The rift stage, induced by the upper mantle rise and attenuation of the "alpine" lithosphere with shallow necking, is marked by submarine Karpatian trachyandesites, Badenian basalts, andesites, dacites and rhyolites, and Pannonian alkali basalts. Extension gave rise to the escape tectonics, i.e., the displacement of the North Dinaridic units to the PB. The main trails for the large scale tectonic transport were the Periadriatic-Sava and Zagreb-Zemplen fault systems and their subparallel satellites.

The strong sin-rift unconformity is placed at the end of the Sarmatian, and break up unconformity at the end of the Pannonian. It is followed by a compressional event, regionally recognised all over the PB. Due to thermal subsidence in Pliocene the South PB was covered with more than 2.000 m of lacustrine fresh-water deposits. There is also some evidence of another, very recent compression phase, especially in the Sava and Mura domains.

Trace elements and isotope geochemistry of ultramafic xenoliths: constraints on the lithospheric mantle beneath the Graz Basin (Eastern Austria)

Orlando Vaselli[1], Hilary Downes[2], A. Zanetti[3], Cs. Szabó[4,5], and G. Ingram[6]

[1] Department of Earth Sciences, University of Florence, Italy
[2] Department of Geology, Birkbeck College, Univ. London, U.K.
[3] Department of Earth Sciences, University Pavia, Italy
[4] Dept. Geochem. Petrol., University Budapest, Hungary
[5] Department of Geology, Virginia Tech, Blacksburg, U.S.A.
[6] Dept. of Geology, Royal Holloway Coll., Univ. London, U.K.

The Plio-Pleistocene alkali basalt activity in the Carpatho-Pannonian Region (CPR) is characterised by the occurrence of a wide variety of ultramafic xenoliths, i.e. spinel lherzolites, clinopyroxenites, harzburgites, wehrlites, amphibole pyroxenites, etc. (Downes & Vaselli, 1995). They occur throughout the whole region from the Graz Basin (eastern Austria-northern Slovenia) to the Persani Mts. (Transylvania), from Nógrád-Gömör (southern Slovakia-Northern Hungary) to Balaton Highlands and Little Hungarian Plain (central-western Hungary).

Detailed isotopic and REE (Rare Earth Elements) and HFSE (High Field Strenght Elements) investigations have previously been performed in the above mentioned localities (Downes et al., 1992; Vaselli et al., 1995a), except for Nógrád-Gömör and Graz Basin. In this work, we present new isotopic and trace element data for 6 xenolith-bearing localities (Tobaj, Güssing, Grád, Kloch, Stradnerkogel, Neuhaus) in the Graz Basin where only the ultramafic xenoliths from Kapfenstein were previously studied (Vaselli et al., 1996). Güssing and Neuhaus can be regarded as new outcrops of mantle xenoliths since no mention of them has been found in literature.

The ultramafic xenoliths are mainly spinel peridotites although websterites, werhlites and pyroxenites have been found. Amphibole is always interstitial although discrete grains have found in Tobaj xenoliths. Textural features of the ultramafic xenoliths investigated indicate low to slight deformation, almost all the xenoliths being protogranular to porphyroclastic. The only exceptions are one xenolith from Neuhaus and one from Kloch which are equigranular and secondary, respectively.

Generally speaking, bulk-geochemistry and mineral chemistry of the single mineral phases indicate that most of the Graz Basin xenoliths seem to have suffered only a depletion by extraction of mafic melts at different degrees of partial melting because they have major and trace element contents which lie close to that of the Primitive Mantle as defined by McDonough (1990) or have lower contents but with the same trend (Vaselli et al., 1995b).

The REE and HFSE patterns for clinopyroxenes and amphiboles from the Graz Basin xenoliths are generally depleted in the more incompatible elements, most of the Ce_N/Yb_N ratios being from 0.23 to 0.65 and 0.23 to 0.57, respectively. Besides, Ti/Ti* and Zr/Zr* in clinopyroxenes and Zr/Zr* in amphiboles Ba, Nb, Sr and Ti contents indicate that mantle amphibole preferentially hosts these elements and their abundances are generally lower compared to amphibole megacrysts from CPR alkali basalts (Zanetti et al., 1995). Szabó et al. (1995) and Vaselli et al. (1995a) found similar values for interstitial amphiboles of ultramafic xenoliths from the Little Hungarian Plain and Persani Mts., respectively.

Sr and Nd isotopic composition for the clinopyroxenes are between 0.70210 and 0.70294 and 0.512960 and 0.51349 which indicate a depleted mantle and these ratios are strikingly similar to those observed in the ultramafic xenoliths from eastern margin of the CPR, i.e. Persani Mts. (Vaselli et al., 1995).

