tertiary (basing on teeth) led to the concept of a gradual shift in primary phaeophytic ecosystems from seagrass to brown algae in a time of gradual cooling earth climate.

The *Gulf of Naples* in Italy is a rhomboid bay opening SW to the Tyrrhenian Sea. The bay is built of volcanic tuffs and ashes at the NW and of Mesozoic limestones at the SE side. The seafloor in the Gulf has a rich topography with an extended shallow coastal plain and two canons leading into the Deep Sea abyssal plain. The main force on shallow water sedimentology are storm winds and coastal parallel water flows as part of the salinity driven *Mediterranean Current System.* Main carbonate producing ecosystems are seagrass meadows close to the island *Ischia* at the northern edge and coralline algae on top of volcanic remains in the bay centre.

Shallow seagrass grows in mats cut by erosion channels because most localities with seagrass stands are stressed by storms and currents. *Maerl* thrives in the centre of the bay in deeper and quiet positions in some distance from land. Hydrodynamic forces on sediments were reconstructed with log normal grain size distributions and settling velocities.

Biogene particles compositions are very often formed by the hydrodynamic conditions. In dynamic localities sediments are rich in gastropods and coralline algae, and poor in bryozoans and foraminifers. Bryozoans and foraminifers are well present in accumulative and quiet positions.

Biogene particles are stored in seagrass mats and set free by eroding waves. Where present currents transport and sort them. Winnowing storm waves mobilise and transport foraminifers from deeper exposed submarine banks into greater depths.

Post-Eocene evolution of the North Alpine Foreland Basin and its response to Alpine tectonics*

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The post-flysch (Oligocene – Miocene) palaeogeographic evolution of the entire North Alpine Foreland Basin (NAFB) between Savoy (France) and Lower Austria is presented in eight sketch maps. The compilation considers the palinspastic evolution of the Alps. It includes intramontane deposits, which represent a continuous marginal facies of the NAFB during Rupelian to Early Burdigalian times.

The facies distribution in the NAFB was driven by two major types of processes, which were related to the tectonic evolution of the Alpine orogen. The first type, representing tectonic processes at the thrust front of the Alps, directly influenced the facies distribution of the narrowing NAFB. The second type represents an indirect impact of Alpine uplift and tectonics to the NAFB, transformed by the varying amount of sediment discharge.

A strong increase in sediment discharge due to uplift of the Alps is the major reason for the generally regressive coarsening- and shallowing-upward cycle of the Lower Marine and Lower Freshwater Molasse (UMM, USM) between 33 and 21 Ma. The development of the „Burdigalian Seaway" at ~ 20 Ma occurred coeval with a reduction of thrust advance rates in the western and central part of the NAFB. Shallow marine conditions (Upper Marine Molasse, OMM) prevailed for ~ 3 Myrs. In the Eastern Alps, reduction of relief caused a strong reduction in sediment discharge due to lateral (east-west-oriented) extension. Closure of the „Burdigalian Seaway" around 17 Ma occurred during a phase of tectonic reorganisation in the Alpine orogen and is coeval with a short-term increase in sediment discharge. Between 17 and 12 Ma, the NAFB was constantly overfilled (Upper Freshwater Molasse, OSM), despite of strongly decreasing sediment discharge. Termination of sedimentation in the (unfolded) NAFB occcured diachronously in an undramatic process. It started in the western NAFB in the course of uplift of the Swiss Jura Mountains after 11 Ma and reached Lower Austria around 6-5 Ma. Strong uplift of Alps and NAFB started at around 6 Ma in the Swiss and Western Alps and at 4-3 Ma in the Eastern Alps. The uplift has been followed by subsequent reworking and erosion of more than 2 km of Molasse sediments in the western NAFB.

*) Title of recent publication by J. Kuhlemann and O. Kempf (Sedimentary Geology, in press).

Frühontogenetische Entwicklung brackischer Mollusken im Miozän der Westlichen und Zentralen Paratethys: systematische und paläoökologische Implikationen

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Die frühe Ontogenese und reflektierte Protoconchmorphologie von Gastropoden und Bivalven des Brackwassers wird anhand ausgewählter Beispiele aus dem Ottnangium der Kirchberger Schichten und Oncophora-Schichten Bayerns (Westliche Paratethys) sowie des Korneuburger Beckens (Zentrale Paratethys) und entsprechender Faunen des Östlichen Mediterrans vergleichend dargestellt. Die Faunen werden auch hinsichtlich der Larvalökologie und ihrer Ökozonierung in den Habitaten charakterisiert und mit sarmatischen Molluskenassoziationen aus dem Eisenstadt-Sopron Becken (Niederösterreich, Westungarn) verglichen.

Die überwiegende Zahl der Brackwassermollusken waren durch eine indirekte Entwicklung gekennzeichnet, in deren Verlauf sich an eine dotterarme Embryogenese ein mehr oder weniger ausgedehntes planktotrophes Larvalstadium anschloss, während dessen eine eigene von der Embryonalschale differenzierte Larvalschale gebildet wurde. Direktentwickler, in deren früher Ontogenese sich an die dotterreiche Embryonalentwicklung der Schlupf in Gestalt kriechender Jungtiere anschloss, traten viel seltener auf.

Protoconchmorphologische Daten ermöglichten neben Interpretationen zur (Larval-)ökologie auch eine gute Abgrenzung nahe verwandter Taxa, insbesondere innerhalb der Neritidae (Neritimorpha, Neritoidea), der Rissooidea (Caenogastropoda, Littorinimorpha) und der Potamididae (Caenogastropoda, Cerithioidea), und auch innerhalb gehäusekonvergenter Gruppen.

Der Vergleich frühontogenetischer Schalen der Ottnang-Faunen zeigte, dass in der Zentralen Paratethys und auch in entsprechenden mediterranen Faunen alle dort hinsichtlich ihrer Protoconchmorphologie bekannten brackischen Mollusken durch eine indirekte Entwicklung gekennzeichnet waren, wogegen in der Westlichen Paratethys nur Bivalven (Cardiidae, Dreissenidae) durchweg planktotrophe Larvalstadien aufwiesen. Die Gastropoden hingegen waren bis auf Vertreter der Gattung *Ctyrokia* (Hydrobiidae) Direktentwickler. In den Ablagerungsräumen der Westlichen Paratethys fehlten ausgedehnte Wattenflächen und Mangrovezonen in der Verzahnung der Küstensümpfe mit dem offenen Meer, die vorwiegend von planktotrophen Vertretern besiedelt wurden. Hier lagen vielmehr ruhigere Küstensumpf-Faziesbereiche vor, an die sich landwärts stärker gegliederte oligohaline bis Süßwasserbiotope anschlossen.

Das völlige Fehlen von Vertretern der Potamididae im Ottnangium der Westlichen Paratethys wird nicht auf klimatische oder ökologische Gründe zurückgeführt, wie auch im Vergleich zu Sarmatischen Faunen mit entsprechender Paläoökologie deutlich wird. Vielmehr spiegelt die Zusammensetzung der Faunen in den einzelnen Ablagerungsräumen eine vollkommene Trennung der Westlichen Paratethys von der Zentralen/Östlichen Paratethys in diesem Zeitraum wider.

