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Alpine Rejuvenation of Epi-Hercynian Foreland – the Complex Morphostructural and Tectonic Analysis (Moravosilesian Region, Bohemian Massif)

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Morphostructural and deformation analysis of the Alpine and Hercynian orogenic belts contact zone in Moravosilesian region is based on the analysis of digital terrain models (DTM), comparison with structure maps and structure field mapping (paleostress and brittle deformation analysis).

The DTM models of the studdied area, based on satellite data and detailed digitalization of the topographic maps 1: 25,000 scale, as well as 3D-digital models of other subsurface structures (e.g., pre-Hercynian crystalline basement, buried pre-Alpine paleorelief, etc.) were compiled using Surfer 7.0, ArcInfo and Arc View GIS 3D Analyst visualization capability (Fig. 1). This was done for the Variscan foredeep (Nízký Jeseník Mts.) together with coal-bearing molasses (Upper Silesian Coal Basin) and Alpine Outer Carpathian Nappes.

Morphostructures of the pre-Alpine autochthon induced tectonic pattern, kinematics and deformation development of the Alpine Subsilesian and Silesian nappes. Epi-Hercynian basement (Brunovistulicum with its Palaeozoic cover) was simultaneously modified by accreted Alpine nappes. This was a result of tectonic loading by Alpine nappes. Moderate, however significant, tilting of epi-Hercynian crust blocks could be recognized along faults delimiting subequatorial pre-Alpine Dětmarovice and Bludovice grabens. This crust segment tilting was related to pre-Alpine (Brunovistulian) foreland brittle lithosphere flexure

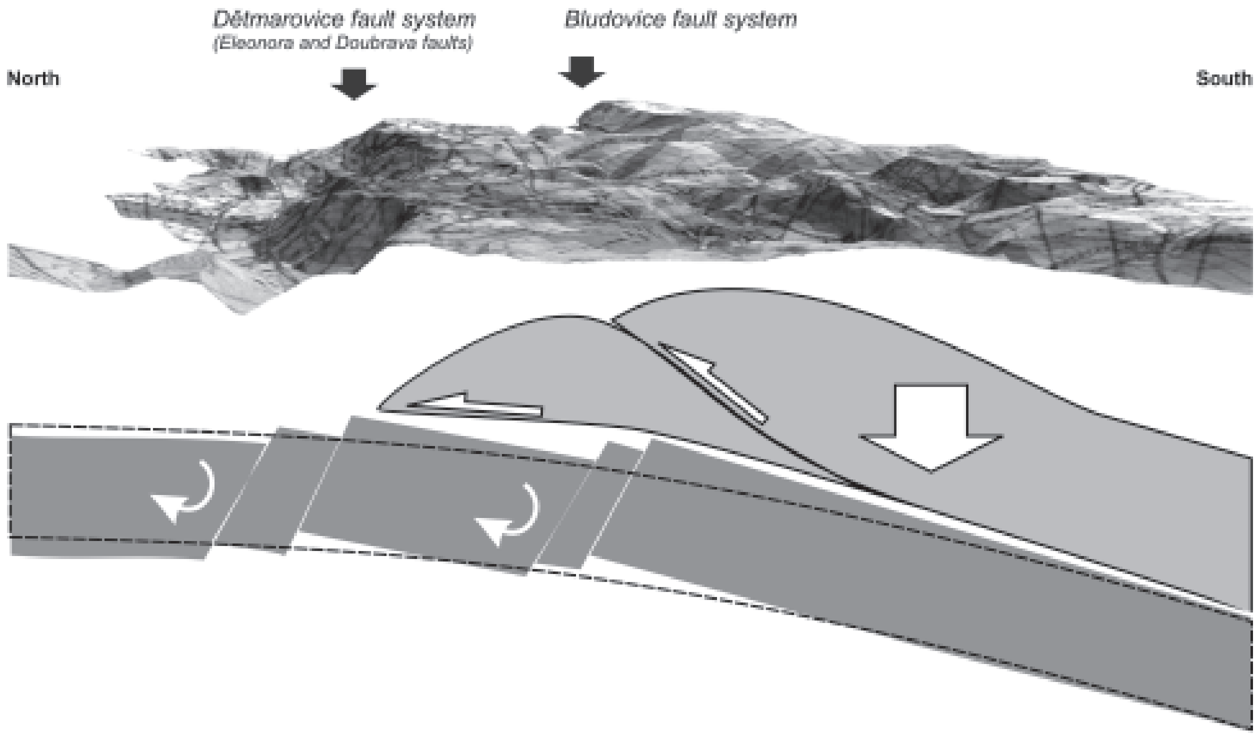

Fig. 1. Principle scheme of the brittle lithosphere (Brunovistulian foreland) break-up on subequatorial fault systems and evoked block tilting due to tectonic loading by Outer Carpathian nappes. Lower schematic profile corresponds to interpretation of the situation, presented on the 3D digital terrain model of buried pre-Alpine paleoreliéf with geological map drift – – upper DTM model.

break-up, caused by tectonic loading. Rejuvenation of pre-Alpine fault system is significant and there is documented by morphostructural analysis. Originated tectonic ramps are very important structural feature of pre-Alpine foreland basement and they evoked some of fault-propagated-fold and duplex structures of Alpine nappes. The Dětmarovice shear zone (Grygar et al. 1989) is the most significant structural element with significant neotectonics rejuvenation. Only this element continues westward into area of Variscan foredeep (Nízký Jeseník Mts), up to Opava town. All others (like Bludovice and Janovice grabens) terminate westward on the Morava Gate fault's system. Special position and significance pertains to system of the Beskydy faults tectonic ramp. This ramp we can track westward up to the Maliník horst and the Upper Morava depression. All subequatorial tectonic zones represent typical hinge fault with westward termination.

