16–9 Ma, 14–0 Ma, respectively. Short-lived subduction-related volcanic activity can be interpreted either as an indication of a limited width of subducted crust (not greater than 200 km) or as an indication of detachment of the sinking slab. Interpretation of the areally distributed felsic and intermediate calc-alkaline volcanic formations are interpreted as being initiated by back-arc extension induced by diapiric uprise of "fertile" asthenospheric material.

The Structural and Metamorphic Record of the Variscan Orogenesis at the Eastern Margin of the Moldanubian Zone in the Bohemian Massif Associated with the Brunovistulian Foreland Underthrusting

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We investigate an orogenic fabric along the E-W cross-section at the eastern margin of the Moldanubian Zone in order to understand the mechnical behaviour during the formation and exhumation of this part of the orogenic root. The cross section is running from the Raabs lower crustal unit in the west, across the underlying Varied unit and the Podhradska unit to the easterly-situated Moravian Zone. The traditional cross-sections show the eastward thrusting of the Raabs lower crust over the Varied group metasediments, which appear in form of a tectonic window (Fuchs, 1976, Matte, 1990). In this concept the granulite sheet at the eastern border of the Moldanubian zone adjacent to Moravian zone is interpreted as a termination of the antiformal stack of the Moldanubian thrust sheet.

The structural observations show the succession of four fabrics. The relics of the first foliation S1 with unknown original orientation are preserved in form of tight to isoclinal folds within the steeply NW–dipping foliation S2 in the Varied and Podhradská units. The steep NW-dipping S2 fabric is reworked by E-verging F3 folds with westerly dipping axial planes and subhorizontal axes. This late folding results in places to almost complete transposition into a moderately W-dipping S3 foliation, developed with greatest intensity in the Raabs unit. The latest locally developed structure is a flat S4 fabric represented by LT shear zones.

The qualitative PT-paths of the rocks from individual units were deduced from the PT-pseudosections constructed in the NCKFMASH system, using the program THERMOCALC for selected samples representing different units: migmatite from the Raabs unit, metapelite from the Podhradská unit and one sample from the granulitic body on the eastern border of the Podhradská unit. The PT-paths were determined on the basis of the succession of the mineral assemblages and zoning of the minerals.

Both the migmatite from the Raabs unit and the granulite from the bottom of the Podhradska unit contain relics of HP metamorphic stage in form of relics of kyanite and big porphyroblasts of perthitic K-feldspar, plagioclase and quartz. This mineral assemblage is overprinted in LP conditions by the growth of sillimanite and biotite at the expense of garnet. The metapelite from the Podhradska unit shows the evidence of prograde PT path in form of garnet zonation (high Ca-content in cores) and staurolite inclusions enclosed in garnet porphyroblasts. The peak PT conditions are represented by the mineral assemblage ky+grt+kfs+plg+bt+qtz. The following retrogression is displayed by the growth of sillimanite and muscovite on the expense of kyanite and K-feldspar.

To obtain absolute PT conditions we have used the average PT calculations for the observed metamorphic assemblages for a granulite sample from the bottom of the Podhradska unit (grt+kfs+plg+qtz+ky/sil+bt±ms), for a metapelite from the Podhradska unit (grt+kfs+plg+bt+ms+ky/sil+qtz±st), for an eclogite from the bottom of Raabs unit (grt+cpx+plg+amp) and for a migmatite of the Raabs unit (kfs+plg+qtz+grt+ky/sil+bt). The PT conditions of HP metamorphic stage were determined on the basis of the eclogite sample to 881±60 °C and 12.8±1.3 kbar. The PT conditions of retrogression were determined to 744 ± 55 °C and 6.9±1.8 kbar for the migmatite from the Raabs unit and 772 ± 83 °C and 10.1±2.5 kbar for the granulite from the bottom of the Podhradská unit. The retrograde mineral assemblage of the metapelite from the Podhradská unit gives PT conditions of 695±90 °C and 7.1±1.7 kbar

On the basis of the structural observations correlated with the PT estimates we have proposed two major thrust-zones developed in the conditions of the thickened lower crust. The first one is situated at the base of the Raabs unit and is marked by a sheet of amphibolites whith boudins of eclogites. The second thrust is located at the base of the Podhradska unit and is marked by a body of felsic ky-kfs granulite with amphibolite lenses. These thrusts were later reworked in conditions of the middle crust.

The structural observations are consistent with the results of numerical modelling of structural evolution of the continental collision in Central Pyrenees (Beaumont et al., 2000). In agreement with their model P5, we put the first pro-wedge thrust on the bottom of the Raabs unit. This thrusting is connected with extreme deformation of the eastern part of the Varied unit. The second pro-wedge thrust marked by granulites brings the whole sequence over the Brunovistulian foreland.