Palaeoecology of a Badenian echinoderm-brachiopod assemblage from the initial Leitha Platform ("Hartl-sands", Eisenstadt – Austria)

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During the Badenian two small carbonate platforms formed in the north western part of the Central Paratethys Sea in the Eisenstadt-Sopron Basin. They acted as barrier between the rather protected Vienna Basin and the wide Danube Basin. However, water exchange between the basins was warranted by a broad connection between the Lesser Carpathians and the Leitha Mountains. A smaller connection was also developed in the very south of the Eisenstadt-Sopron Basin. Finally, a narrow sea way of hardly 5 km width was present between the Leitha platform in the north and the Fertörákos platform in the SSE. This palaeogeographic situation seems to have favoured considerable currents in this strait. Consequently, the nearshore biotas along the southern Leitha Mountains profited from high agitation and rich nutrient supply.

An exceptional site documenting such a Badenian palaeoenvironment is outcropped close to Eisenstadt. The deposits were introduced as the so-called "Hartl sands" or "Terebratel sands" - moderately to well sorted, coarse sandy sediments. Their source rocks are the metamorphic units of the Lower Austroalpine which form the core of the Leitha mountains. The dating into the Early Badenian Late Lagenid Zone and their position below the Leitha limestones reveal these siliciclastics as the basal development of the Badenian cycle. Thus they document the very initial phase of the platform development. Within a sequence stratigraphical system the deposits belong to the basal Carpathian-Pannonian Cycle 4 after BÁRATH & KOVÁC (2001) and correspond to the transgressive systems tract (TST 2) of the Vienna Basin after WEISSENBÄCK (1996).

The sands are very rich in bioclasts, namely brachiopods, bryozoans and echinoderms. More rarely, calcitic molluscs, balanids and crustaceans occur. The sediments are characterised by intense cross bedding, indicating a nearshore environment with higher water energy. The brachiopod fauna is dominated by "*Terebratula*" *macrescens* DREGER, which can be found throughout the section, locally forming small shell beds. The valves of this species act as secondary hardgrounds, which are settled by a diverse bryozoan fauna. *Megathiris detruncata* (GMELIN), a very small species, which is still living in the Mediterranean sea, occurs less commonly.

The echinoderm fauna is preserved in form of disarticulated ossicles, which show signs of intense abrasion due to the high water energy. Vertebrae of Gorgonocephalids with branched arms are very common. These ophiuroids are suspension-feeders, which occupy regions of moderately strong water currents. In extant settings they are associated with gorgonians, stony corals, fire corals and sponges. During the day the animals are usually hidden in crevices. At dusk they leave their shelter and ascend an elevated perch, where they attain their feeding posture. Other ophiuroids are rare and preserved in form of few heavily abraded lateral plates only, which cannot be determined specifically.

Another common echinoderm group are the echinoids, which are represented by several species within the section. Most abundant are spines and plates of *Eucidaris zeamays*, a small cidaroid, which lived as a cryptic omnivore in the shallow subtidal. Closely related extant species are typically associated with coral reefs, coral carpets and sands with coral patches (*E. metularia*), as well as sandy or rocky bottoms with turtle grass (*E. tribuloides*). Spines and less commonly isolated coronal plates of Diadematids are also very frequent. This group of long-spined echinoids is characteristic of the shallow littoral and sublittoral of warm temperate to tropical seas and are often associated with coral reefs. They do also occur on sandy bottoms, in association with sea grass. *Arbacina* sp., a small temnopleurid, presumably was epibiont in sheltered subtidal environments, such as bryozoan thickets, macroalgae, and seagrass meadows. *Echinocyamus stellatus*, a minute ovoid clypeasteroid, occurs abundantly in the samples from the lower part of the section. Extant *Echinocyamus* inhabit a wide range of sediments ranging from muddy sands to gravel but are associated with seagrass in most cases.

Two groups of asteroids are recognised within the samples: astropectinids, represented by *Astropecten* sp. and *Luidia* sp., and undetermined goniasterids. Both *Astropecten* and *Luidia* are typical inhabitants of sandy bottoms and are occasionally associated with seagrass patches. Rare crinoid remains consist of indeterminable brachial and cirral ossicles and a single calyx of a comatulid. The comatulids are nocturnal suspension feeders, which facilitate elevated structures on the seafloor to improve the feeding success.

Aragonitic hard parts are dissolved but may be still traceable by moulds and imprints in colonies of fouling organisms such as bryozoans. Among these especially the large colonies of celleporids predominate the sediment. Many of these colonies bear witness to pagurizaition by hermit crabs, because they encrust gastropod shells down to the aperture without closing it. Similar features were described from coralline red algae encrusting pagurized gastrops in a rocky tidal flat in the Red Sea (ZUSCHIN & PILLER, 1996).

Thus the preserved echinoderm, brachiopod, bryozoan assemblage is typical for a very shallow, coarse sandy habitat with seagrass and/or coral patches, indicating the presence of moderately strong currents, which were facilitated by the suspension feeding taxa.

Stable isotope signatures at the Karpatian-Badenian boundary in the Styrian Neogene Basin

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The Styrian Neogene Basin is a subbasin of the Pannonian Basin System and part of the Central Paratethys (Rögl 1998). It is divided by the Middle Styrian Swell into the shallower Western Styrian Basin and the deeper Eastern Styrian Basin consisting of the Gnas and Fürstenfeld Basin. The South Burgenland Swell separates the Styrian Basin from the Pannonian Basin.

The Neogene sedimentation starts in the Ottnangian. During the Karpatian rapid subsidence due to a synrift phase and a transgression from the south leads to the sedimentation of calcareous mudstones and siltstones of some hundred meters thickness ("Steirischer Schlier") in the Gnas and Fürstenfeld Basin. At the end of the Karpatian tectonic activity increases and causes block rotations and uplift of the western hinterland and the Middle Styrian Swell ("Styrian phase"). Although subsidence rates decreased in the Badenian, the sea reached its largest extent at the end of the Early Badenian (Ebner & Sachsenhofer 1991, Sachsenhofer 1996). The "Styrian unconformity" above the "Steirischer Schlier" is datet in the Karpatian after Friebe (1991) but in the Badenian after Auer (1996).