The next epi-Hercynian fault system, rejuvenated in the time of Alpine tectogenesis, corresponds to NW-SE up to N-S striking faults, nearly perpendicular (radial) to strike of the Outer Carpathian Belt. The dominant role is ascribed to Karviná graben fault system and Těšín fault. Remarkable Alpine motions along these normal faults are, among others, supported by very good interference of both present-day georelief and buried pre-Alpine paleorelief.

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Ultrapotassic Intrusions of the Bohemian Massif: Insights into the Variscan Sub-continental Lithospheric Mantle?

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Ultrapotassic (UK) rocks of Variscan age form numerous dykes and small plutonic bodies scattered over the Bohemian Massif. The most widespread dyke rocks are minettes being frequent, particularly, in the Central Bohemian Plutonic Complex (CBPC) along the Moldanubian-Barrandian boundary zone and in some parts of the Moldanubian, Lugian, and Saxothuringian areas. Voluminous intrusions of durbachites and similar plutonic types corresponding compositionally to minettes are restricted almost exclusively to the Moldanubian area. Durbachites and the majority of minettes from the CBPC intruded during a short time span between 345 and 340 Ma (Holub et al. 1997; Žák et al. 1998) but lamprophyres in other regions could differ in age and at least some of them are significantly younger.

Mafic varieties of UK rocks display typical features of mantle-derived magmas (high mg-values, high contents of MgO, Cr, Ni). Despite of their potassium and incompatible trace element abundances, they exhibit more primitive nature as compared with other mantle-derived dykes and plutonic rocks corresponding to the calc-alkaline, high-K calc-alkaline and shoshonitic series from the CBPC.

All these rocks display high LIL/HFS elemental ratios indicating derivation of their parental magmas by partial melting of subduction-modified sources and none of them could be derived from fertile asthenospheric mantle (Holub 2000). However, compositional diversity and large differences in incompatible elemental ratios between the UK and other types cannot be ascribed only to an increased degree of enrichment superimposed on a common mantle lithology, or to decreasing melting degrees. Geochemical characteristics and variability of K-rich magmas can be due to distinctive sources within the heterogeneous subcontinental lithospheric mantle with complex history.

High contents of Si, Mg and Cr, high Cr/V, low Ca, Na and Sr in the UK rocks (both durbachites and low-Ca minettes) from the Moldanubian area reflect highly refractory nature of their mantle sources. Abundances of K, Rb, Cs, Th, U and some other incompatible elements require a source that must have been strongly enriched in these elements. Such a source could correspond to phlogopite harzburgite. Unusually high $^{87}Sr/^{86}Sr$ ratio comparable with mature continental crust indicate that the enriched source with high Rb/Sr could be significantly older than the Variscan orogeny. Peralkaline dykes require derivation from distinct K-amphibole-bearing domains.

Petrographically equivalent lamprophyres from some parts of the Bohemian Massif are geochemically distinctive. Melakersantites from the Moldanubian area and from the Barrandian, though very similar in major oxides, differ significantly in some LIL elemental ratios. It seems that although their source mineralogy and overall melting conditions were the same, the enrichment processes in the source were different. Also minettes occurring close to the Central Bohemian Suture Zone display significant geochemical gradient from the Moldanubian block (with low K/Rb, Eu*/Eu, and unusually high Rb/Sr) towards the adjacent Teplá-Barrandian block. Such differences may be attributed to distinct histories of source regions located in the continental mantle lithosphere. This and other geochemical boundaries indicate that the Variscan strike-slip tectonics might have played a significant role in juxtaposition of distinct lithospheric mantle domains in a similar way as, e.g., major faults in the Scottish Caledonides (cf. Canning et al. 1998 and several other papers).

Geochemically anomalous mantle sources capable of producing UK magmas could be reactivated due to the influx of hydrous fluids released from a deeply subducted slab during the Devono-Carboniferous subduction activity. However, the partial melting could be triggered also by restoration of heat flow from underneath the subducted slab after cessation of subduction, or, in other regions, by increased thermal input associated with lithosphere delamination or similar processes unrelated to the subduction itself. This assumption can explain why roughly similar mafic magmas with "subduction geochemical signature" were produced in both spatial and temporal association to subduction-related CA or HKCA magmas (e.g., in the CBPC) as well as in distal regions and in different times (tens of Ma). Geochemistry of these rocks offers information on compositional features and processes forming various subcontinental