In conclusion, the REE and HFSE contents and the Sr and Nd isotopes for the ultramafic xenoliths from Graz Basin indicate that the lithospheric mantle beneath this region suffered enrichment/depletion processes very similar to those already observed for the xenolith suite from the Persani Mts. the two localities being situated at the peripheral parts of the mantle diapir which has been recognised by geophysical studies (e.g. Horváth, 1993; Lillie et al., 1994). Thus, the host magmas could have collected ultramafic xneoliths from a brittle-veined lithospheric mantle. No unequivocal evidence of subduction in the lithospheric mantle has been recorded in the Graz Basin ultramafic xenoliths and we may speculate that the processes which formed the interstitial amphiboles are related to metasomatic events.

Downes, H., et al., 1992. Contr. Min. Petr., 109, 340-354.
Downes, H. and Vaselli, O., 1995. Acta Vulcanol., 7, 219-229.
Horváth, F., 1993. Tectonophysics, 226, 333-357.
Lillie, R., et al. 1994. Tectonophysics., 231, 215-235.
McDonough, A., 1990. Earth Plan. Sci. Lett.,101, 1-18.
Szabó, C., et al., 1995. Acta Vulcanol., 7, 249-263.
Vaselli, O., et al., 1995a. J. Petrol., 36, 23-53.
Vaselli, O., et al., 1995b. PANCARDI Meeting 1995, Stara Lesna, Slovakia.
Vaselli, O., et al., 1996. Miner. Petrol., 57, in press.
Zanetti, A., et al., 1995. Acta Vulcanol., 7, 265-276.

Results of deep seismic reflection profiling across the East Rhodopes, South Bulgaria

Alexander Velev[1], Ivan Boyanov[2] and Yotzo Yanev[2]

[1] Geology and Geophysics Corp., Sofia, Bulgaria
[2] Geological Institute, Bulgarian Academy of Sciences, Sofia

According to recent plate tectonics concepts a probable collage zone is located south of the Moesian platform. This zone consists of terranes detached from Africa and accreted to Eurasia. The East Rhodope exotic terrane is one of them. It is composed of Proterozoic (?) amphibolite facies metamorphics, Mesozoic metamorphic rocks, sediments and basalts intruded by Late Cretaceous granites, all locally overlain by Paleogene sediments and volcanics. The East Rhodope terrane is a pile of thrusts, its deep structure and relations to the West Rhodope terrane being under debate.

According to the first deep seismic reflection profile Ardino-Ivailovgrad (ER1), the thickness of the Paleogene cover is up to 2.3 km. The crust is divided into four superlayers A, B, C and D. The main result is the discovery of a so far unknown tectonic zone imaged on the line ER1c by an about 10 km wide, SW dipping band of moderate to strong reflectors (superlayer D). It cross-cuts superlayers A, B and C and extends into the upper mantle. Superlayer D is interpreted as a pre-Late Cretaceous obduction zone (East Rhodope thrust front) marking the boundary.

Style of postsedimentary deformation in Plio-Quaternary Velenje basin, NE Slovenia

Marko Vrabec

University of Ljubljana, Slovenia

Velenje basin is 10 km long elongate Plio-Quaternary intermontane depression, bounded by the Periadriatic line zone to the North and by the WNW-ESE trending Šoštanj fault to the South. Basin presumably originated in the regime of dextral transtension between these two fault systems. The basin fill is up to 1000 m thick and shows a typical fill-up sequence ranging from subaerial to lacustrine clastic sediments (Brezigar, 1986). The age of the sediments is poorly constrained except for the mammal remains and pollen content in the upper part of the stratigraphic succession, which indicate Upper Pliocene and Quaternary age (Brezigar et al., 1983), and the age of the basin is arbitrarily taken as Pliocene.

The main part of the basin is a 2 km wide trough-like structure between the Šoštanj fault and similarly WNW-ESE trending Velenje fault. In the basin area, Velenje fault is a boundary between major tectonic units of Kamnik-Savinja Alps to the South and Karavanke to the North (Mioè and nidarèiè, 1983, Brezigar, 1986) and is also a part of the Donat zone sensu Jelen (Jelen, 1994), which separates two major Tertiary tectono-stratigraphic units.

The largest part of data about the basin comes from the Velenje lignite mine. Borehole, seismic and other data show that lenticular, up to 160 m thick lignite seam has a synclinal shape, which is mostly due to the differential compaction of the basin fill. Lignite seam at the SE margin of the basin along the Šoštanj fault is cut by secondary faults and strongly segmented with up to several tens of meters of vertical offset between fault blocks, whereas above the Velenje fault the lignite seam is practically undeformed by faulting.

Using the data of more than 1000 boreholes, the geometry of the upper boundary of the lignite seam in the Šoštanj fault area was modeled and analyzed with various computer-aided techniques. The fault architecture and arrangement and geometry of minor tectonic blocks clearly indicate that the origin of structures is related to dextral movements along master fault(s) of the Šoštanj fault zone.

Brezigar, A., 1986. Premogova plast rudnika lignita Velenje. Geologija 28/29, 319-336.
Brezigar, A., Šercelj, A., Velkovrh, F., Vrhovšek, D. and Kosi, G., 1983. Paleontološke raziskave pliokvartarne skladovnice velenjske udorine. Geol. zbornik 3, 31-33.