The main part of the section of Wagna is built of Karpatian siltstones and mudstones. Early Badenian sedimentation above the "Styrian unconformity" starts with siltstones and fine sands. Paleodepth estimations yield water depths between 150 to 210 m with a shallowing upward trend (Spezzaferri et al. 2001). Two parallel sections in Wagna (Wagna 1 and 2) have been sampled for stable isotope analyses. Measurements were made on bulk-rock samples. The isotope ratios of carbon and oxygen, the total carbon content, the organic carbon content, sulfur content and carbonate content were determined on 24 samples from Wagna 1 and on 18 samples from Wagna 2. In both sections oxygen isotopes show an abrupt decrease at the unconformity of about 1.7 ‰. Wagna 1 shows values between -4.39 ‰ and -3.18 ‰ below the unconformity. After the abrupt decrease values range from -5.94 ‰ to -4.88 ‰. The section Wagna 2 yields similar values: $\delta^{18}O$ values range from -4.16 ‰ to -3.31 ‰ in the lower part of the section and above the unconformity encompass values from -6.52 ‰ to -3.38 ‰. Comparing Wagna 1 and 2, the isotope trends up to the unconformity are the same but above the unconformity $\delta^{18}O$ differs in the two sections. Carbon isotopes show also a decrease at the unconformity, which is about 0.5 ‰ in Wagna 1 and 0.8 ‰ in Wagna 2, respectively. Wagna 1 and 2 show the same trends in δ^{13} C values. The shift in the iostope signal at the unconformity indicates drastic environmental changes. The decrease in δ^{18} O may be indicative for an increase in water temperature.

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Middle Miocene mollusc bearing series of Gainfarn (SW Vienna Basin, Austria)

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New aspects of facies development, depositional history, palaeogeographic and stratigraphic settings of the Middle Miocene fossil lagerstätte at Gainfarn in SW Vienna Basin (Austria) became available. Although taxonomy of its extraordinary rich fossil record conspicuously dominated by molluscs became documented in detail by numerous studies, their distribution within the sediment remains more or less unknown. In fact, those studies did not consider the whole succession and in consequence could not gather any shifts in palaeoenvironments. Moreover, despite the diverse and indicative mollusc assemblages, no modern analyses of the palaeocommunity structures or interpretations of palaeoenvironments were based on the molluscs which made Gainfarn one of the classical Middle Miocene sections. Also due to missing natural outcrop, the detailed facies developments of the locality as well as comprehensive studies of palaeoecological and taphonomic features, have not yet received much attention. Thus to shed more light onto these relationships and developments, seven artificial outcrops along a slope ascending south of the village Gainfarn were investigated in the present study, providing for the first time a complete picture of the depositionary and environmental history of that unique site.

Three distinct sequences - two coarsening upwards cycles and one lagoonal sequence - characterised by conspicuously different biofacies types has been discovered due to series of artificial outcrops. A quantitative and qualitative analysis of molluscs which dominate the macrofossil record as well as the consideration of sedimentological features, allowed us to interpret the series as result of repeated fluctuations in water energy and oscillating sea-level. Age inference by biostratigraphical and sequence stratigraphical methods allowed cautious correlation of the boundary between 2nd and 3rd cycle with the Upper Lagenidae and *Spiroplectamina* Vienna Basin ecozone boundary, corresponding to Lower to Middle Badenian transition and upper part of the Langhian Standard Stage, respectively.

Two basal cycles reflect coarsening and shallowing upwards trends. Both start with calm, muddy environments below the wave base and terminate in well agitated shoreface facies, hosting a highly diverse mollusc fauna. The first one is a 4 meter thick sequence beginning with silty clays passing upsection into coarse sands and gravels. The sorting becomes better upwards. The coarse sediment package is characterised by two distinct layers with *Panopea* shells in life position interbedding with two shell accumulations, interpreted as tempestites. The second cycle attains a thickness of 6 meters and shows similar sedimentary development, except for the upper part characterised by a prominent, horizontal cobble layer followed by a shell accumulation showing highly developed relief and characterised by a conspicuously diverse mollusc fauna, containing the typical taxa the site is famous for (e.g. *Strombus*, *Codakia*, *Megacardita*).

The third and uppermost cycle is 5 meter thick and differs from former ones by a striking change of the biofacies and consistently fine grained (clay-silt) sediment. It begins with a remarkable faunal assemblage dominated by oysters (*Ostrea*) and vermetids (*Lemintina*) which inhabited this pelitic environment by forming clusters and/or small-scale thickets (oyster beds). We interpret the environment as a sheltered, possibly lagoonal setting still characterised by an increasing turbidity load. In fact on basis of dynamic and vibrant biofacies development, a fair surface water exchange with the open sea can be postulated. Finally, upsection, a distinct shift from those epibenthic, vermetid-oyster facies towards infaunal, nuculid bivalve dominated assemblages within the upper part of that third cycle occur, reflecting a considerable deepening of the depositional environment.

Facies Architecture of the southern part of the Carpathian Foredeep (Subsurface Data)

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The Carpathian Foredeep is peripheral foreland basin formed as the result of flexural down buckling of the passive North European Plate margin (represented by Bohemian Massif in the area of study) in the foreland of the Alpine-Carpathian orogene belt. Neogene (Egerian to Lower Badenian, i.e. 22,5 Ma - 15,5 Ma) deposits fill the basin in the studied area.

The aim of the study of subsurface data (wireline logs, seismic reflection profiles, drill cores) was collection of the data for the lithostratigraphy of the basin and application of "alternative" stratigraphic techniques. Studied area represents proximal (i.e. adjacent to the active thrust front) part of the basin with strong dominance of basinal deposits.

Several macro-elements can be followed within the studied part of the basin in seismic reflection profiles. Recognised elements represent "superior" evolutional stages of the basin development. Basin configuration differs significantly during these stages and is predominantly driven by tectonic processes within the accretionary wedge.

Lower element cover/mantle flexural bending of the pre-Neogene basement of the basin. Basement morphology influenced thickness, provenance, development and character of deposits. Eggenburgian deposits form the lower element. Middle element is typical by its generally wedge shape, gradual onlap of its base towards the W, and thickening generally from W, NW towards E, SE. Predominantly Karpatian deposits form the middle element. Eggenburgian (Ottnangian?) deposits were locally recognised on its base. The shape of the upper element resembles flat depression. Element is situated in the middle part of the basin and limited by seismic reflector (termination surface). The surface is interpreted as tectonic line (detachement horizon). Lower Badenian and Karpatian deposits form the upper element. More complicated internal organisation of the upper element is supposed.

Significant differences in lithology (sedimentary textures and structures) and petrography of sedimentary fill of elements reflect the existence of individual depositional cycles and lithofacies within them. "Subordinate" evolutional stages of the basin can be followed. Formation of accommodation space, facies architecture and distribution were governed by tectonic processes, relative sea-level changes and sediment supply. Erosion and tectonic deformation contributed to relative narrow shape of the basin (the rigidity of the Bohemian Massif was principal). Large volumes of deposits (especially Karpatian and Lower Badenian ones) were eroded. Both strong dominance of basinal lithofacies (Karpatian schlier, Lower Badenian tegel) and almost an absence of their marginal equivalents confirm this erosion. Geologic situation in the proximal part of the basin can be only partly compared with the situation on the opposite distal (i.e. adjacent to the forebulge) part of the basin (Nehyba 2000).

