Tectonometamorphic Evolution of the Velké Vrbno Unit – Evidence of Subduction of the Western Margin of the Silesian Domain

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The Velké Vrbno unit occurs at the NE margin of the Bohemian Massif along the intraplate boundary between the structurally upper Lugian domain and the underlying Silesian domain, which were amalgamated during the Variscan orogeny. The boundary between these two crustal domains was usually traced below the Velké Vrbno unit but some authors put the major boundary above this controversial unit. In order to decipher the position of the major intraplate boundary in the area, and in order to understand the role of the Velké Vrbno unit during the Variscan collision, we investigated its protolith ages, structural and metamorphic evolution in comparison with the Lugian and Silesian domains.

The Lugian domain consists predominantly of orthogneisses, migmatites and volcanites with protolith ages between 480 and 520 Ma. The orthogneisses were affected by the widespread Variscan migmatitization and high-temperature deformation. Lenses of eclogites and HP granulites show peak metamorphic conditions of 20 kbar and 900°C, indicating important thickening during the Variscan Orogeny. The eastern margin of the Lugian domain, just above the Velké Vrbno Unit, is built of the so-called Staré Město Belt. This belt, containing lower crustal rocks with protolith ages around 500 Ma, only weakly affected by the Variscan metamorphism, has been recently interpreted as an exhumed Cambro–Ordovician intracontinental rift.

The Silesian domain consists of two crustal-scale units called the Keprník and the Desná domes which are composed of pan-African orthogneisses with protolith ages between 680–550 Ma, being overlain by Devonian sedimentary basins. Variscan collision in the Silesian domain resulted in two-stage tectono-metamorphic evolution. The first event was associated with underthrusting of the Keprník and Desná crustal boudins, being characterized by the development of pervasive Barrovian fabric with metamorphism increasing from the chlorite zone in the east to the staurolite zone in the west. The second event is characterized by the development of cross folds in the Desná Unit and is attributed to the late buttressing stage. The Keprník Unit experienced late HT/LP metamorphic overprint associated with extensional tectonics and important magmatic underplating.

The lithology of the Velké Vrbno Unit is complex and consists of tonalitic gneisses, granitic orthogneisses, metavolcanites, banded amphibolites, metagabbros, metapelites, paragneisses, calc-silicate rocks, marbles and quartzites. All these lithologies are tectonically interlayered to various extent, and contain numerous large-scale boudins of retrogressed eclogites. Three samples of tonalitic gneisses and one sample of granitic orthogneiss were dated by zircon evaporation techniques in the range of 561 Ma and 626 Ma. Protolith ages indicate clear affinity of the Velké Vrbno Unit to the Silesian domain.

The first deformational event in the Velké Vrbno unit is characterized by the development of a pervasive S_1 amphibolite-facies metamorphic foliation, isoclinal to rootless folds and N–S-trending mineral and stretching lineation. Kinematic criteria such as asymmetrical boudinage and shear bands indicate predominantly N-directed thrusting. The S_1 foliation is folded by open to close N–S-trending F_2 folds with W-dipping axial planes. The folding led in some places to the development of W-dipping crenulation cleavage or to complete transposition of the early S_1 foliation into W-dipping localized greenschist-facies shear zones S_2. This structural succession is almost identical to that described in the Keprník and Desná domes of the Silesian domain.

The peak metamorphic conditions are represented by mineral assemblage in the eclogite boudins, where the jadeite content in relict omphacite indicates the minimum pressure conditions of 15 kbar. The late-eclogitic stage is characterized by the assemblage amp + cpx + grt + plg + rt + qtz ± ep and is associated with the development of S_1 foliation and PT conditions estimated at 680–710 °C and 12–13 kbar. The peak metamorphic conditions in amphibolites were calculated using the assemblage grt + amp + plg + qtz + rt to 650–700 °C and 10–11 kbar. Subsequent decompression led to the decomposition of garnet and growth of zoisite, new plagioclase, ilmenite and sphene in the amphibolites. The calculated temperature conditions for this stage are 650–700 °C, indicating the near isothermal decompression. The succession of metamorphic assemblages in metapelites indicates very complex metamorphic evolution. The inclusions of chloritoid + chlorite + margarite + paragonite + ilmenite in the cores of garnets may indicate early stages of underthrusting. Inclusions of staurolite and rutile occur near the rims of garnet, thus suggesting increasing PT conditions, hence a continuous burial. In the matrix, the peak metamorphic assemblage comprises ky + grt + st + bt + ms + rt. Succession of mineral assemblages in metapelites and prograde chemical zoning in garnet suggest continuous increase in pressure and temperature under typical Barrovian gradient and burial. The calculated peak PT conditions for the kyanite grade correspond to 680 °C and 10 kbar. Growth of sillimanite succeded by the growth of andalusite started locally during the decompressional stage. The entire metamorphic evolution in metapelites was terminated by heterogeneous greenschist-facies retrogression. Different stages of metamorphic evolution enregistered by different lithologies indicate continuous underthrusting of the Velké Vrbno Unit up to the eclogite-facies conditions followed by near-isothermal decompression. The Barrovian metamorphic evolution developed in the Velké Vrbno Unit is a logical continuation of the zoning documented in the Silesian domain and reflecting the paleothermal gradient. Similarly, a LP/HT overprint can be compared to that developed in the Keprník Unit.

