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Structural Position and Metamorphism of Peridotite and Eclogite Bodies within Granulite in the Bestvina Unit, Bohemian Massif

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The Bestvina unit represents the westernmost part of the Kutná Hora crystalline complex and occurs in the central part of the Bohemian Massif. It tectonically overlies the Varied group of the Moladnubian domain in the SW and consists mainly of retrogressed felsic granulites, biotite gneisses, migmatites and several small isolated bodies of peridotite and eclogite (Pouba et.al. 1987, Synek and Oliveriová 1993). Two different deformation planar fabrics have been recognized during field works in the Bestvina unit. The older F_1 fabric has been observed in coarse-grained and weakly retrogressed granulites and in eclogites. It is parallel to layers of olivine and garnet-bearing pyroxenite occuring in peridotites. This planar fabric strikes NE-SW and dips under steep angles to NW or SE. Isoclinal fold of the F_1 fabric has been observed inside the eclogite body having steep axial plane striking SW-NE and subhorizontal fold axis. A younger F_2 fabric is extensively developed in the majority of the unit, where F_1 fabric is preserved in the low-strain domains only. The F_2 fabric moderately dips towards ENE to NE and it is developed in retrogressed and mylonitized granulites and migmatites. The mylonitic foliation F_2 is parallel to the foliation observed in paragneisses of the Varied group below the Běstvina unit.

Detailed petrological study has been carried out on ultramafic and eclogite bodies near Spačice and on peridotite at Doubrava and Úhrov in order to constraint PT conditions of the studied rocks. The Spačice eclogite forms ca 60 m long sigmoidal lens that occurs within retrogressed granulite. The original metamorphic assemblage of eclogite consists of omphacite, garnet, kyanite and rutile. Two textural and compositional varieties of garnet and of clinopyroxene are present in this eclogite. The eclogite facies garnet – Gr I (Py_{36}, Grs_{34}, Alm_{28}) contains rutile inclusions and associates with omphacite Cpx- I (Jd_{29}). Omphacite in some samples is characterized by the presence of quartz rods that usually occurs in ultrahigh-pressure metamorphic rocks. Garnet I is partly replaced by Al-rich clinopyroxene (Cpx II) and anorthite. A new Ca-rich garnet Gr-II (Py_{10}, Grs_{65}, Alm_{23}) that forms either individual grains or rims of the coarse-grained eclogite facies garnet, indicate textural equilibrium with Al-rich clinopyroxene and plagioclase. There is a sharp compositional jump with a very weak diffusion profile between these two garnet varieties. Mn content is low in both garnet, but the Ca-rich garnet has relatively higher Mn, suggesting decomposition of older garnet. Small amount of tschermakitic amphibole replacing Ca-rich garnet is also present. The Doubrava peridotite forms ca 40 m wide lens-shaped body surrounded by coarse-grained and retrogressed granulites. Within the peridotite body, there is small body of garnet rich eclogite, and olivine and garnet-bearing pyroxenites. Pyroxenites form up to 30 cm wide parallel oriented and steeply dipping layers providing primary anisotropy of peridotite body. The garnet peridotite has relicts of olivine, orthopyroxene, clinopyroxene, spinel and rarely of amphibole. Chromium-rich spinel forms inclusions in garnet and in clinopyroxene. Compositional maps indicate progressive formation of garnet after spinel. Garnet is rich in Mg (Py_{69},$Grs_{11}Alm_{18}$) and forsterite content in olivine is about 93 mol%. Clinopyroxene is diopside with $X_{Mg} = 0.9$. Orthopyroxene with $X_{Mg} = 0.8$ has Al_2O_3 about 1.7 wt.%. Spinel corresponds to Al-chromite with composition of $Mg_{0.54}Fe_{0.47}Al_{0.73\text{-}1.0}Cr_{0.8\text{-}1.19}O_8$. The eclogite within garnet peridotite has relatively high-Mg garnet (Py_{42}, Grs_{34}, Alm_{22}) and omphacite with Jd_{30}. Similar to eclogite from granulite, garnet is replaced by Al-rich clinopyroxene and anorthite ± amphibole and kyanite by anorthite, spinel and locally clinopyroxene. Garnet contains rutile needles that mostly have parallel orientation. The Úhrov peridotite is poorly outcropped and does not provide any strain features in the field our analyses showed its textural and mineralogical similarity to the Doubrava petridotite. Maximum PT conditions of ~4 GPa at 700 °C were calculated for Spačice eclogite as well as for eclogites inside the Doubrava and the Úhrov peridotites. Garnet peridotites reveal pressure conditions similar to eclogite but at high temperature of about 1000 °C. Textural relations and chemical composition in all rock types, but mainly the presence of Ca-rich garnet in eclogite, suggest that decompression was followed by rapid cooling.