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Lower Badenian coarse-grained deltas in the southern part of the Carpathian Foredeep (Czech Republic)

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The Carpathian Foredeep is peripheral foreland basin formed as the result of flexural down buckling of the passive North European Plate margin (represented by Bohemian Massif in the area of study) in the foreland of the Alpine-Carpathian orogene belt. Neogene (Egerian to Lower Badenian, i.e. 22,5 Ma - 15,5 Ma) deposits fill the basin in the studied area.

Lower Badenian (16,5 Ma – 15,5 Ma) deposits represent the final stage of basin evolution. Two dominant lithofacies were recognised within the Lower Badenian deposits in the southern part of the basin. Coarse clastics (gravels, gravely sands, coarse-sands) were traditionally assigned as basal or marginal ones, owing to the relation to the dominant Lower Badenian pelitic facies ("Lower Badenian tegel"). Coarse-grained Lower Badenian clastics overlie older fine-grained basinal Karpatian deposits of the basin or lie directly on the basement. The thickness of gravels and gravely sands ranges in the studied part of basin from several m to 175m. Gravels are polymict and their composition is directed by the local sources (Precambrian crystalline rocks, Palaeozoic graywackes and shales, Mesozoic carbonates). Presence of mudstone intraclasts is characteristic. Their fossil content (foraminifera, calcareous nannofossils, mollusca shells) is mainly of Lower Miocene age (Eggenburgian, Ottnangian, Karpatian), reflecting erosion (cannibalisation) of basin fill itself.

The clastics are interpreted as products of coarse-grained delta systems. The presence of coarse-grained delta deposits reflects important reconstruction of the foreland basin configuration. Coarse-grained deltas developed on the both active and passive margins (i.e. thrust front and peripheral bulge) of relative narrow (about 10 km wide) basin during less than 1 Ma. Interaction of tectonic activity (both foreland bulge and thrust belt) and sea level change were in general the major ruling factors for the evolution of basin and its fill. Detailed study of drill holes revealed complicated relations of coarse clastics to basinal pelitic deposits in various parts of the basin. Influence of various "local" ruling factors (sediment supply, basin margin topography, etc.) can be used for explanation. Combination of "general" and "local" factors led to distinct evolution of the diverse delta systems. Importance of understanding of position and development of these systems in time and space for high-resolution sequence stratigraphy of the basin is evident.

Studied coarse-grained deltas can be classified as shallow-water ones (Postma 1990). Deposits of gravity flows (Nemec 1990) formed on the primary inclined subaqueous delta slopes. The scarcity of mud fraction within the foresets deposits probably played important role for characteristics of transport.

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Chemosymbiosis, fossil lucinoid bioturbations and the *Chondrites* enigma

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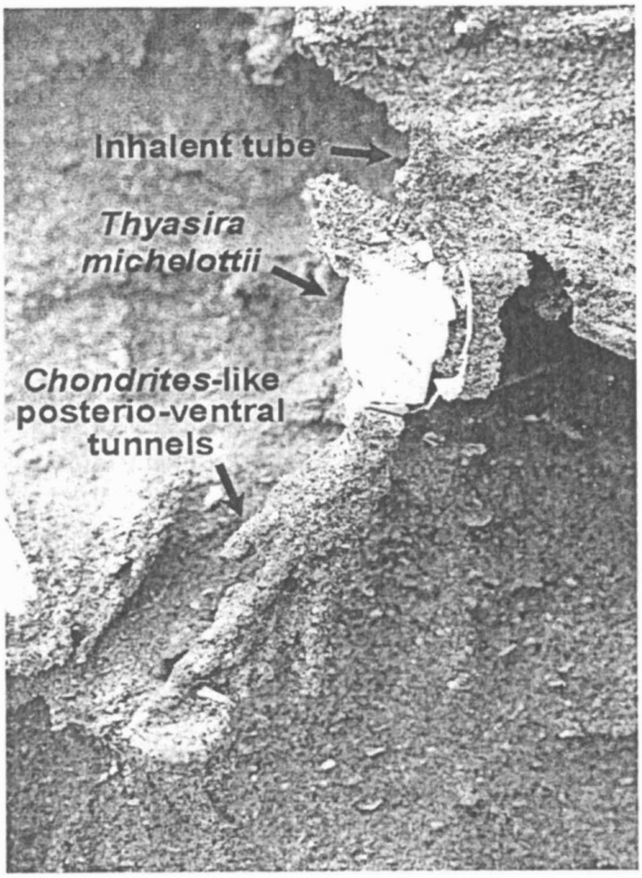
The trace fossil *Chondrites*, although widespread in different trace fossil assemblages, is used as an indicator of low-oxygen (dysaerobic) conditions if occurring as single feature. Sediment-ingesting polychaetes, sipunculids, or even detritus-feeding arthropods had been regarded as potential constructors of *Chondrites*-like structures, yet solid proof is missing. Here, we present the unique in situ preservation of the burrowing bivalve *Thyasira michelottii* (R. Hörnes, 1875) together with its *Chondrites*-like bioturbations and provide evidence for chemosymbiontic life strategies under dysaerobic conditions.



Thyasira michelottii from shallow marine sediments of the Austrian Miocene (Grund Formation, Lower Badenian) produced not only the inhalent tube but also a system of ramifications below their life position. The circular to blade-shaped and weakly to densely branching shafts have diameters up to 3 mm and reach down to 10 cm into the sediment below the ventral shell margin. The *Chondrites*-like posterio-ventral tunnel branchings reflect the search of the burrowing, worm-shaped foot for short-lived pockets of sulfidic material in an otherwise low-sulfide environment.

Chemosymbiontic strategies are responsible for the morphological similarity between recent *Thyasira* burrows and *Chondrites* trace fossils. In chemoautotrophic symbioses, bacteria provide the host with some form of chemosynthetically fixed carbon obtained through the oxidation of reduced sulfur; the bacteria benefit from a protected environment. Among the Lucinoidea, special anatomical and morphological features like thick gills, reduced palps, short simple gut, and an elongated burrowing foot are interpreted as an adaptation to oxygen- and nutrient-poor habitats. The *Chondrites*-like branching burrow systems are formed when the clams use their extendable feet to obtain hydrogen sulfide from interstitial water in the underlying sediments.

Environmental significance of bioturbations in the Grund Formation (Miocene, Lower Badenian) in northern Lower Austria.

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Sedimentology, Paleontology and Ichnology of the lower Badenian (early Middle Miocene) Grund Formation could be studied during field campaigns in 1998 and 1999. Several deep trenches (profiles A, B, C, D, E, F, G, H) were excavated in the farmland between the villages of Grund and Guntersdorf north of Hollabrunn in northern Lower Austria.

The profiles at the type locality Grund show sediments from a shallow marine, highly erosive environment with small channels. The channel-fill with densely packed (bioclast supported) shell-layers at the base, fining upward cycles of coarse to fine sands, and thin pelitic layers on the top indicate periodically high-energy events with rapidly decreasing energy level. The channels always have a sharp erosive base and maximum visible extentions of 7 to 8 meters with a depths of 0.5 to 1 meter.