New Neoproterozoic protolith ages, together with the structural and metamorphic history of the Velké Vrbno Unit, clearly show remarkable similarity with the Keprník and Desná units

farther to the east. The only difference is seen in higher degree of metamorphism of the Velké Vrbno Unit relative to the Keprník and Desná units in the east. In such a context, the Velké Vrbno Unit represents only the westernmost part of the Silesian domain that experienced the deepest continental subduction. Therefore, the major intraplate boundary between the Lugian and the Silesian domains should be located farther to the west between the Velké Vrbno Unit and the Staré Město Belt.

Carbonates of the Devonian Transitional Development in the Surroundings of Valchov (Němčice–Vratíkov Belt, Drahany Upland)

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The Němčice–Vratíkov belt of the Devonian Transitional Development, which was defined by Chlupáč (1959) but described as juxtaposition of two facies by Kettner (Kettner 1967), is situated at the eastern margin of the northern part of the Brno massif, stretching from Šebetov across Vratíkov, Valchov and Němčice to Petrovice. Devonian and Lower Carboniferous carbonates crop out in many isolated and strongly tectonically strained bodies. Tectonic pattern of the Němčice–Vratíkov belt was described by Melichar and Kalvoda (1997). The study of conodont assemblages and microfacies investigations of carbonate rocks from the abandoned quarry SW of Valchov were performed.

1. The western part of the quarry is formed by layers of grey to black biomicritic, thin-bedded limestones (2–10 cm thick) with abundant black shale intercalations (1–4 cm thick) dipping towards ESE. This sequence shows thinning- and fining-upward trend, with frequent parallel lamination in the carbonate beds. The carbonates can be classified as moderately sorted wackestones–packstones. Shallow-water grains are represented by small crinoids and detrital quartz grains. Pelagic styliolinids are locally abundant. The matrix is composed of neomorphic microspar. These rocks can be regarded as distal calciturbidites. The mixed conodont assemblages belong to the Upper Frasnian Pa. rhenana and Pa. linguiformis zones.
2. The eastern part of the Valchov quarry is formed by grey coarse-grained biodetrital limestones. They may be described as poorly sorted floatstones–rudstones with abundant fragments of corals and stromatoporoids (often silicified) and crinoids. Detrital quartz grains form a minor contribution. Matrix is composed of neomorphic microspar. The limestones probably represent sediments of fore-reef talus. The rich conodont assemblages belong to the Upper Frasnian Pa. rhenana Zone and correspond to the Palmatolepid–Polygnathid biofacies of the upper to middle slope environment.

The study of conodont assemblages and sedimentological and microfacies investigations indicate that two tectonically juxtaposed facies of different sedimentary environments appear in the Pa. rhenana Zone.

References

CHLUPÁČ I., 1959. Stratigrafický výzkum moravského devonu v severní části Drahanské vysočiny. *Věst. Ústř. Úst. geol.*, 34: 193-200

KETTNER R., 1967. Problém tektoniky Moravského krasu. *Čs. Kras*, 18 (1966): 69-90.

MELICHAR R., KALVODA J., 1997. Strukturně-geologická charakteristika němčicko-vratíkovského pruhu. II. seminář České tektonické skupiny, Ostrava, pp. 51-52.

Preliminary Data on the AMS Fabric in Crystalline Rocks from the West/East Sudetes Contact Zone in the Fore-Sudetic Block – Structural Implications

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Introduction

Crystalline complexes situated in the Sudetic foreland east of the Góry Sowie massif were investigated by means of anisotropy of magnetic susceptibility (AMS) method. The AMS data combined with the available structural data allow a new approach to be undertaken in the reconstruction of tectonic evolution of the West/East Sudetes contact zone.

Geological background

Crystalline rocks in the eastern Fore-Sudetic Block have experienced three deformation events, D_1, D_2 and D_3 (Mazur and Puziewicz 1995; Mazur et. al. 1997; Mazur and Józefiak 1999; Szczepański and Józefiak 1999). Deformation D_1 produced the main foliation S_1, which is now mostly steeply dipping. The locally preserved L_1 stretching lineation trends gen-