Field structural data suggest that peridotites penetrate granulites during large scale folding of coarse-grained granulites along steep axial plane striking SW-NE. Pyroxenite layers provide very likely compositional as well as mechanical anisotropy in peridotite that helped to dismember mantle rocks to small bodies during variscan exhumation. However, PT estimated form peridotites, eclogites and granulites (Medaris et. al. 1995, Medaris et.al. 1998) show large disagreement between each other and it is difficult to link individual tectonic events with metamorphism. Later fabric F_2 corresponds to mid crustal deformation event that affect whole Běstvina unit together with Varied group in the Moldanubian domain.

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Neotectonic Investigations of the Érmellék Region (NE Pannonian Basin, NW Transylvania)

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Neotectonic investigation has been carried out along the Ér-river valley, and between the Ér- and Berettyó-river valleys (Érmellék region). This ENE-WSW striking hilly region is situated on the northeastern part of the Pannonian Basin and NW of the Transylvanian (Apuseni) Mountains. The aim of the study was to find evidences for the hypothetised neotectonic control on river network development of the Körös Basin. The Émellék region represents a natural link between the uplifting Apuseni Mountains and Körös Basin which is the deepest sub-basin of the subsiding Great Plain. The Érmellék region is famous for its presumed neotectonic activity is shown by two larger historical earthquakes occurred in 1829 (M = 4,9; I_{max} = VII) and 1834. (M = 6,3; I_{max} = IX) (Réthly 1952).

The hilly part of the region is mainly covered by loess and "red clays" (Sümeghy 1944). The latter is a brown forest type paleosoil complex of the loess sequence which is resistant to erosion and dominantly covers the top of the ridges. The age of the loess sequence was not dated till this time, but was preliminary correlated to paleosoil horizons and may represent loess up to Middle Pleistocene (Upper sequence of the Old Loess series of the Paks Loess Formation, Marsi et al. 2004). In the Ér-river valley Late Pleistocene – Holocene alluvial sand and aleurolite can be found at different topographic height which are probably the remnants of terraces of the palaeo-Tisza, which was flowing along the northeast-southwest striking Érmellék depression (Ér-river valley) during the Late Pleniglacial (Gábris and Nádor in press).

We investigated the outcrops of the above mentioned Quaternary sediments of the region by structural, tectono-morphological and sedimentological methods to quantify the main fault directions in the field, and analysed the morphology and river network to determine the style of neotectonic deformation. We found two phases of deformations, based on microtectonic investigation of the area. The older is reflected by NE-SW trending normal faults, joints and dykes in the loess, filled with reddish, brown aleuritic clay. This is a redeposited material of the brow forest paleosoil complex. The younger/second phase is mainly reflected by rejuvenated shear faults of the first phase and Riedel-faults. These are usually filled by greyish-brown aleuritic clay wich are probably originated from chernozem-brown paleosoil of the eroded Upper Pleistocene paleosoil complex or recent zonal soil. Apart from small scale faulting, the most characteristic neotectonic feature is surface undulation. This phenomenon is probably related to folding, based on the en-echelon arrangement of the ridges of elongated undulations.

Combination of microtectonical datas with the morphotectonical observations and river network analysis, we concluded that the Érmellék region was a left lateral ENE-WSW striking fault zone with NE-SW compression and perpendicular extension up to the Middle Pleistoce. The second phase was a reactivation of the „first" phase, generated by WNW-ESE compression, and caused right lateral transpressions. This seems to be active till this time. Active deformation is also supported by the presence of historical earthquakes, too. This zone is in the norteastern continuitation of those tectonical lines which were analysed from seismic sections of the Körös Basin and caused main tectonic control on river network developement during the Late Pleistoce (Nádor et al., in press).

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