In the lower part of the sequence (profiles A, B) sandy beds with a thickness from 60 to 120 cm contain up to 40 cm thick layers of pelitic clasts, showing strong reworking. Besides the clasts these layers contain a mixed allochthonous fauna with marine mollusks, terrestrial gastropods and bones of different vertebrates (turtles, whales, rhinos, small carnivores and micro mammals).

Towards the top of the sequence thickness and grain size of the beds are decreasing. In the middle part of the sequence in profiles C and D 20 to 45 cm thick medium to fine grained sandy beds show fining upward and even lamination. Current ripples and plant debris at the top of some beds show the reduction of current velocity too. Several cm-thick pelitic layers mostly cover the laminated sands. Intense but monospecific bioturbation (*Asterosoma*) starts from these layers but reaches down only up to 5 cm into the sandy layers. The sandbodies in this part are mostly tabular sometimes slightly wedge-shaped. In rare cases small and narrow runnels, 60 to 80 cm wide and 10 to 25 cm deep, with erosive base and filled with pelitic clasts can be found.

The uppermost part (profiles E, F, G, H) also contains evenly laminated, medium to fine sands with graded bedding but thickness of the pelitic layers is increasing towards the top of the sequence. In some cases shell-layers and small pelitic clasts at the base and plant debris on the top still occur in the sands. Developing from the 10 to 20 cm thick pelitic layers a diverse trace fossil community reaches down into the sands. *Rhizocorallium*, *Teichichnus* and *Zoophycos* are very frequent structures but also *Ophiomorpha* can be observed. The chemosymbiontic bivalve *Thyasira michelottii* occurs as exclusively autochthonous inhabitant of these layers. The Thyasira-shells sometimes are connected with deep shafts, but in most cases with *Chondrites*-like ventral tunnels.

The distribution and diversity of bioturbations is highly correlated to the hydrodynamic level. The basal sections of the sequence show the highest disturbance of the benthos. Only oportunistic organisms with burrowing strategies fitting to the mobile sediment can settle during short periods of quiet conditions.

Probably the deepening of this environment caused the increase of calm periods toward the top. Longer periods of benthic recovery after physical disturbances lead to the increase of burrowing depth and diversity. Deposit feeding and chemosymbiontic strategies are characteristic features of the uppermost parts in the excavated sections of the Grund Formation.

The decrease of the hydrodynamic energy level from the base of the sequence to its top is obvious in the sedimentological record as well as in the development of trace fossil assemblages. This fits very well to the regional transgressiv trend of the lower Badenian.

Untermiozäne Foraminiferenfaunen aus dem Raum Wels

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Eine Gruppierung von 83 quantitativ ausgewerteten benthonischen Foraminiferenfaunen aus Sedimenten des obersten Eggenburgiums und des Unteren Ottnangiums der Molassezone des Welser Großraumes (ÖK 49 Wels und ÖK 67 Grünau i. Almtal) mittels Clusteranalyse (Q-mode Analyse) ergab bei einer Varianz von 2 (Abb. 1) drei Faunengruppen (Rupp & Haunold – Jenke, 2002): die Faunen der ersten Gruppe (Cluster 1) sind durch das starke Auftreten der Gattung *Lenticulina* charakterisiert, die Faunengruppe des Clusters 2 weist überdurchschnittlich hohe Werte von *Ammonia*, die des Clusters 3 hohe Werte der Artengruppe *Cibicidoides* & *Lobatula* auf. Die Faunen des Clusters 2 charakterisieren die ältesten untersuchten Sedimente (Almtal S Vorchdorf, oberstes Eggenburgium bis unterstes Ottnangium, Haller Schlier und „Robulusschlier mit Sandrinnen“; Rupp & Krenmayr, 1996), im Hangenden des „Robulusschlier mit Sandrinnen“ sind zwischen Vorchdorf und Wels Sedimente (Vöckla Schichten, Robulusschlier) mit Faunen des Clusters 3 entwickelt, welche N Wels stark mit denen des Faunenclusters 1 verzahnen (Cluster 1: Robulusschlier, Kletzenmarkt Fm.; Cluster 3: Ottnanger Schlier, Atzbacher Sande, Kletzenmarkt Fm., Robulusschlier). Hier wird deutlich, daß das heterogene Faunenbild des (mikrofaunistisch definierten) Robulusschliers eine Neudefinition dieses Schichtgliedes (bei gleichzeitiger Ausgliederung des untersten, Ammonien-dominierten Abschnittes) notwendig macht.

Viele der bearbeiteten Foraminiferenfaunen bestehen vorwiegend aus kleinen, häufig verfärbten, oft schlecht erhaltenen Gehäusen von annähernd gleicher Größe. Nach Vermessung von mindestens 100 Individuen aus mehreren Proben jedes Clusters wird deutlich, daß vor allem die Faunen der Cluster 2 und 3 von solchen kleinen Gehäusen der Größenklasse 200-250µ aufgebaut werden, während die Faunen des Clusters 1 bedeutend mehr mittelgroße und große Gehäuse (bis 1mm Dm.) aufweisen. Die Faunen der Cluster 2 und 3 sind somit zu einem überwiegenden Teil größensortiert, was auf Transport der Mehrzahl der Gehäuse hinweist (überwiegend allochthone Faunenelemente).

Die am häufigsten vermessenen Gattungen machen die unterschiedlichen Sortierungseffekte in den Faunen der einzelnen Cluster deutlich. So geben die Gehäusegrößen der Gattung *Lenticulina* (Cluster 1!) eine annähernd logarithmische Normalverteilung wieder (autochthones Element), während die Gehäuse der Gattung *Ammonia* (Cluster 2!) als auch die der Artengruppe *Cibicidoides* & *Lobatula* (Cluster 3!) stark auf den Bereich von 150µ bis 300µ konzentriert sind und kaum größere, adulte Gehäuse aufweisen, sie sind deutlich größensortiert und als transportiert, also allochthon zu interpretieren. Diese Häufung von transportierten Gehäusen paßt gut in das Bild stark gezeitenbeeinflusster Sedimente wie die ottnangischen Vöckla Schichten, Atzbacher Sande etc. (Faupl & Roetzel, 1987; Krenmayr, 1991). Für eine paläoökologische Interpretation dieser Foraminiferenfaunen ist das Erkennen von allochthonen Faunenelementen von größter Wichtigkeit. So können für eine

Rekonstruktion des Ablagerungsraumes nur die mehrheitlich aus autochthonen Elementen zusammengesetzten Faunen des Clusters 1 und Teile des Clusters 3 (mit höheren Anteilen von ausgewachsenen, wahrscheinlich autochthonen Individuen) herangezogen werden. Die besonders deutlich sortierten Benthosfaunen des Clusters 2 bestehen vorwiegend aus eingeschwemmten Elementen und sind somit nicht indikativ für ihren Ablagerungsraum.