Now we have started to investigate a southerly situated cross section, which is running from Monotonous unit in the west, across the body of Rastenberg granodiorite, Dobra orthogneiss, Varied unit, Gfohl unit and a body of felsic granulite, which is enveloped by amphibolites. Than the cross section continues to the east over the Gfohl and Varied units again and it ends on the border of Brunovistulian. The dominant foliation in the western part of the cross section is dipping to the E or SE under intermediate angles and lineatinons dipping in the SE to S-direction. This fabric contains relics of a subvertical foliation of N-S direction. The eastern part contains structures of opposite direction. The foliatins in the body of felsic granulite, which is in the centre of this fan-like structure, are relatively flat and are dipping to the south in the northern part of the body and to the north in the southern part. The lineations in the granulite are subhorizontal and have W-E direction. The aim of this investigation is to understand the structural evolution of this area, to correlate it with the metamorphic history and to resolve the emplacement of the granulitic body with evidently discordant structural characteristics correspondingly to the surrounding units.

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Thrust Tectonics in the Southern Part of the Moravian Karst

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The Moravian Karst is a terrain made up from a carbonate complex of Devonian to Carboniferous age (Eifelian to Vis?n) and represents carbonate ramp sedimentation to sedimentation from calciturbidites. Thrust tectonics was recognized by Kettner (1949), but a long time prevailed fixistic interpretations of structures observed (e.g. Dvo?k, Pt?, 1963). Recently thrust conception was revived by Hladil (1991), but many problems have remained. This contribution tries to explain the deformation history of the southern part of Moravian Karst using the best exposed and well investigated region of Mokr quarries as a model.

The rocks found in the vicinity of Mokr quarries are represented by the Vil?ovice Limestones (Givetian-Frasnian, light grey, massive) and the K?iny and ??ka Limestones (Famenian-Visean, dark grey, well bedded). These limestones are folded in two systems of folds, the older one oriented NNW–SSE is refolded by the younger system of ENE–WSW direction (Fig. 1a). The folds are asymmetric and mostly recumbent. Limestones are also affected by brittle fracturing of several generations as well as ductile to brittle-ductile failures (en echelon arrays of carbonate veins, ductile shear zones accompanied by pressure solution, etc.).

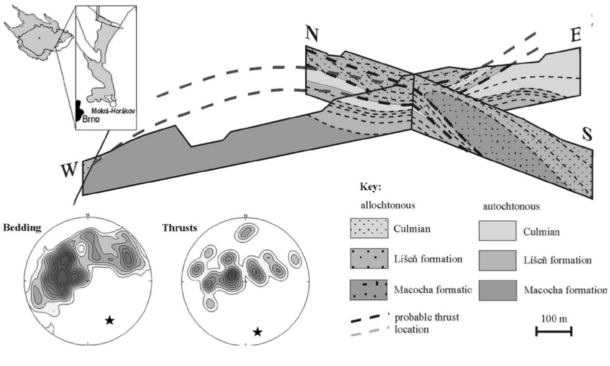

Fig. 1. Schematical cross- section through Mokr -quarries suggesting localisation and refolding of the main thrust zones and their obliquity to footwall and basic structural plots.

The most important structures observed are, however, thrust faults subparallel to bedding the cores of which are marked by a black ultracataclasite layer. These thrusts originated in the end of the older phase of folding because they were folded together with the bedding and their fold axes are in the same direction. These thrusts were refolded in a younger system of folds as well (Fig. 1). Stereographic projections on figure 1 suggest together with field observations, that the thrust planes are oblique to bedding planes (the angle between mean thrust plane and bedding plane is about 18?). This explains the localisation of thrust planes in various stratigraphical levels in different places of the quarries. It seems that the thrust planes climb up from west to east within the bedrock (Fig. 1). The hanging wall rocks seem to be always the same, lower Tournasian nodular K?iny limestones. Based on several striations recognized on the thrust planes the NE displacement direction could be suggested. In some places these thrusts are masked by younger, more brittle faults.

Combination of the precise stratigraphic and structural data allows us to interpret the 3D tectonics of the area as an anticline the axis of which dips to the SE with the dip of 21?. The deformation phases are as follows: D1 – the first phase of folding oriented NNW–SSE; D2 – thrusting in terminal phases of folding D1 subparallel to bedding planes with NE displacement direction; D3 – folding with fold axes oriented ENE–WSW; D4 – several phases of younger (Alpine?) fracturing.

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