Paläoökologische Auswertung der bearbeiteten Foraminiferenfaunen (nach Murray, 1991):

Die Foraminiferenfaunen des Clusters 1 werden zumeist von der Gattung *Lenticulina* (kühl, äußerer Schelf bis Bathyal), einige Proben von *Cibicidoides* (kühl, Schelf bis Bathyal) dominiert. Zusätzlich sind höhere Werte von *Charltonina* (äußerer Schelf bis bathyal), *Melonis* (<10° C, Schelf bis Bathyal) und auch von *Ammonia* (kleine Gehäuse, allochthon) zu verzeichnen. Die Planktonraten schwanken sehr stark, die durchschnittliche Planktonrate liegt bei 48%. Interpretation: kühl, tiefer Schelf.

Die weniger stark größensortierten Faunen des Clusters 3 weisen neben der dominanten Gattung *Cibicidoides* (kühl, Schelf bis Bathyal) höhere Werte von *Lenticulina* (kühl, äußerer Schelf bis Bathyal), *Charltonina* (äußerer Schelf bis bathyal), *Melonis* (<10° C, Schelf bis Bathyal), *Nonion* (Schelf), *Ammonia* und *Elphidium* (beide mit zumeist kleinen Gehäusen, allochthon) auf. Auch hier schwanken die Planktonraten erheblich, durchschnittlich liegen sie über 60%. Interpretation: kühl. tiefer Schelf.

Einzig die Faunen des Clusters 2 entziehen sich auf Grund der hohen Anteile allochthoner Elemente vollständig einer paläoökologischen Interpretation, die Planktonraten der Foraminiferenfaunen des Clusters 2 liegen durchschnittlich bei 53%, sind mit denen der Faunen der beiden anderen Cluster vergleichbar und lassen keine gravierende Veränderung des Lebensraumes im Grenzbereich Eggenburgium / Ottnangium erkennen.

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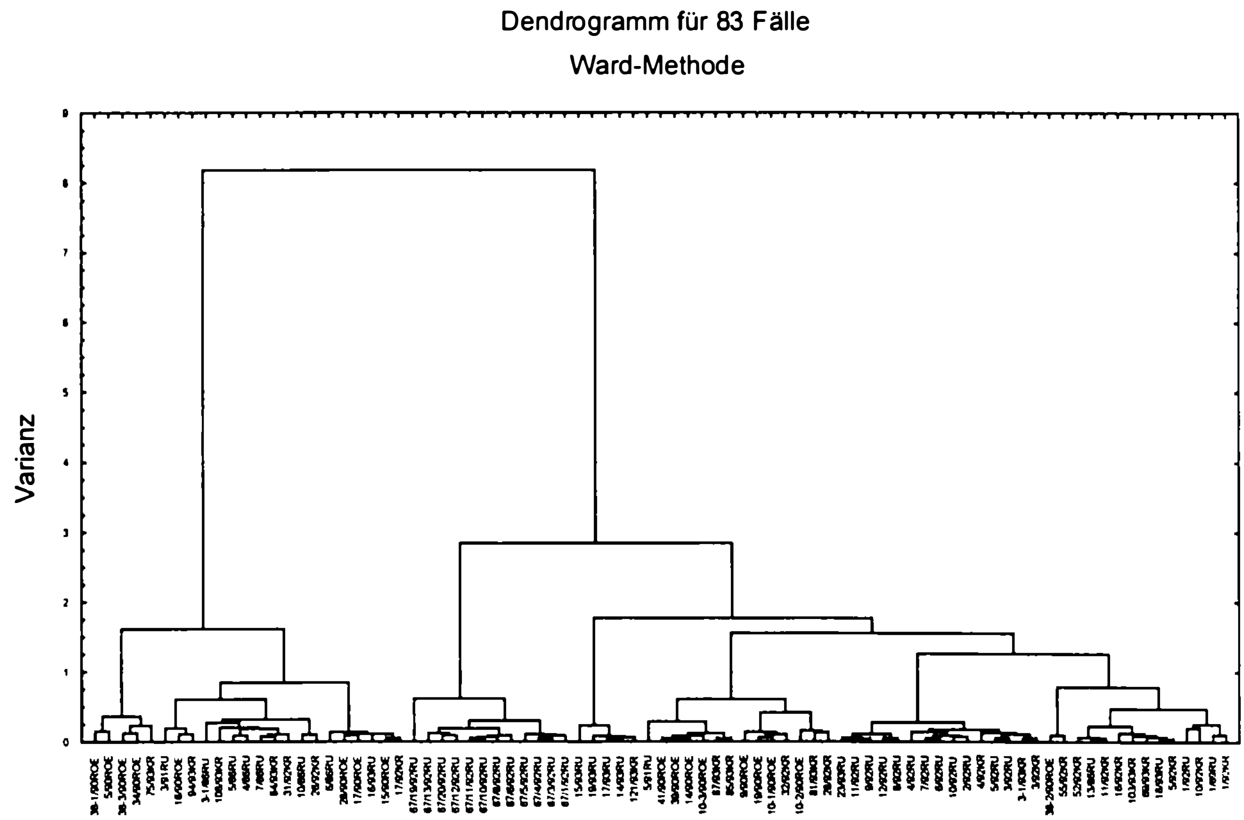

Abb. 1: Dendrogramm (Q-mode Analyse) der bearbeiteten untermiozänen Proben.

Das Sindelsdorf-Profil bei Penzberg in der bayerischen Faltenmolasse - Fossilinhalt und Biostratigraphie

Bettina Schenk, Undine Uhlig, Bettina Reichenbacher, Thorsten Kowalke, Barbara Bassler & Renate Matzke-Karasz

Das Sindelsdorf-Profil befindet sich ca. 50 km südlich von München an der Autobahn A 95, im Südflügel der Penzberger Mulde. Aufgeschlossen sind die Höheren Baustein-Schichten (oberstes Schichtglied der Unteren Meeresmolasse), die Unteren Cyrenen-Schichten (Untere Brackwassermolasse) und der unterste Abschnitt der Unteren Süßwassermolasse.

Obwohl das Profil seit dem Autobahnbau 1969/70 aufgeschlossen ist, wurde es bisher kaum paläontologisch bearbeitet. Im Sommer 2000 nahm Undine Uhlig am Sindelsdorf-Aufschluß ein feinstratigraphisches Profil durch die Unteren Cyrenen-Schichten (121 m mächtig) und die untersten 52 m der Unteren Süßwassermolasse auf. Es wurden 17 Proben entnommen, darunter 14 Proben à ca. 7 kg zum Ausschlämmen von Mikrofossilien.

Die Untersuchungen erbrachten sechs Charophytentaxa (*Chara tornata*, *Rhabdochara exigua, Stephanochara pinguis, Sphaerochara ulmensis, Nitellopsis merianii* und *N. m.* forma *globula*), Samen von *Stratiotes* cf. *websteri*, Früchte von *Celtis lacunosa*, zwei Foraminiferentaxa (*Quinqueloculina* sp. und *Ammonia kiliani*), zwei Bivalventaxa (*Margaritifera inaequiradiata* und *Polymesoda s. subarata*), elf Gastropodentaxa (*Hydrobia* sp., *Pomatias a. antiquum, Protoma diversicostata*, *Potamides* sp., *Granulobium* cf. *plicatum*, *Tympanotonos margaritaceus*, Thiaridae gen. et spec. indet., *Radix* sp., *Planorbarius* sp., cf. *Zonites* sp. und cf. *Cepaea* sp.), vier Ostrakodentaxa (*Phlyctenophora grosdidieri, Leptocythere cf. lacertosa, Cytheridea* cf. *bavarica* und *Palmoconcha* cf. *turbida*) sowie neun Fischtaxa aufgrund von Otolithen und Lapilli („genus Cyprinidarum“ sp., *Palaeumbra moguntina*, „genus Umbridarum“ *crassus, Palaeolebias symmetricus, Dapalis carinatus, D. rhomboidalis,* „genus Apogonidarum sp./aff. *kosdensis*, „genus Eleotridarum“ sp. und „genus Percoideorum“ sp.) (UHLIG et al., subm.).

Mit Hilfe dieser paläontologischen Daten waren erstmals Aussagen zum Alter der Unteren Cyrenen-Schichten in der Penzberger Mulde möglich. *Palaeolebias symmetricus* ist die Leitart für die Otolithenzone OT-O2, die mit dem späten Rupel und dem frühen Chatt korreliert wird sowie mit der Säugerzone MP 24 (vgl. REICHENBACHER 1999). Allerdings kann aufgrund der Operkel-Funde von *Pomatias antiquum* Rupel ausgeschlossen werden, da dieser Landgastropode als Leitfossil für das Chatt gilt (Zöbelein 1953).

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The Molasse and Styrian Basins (Central Paratethys) show different paleoceanographic evolution during the Karpatian: Evidence from microfossil assemblages. Results from FWF Project P-13743-Bio

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We present here a synthesis of the paleobiogeography and ecology of Molasse and Styrian Basins based on planktonic and benthic foraminifera and calcareous nannofossils during the Karpatian age which spans 16.4 to 17.2 Ma and corresponds to the Late Burdigalian. The investigated sections are located in the Austrian basins within the Central Paratethys: in the Molasse Basin at Laa an der Thaya (Hole BL 503) and Göllersdorf in Lower Austria, Wagna and Retznei in the Styrian Basin.

Our data indicate that the Early to Middle Karpatian was characterized by temperate to cool paleoclimate interrupted by short warming episodes as indicated by the climatic curve from the Molasse Basin. The Molasse and Styrian Basins, although adjacent, underwent different paleoceanographic evolution during the Karpatian. The Molasse Basin was characterized by dysoxic bottom water conditions and reducing microenvironments, which allowed formation of ferrous sulfide-rich levels "*Virgulinella* Horizons". Calcareous benthic assemblages consist of low oxygen adapted species, the remaining benthic assemblages respond to oxygen deficient environment in reducing size. High primary production and high surface water fertility due to the intense volcanic activity characterized the Styrian Basin. High nutrient concentration is also responsible of planktonic depleted foraminiferal assemblages. Suboxic bottom water conditions allowed proliferation of agglutinated with respect to calcareous benthic forms. Paleodepth estimated by 100P/(P+B) can be biased by depletion in planktonic forms due to ecological conditions in enclosed basins, and therefore new paleocenographic proxies and tools for paleodepth estimates are needed.

In conclusion, this study shows that paleobiogeography of foraminifera and calcareous nannoplankton from small adjacent basins is strictly related to local ecological conditions and demonstrates that quantitative ecological studies are an innovative way to monitor the biogeographic evolution of enclosed basins.

Loading fractures and Liesegang laminae: large-scale and small-scale sedimentary structures found in the northwestern part of the Molasse Basin in southwest Germany

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At the base of the Graupensandrinne near Ulm have been found two new types of sedimentary structure - 'loading fractures' and 'Liesegang laminae'. They have greatly different spatial scales, but are intimately related. The loading fractures are metre-scale conical fractures, each of them filled with sand and gravel and lined with what was originally a bed of organic mud. This bed is referred to here as the Dark Claystone Bed (DCB). The Liesegang laminae are millimetre-scale quartz laminae that evidently formed within the DCB during early diagenesis. Their formation converted the central layer of the DCB into a hard and brittle quartzite, the existence of which was the key to the later formation of the loading fractures.

The sediments immediately underlying the loading fractures are grey marls belonging to the Ulmer Schichten. They were deposited in the shallower parts of lakes that existed on a sediment-starved floodplain in the late Oligocene and lowest Miocene. In the deeper parts of those lakes were deposited organic muds, especially during lake highstands. Some of these muds were effectively beds of gyttja, and in some of these the interstitial water was supersaturated in silica. This silica was derived by dissolution of diatom frustules. The DCB was one of these silica-supersaturated gyttja beds. When floodplain deposition ceased, either as a result of subaerial exposure or as a result of a marine transgression, oxic groundwater circulated downwards into the Ulmer Schichten. The oxygen diffused slowly into the DCB, allowing Liesegang laminae to form there and to grow together to form a central layer of laminated quartzite. The outer layers of the DCB remained a highly ductile organic mud. The quartzite formation probably took place no later than the Lower Eggenburg.

Marine deposition continued into the Middle Ottnang, and was then succeeded locally by submarine erosion. This erosion was strong enough to remove still-unconsolidated sediments from the sea floor, but was unable to penetrate the DCB. The DCB thus became exposed on the sea floor. A single sudden depositional event occurred at some time in the Middle or Upper Ottnang, the laying down of a 2.5-metre-thick bed of sand and gravel. Though it had been able to resist submarine erosion, the DCB could not support this new superincumbent load. The central quartzite layer of the DCB ruptured wherever it was weakest, the outer ductile layers of the DCB stretched in response to the predominantly tensile stress field, and the newly deposited sands and gravels sank rapidly into the still-soft grey marls underneath. The structures that formed are the loading fractures. Marine deposition continued after this event had taken place, and the remaining Grimmelfinger Schichten were deposited.

Paläoökologische und paläoklimatische Untersuchungen im Oligozän des Süddeutschen Molassebeckens

Undine Uhlig, Bettina Reichenbacher, Barbara Bassler, Thorsten Kowalke, Renate Matzke-Karasz & Bettina Schenk

In den zurückliegenden drei Jahren erfolgte erstmals eine intensive paläontologische Bearbeitung der Unteren Cyrenen-Schichten, dem unterstes Schichtglied der Unteren Brackwassermolasse. Die Unteren Cyrenen-Schichten sind in der Süddeutschen Faltenmolasse am Ostende der Murnauer Mulde und im Südflügel der Penzberger Mulde sehr gut aufgeschlossen.

Lithologisch sind die Unteren Cyrenen-Schichten durch eine Wechsellagerung von Mergeln, Kalkmergeln und Feinsandsteinen charakterisiert; sporadisch treten Konglomerate, Stinksteine und Kohleschmitzen auf. Aufgrund unserer paläontologischen Untersuchungen sind aus diesem Schichtglied mittlerweile zwölf Charophyten-, zwei Foraminiferen-, 13 Mollusken-, vier Ostrakoden-, zwölf Fisch- und 14 Säugertaxa bekannt (UHLIG 1999, UHLIG in press, UHLIG et al. 2000, UHLIG et al. subm, REICHENBACHER & UHLIG, in press.).

Die Auswertung der lithologischen und paläontologischen Daten ergab für die Unteren Cyrenen-Schichten eine engräumige Verzahnung von marin-brackischen, brackischen, lakustrinen, fluviatilen und terrestrischen Habitaten (z. B. Lagunen, Ästuare, Süßwasserseen, Flüsse, Sümpfe), wie sie rezent in Deltaebenen beobachtet werden kann.

Aussagen zum Paläoklima lieferten insbesondere der Gastropode *Tympanotonos* und die Fischfauna. *Tympanotonos* ist ein wärmeliebendes, stenothermes Element und die Familien Eleotridae, Ambassidae und Apogonidae sind heute überwiegend in den Tropen vertreten. Diese Befunde lassen auf ein sehr warmes, mindestens subtropisches Klima schließen.

Darüber hinaus bilden rezente Apogoniden in ästuarin beeinflußten, mit Mangroven bewachsenen Gewässern ein quantitativ wichtiges Faunenelement (vgl. u. a. KIMANI et al. 1996). Auch die Molluskenfauna erinnert an rezente Faunen in Mangrovesümpfen, insbesondere die Präsenz von *Tympanotonos* (BANDEL & KOWALKE 1999). Damit bekräftigen unsere Untersuchungen die Annahme BARTHELT`s (1989), daß die Küste des oberbayerischen Molassemeeres mit Mangroven bewachsen war.

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Paläoökologische und paläoklimatische Untersuchungen im Oligozän des Süddeutschen Molassebeckens

Undine Uhlig, Bettina Reichenbacher, Barbara Bassler, Thorsten Kowalke, Renate Matzke-Karasz & Bettina Schenk

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Karpatian to Early Badenian faulting in the central Vienna Basin (Austria)

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Based on the backstripping method of ten Veen and Kleinspehn (2000) and Wagreich & Schmid (in press) we calculated apparent dip-slip rates, i.e. the vertical component of displacement, for faults in the central part of the Miocene Vienna Basin. The difference of basement subsidence values from both the hanging wall and the footwall blocks adjacent to major synsedimentary normal faults are calculated stepwise for each stratigraphic unit. These values give a relative dip-slip value for each stratigraphic interval, which is divided by the time duration to give apparent dip-slip rates for each fault. The sense of fault movements can be directly determined: Positive or negative values indicate which fault block moved faster; fault inactivity or pure strike slip motion result in zero values in these plots.

The Neogene Vienna Basin is situated at the junction of the Eastern Alps and the Western Carpathians. The structural evolution of the Vienna Basin is characterized by an interplay of compression, strike-slip movements and extension, related to compression and lateral extrusion within the Eastern Alps. The evolution of the Vienna Basin started during the Early Miocene (Eggenburgian-Ottnangian-Karpatian, ca. 20.5 - 16.4 Ma) with the development of a partly non-marine **piggyback basin** on top of N/NW-moving Alpine thrusts to the north of Vienna. Paleostresses changed to **sinistral transtension** around the Early/Middle Miocene boundary (ca. 16.4 Ma), leading to the formation of a **pull-apart basin** in the Badenian (16.4 - 13.0 Ma) and the Sarmatian (13.0 - 11.5 Ma). Up to 3000 m thick successions of marls and sandstones characterize the central parts of the basin, whereas delta sands and carbonates were deposited along basin margins. Maximum water depths in the central part of the basin probably never exceeded 200 m and thus basement subsidence values are mainly controlled by stratigraphic thicknesses. During Sarmatian and Pannonian (11.5 - 7.1 Ma) times, salinity decreased, leading to limnic-fluvial deposits during the Late Pannonian.

Using the fault backstripping method we calculated apparent dip-slip rates. The method indicates major fault activities during the Karpatian, which were previously underestimated. Two tectonic phases can be recognized. During the Early Karpatian (sedimentation of Gänserndorf Formation) sedimentation was largely confined to areas in the basin center. The sense of fault movement reversed during the Late Karpatian (sedimentation of the Aderklaa Formation). During a short period in the lowermost Badenian (16.4 - 16.1 Ma; sedimentation of the Aderklaa conglomerate) there are indications for a reversal of movements along several faults. Although the calculated dip-slip rates for this time interval are rather low, this time of apparent reverse faulting nicely correlates to geological evidence for uplift and erosion in the same time interval to the north of the investigated section. The Bisamberg Fault, which bordered the basin during Badenian-Sarmatian times to the west, displays no dip-slip activity during the Karpatian to lowermost Badenian.

Thus, reverse faulting during the Early Karpatian is not in accordance to later pull-apart basin geometries and supports the interpretation of the early basin history as a piggyback basin. During the Late Karpatian, fault senses in the central basin indicate normal sense of dip slip, marking the beginning of the development of the typical small-scaled depocenter geometry on hangingwall blocks of the Middle Miocene Vienna Basin. This type of faulting is regarded as marking the beginning of pull-apart basin formation during the Late Karpatian.

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The molluscan fauna of the tempestitic shell beds at Grund (Lower Badenian, Austria)

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An excavation was undertaken at Grund in Lower Austria during the summer of 1998. Five artificial outcrops of Lower Badenian deposits were examined, paying particular attention to sedimentologic features and paleontologic composition.

The studied section of the Grund Formation shows a total thickness of approximately 9.5 m and is characterised by a rapid change of allochthonous psammitic and autochthonous pelitic sedimentation with a distinct decrease in water energy from the base to the top. The sandy layers, especially in the lower part of the section, show abundant channel-structures and consist predominantly of thick skeletal concentrations, commonly with sharp erosive bases, graded bedding and a densely packed (bioclast supported) biofabric. They are therefore interpreted as high energy, short-time events and most likely represent proximal tempestites. The skeletal concentrations are composed mainly of a well preserved fauna indicative of a shallow to moderately deep sublittoral, soft bottom environment: We studied 5 bulk samples quantitatively and distinguished 129 species from more than 4200 individuals. Despite this high sampling effort species accumulation curves indicate that continuous sampling would still increase the number of species. The quantitatively most important individuals of the complete data set are the venerid bivalve *Timoclea marginata*, the lucinid bivalve *Loripes dentatus*, and the rissoid gastropod *Sandbergeria perpusilla*. Quantitative comparisons indicate significant differences for the molluscan composition between samples which could be due to different source areas for the individual tempestitic layers, or different storm intensities.