Brunovistulian Terrane – Synthesis of Morphostructural Analysis and Geophysical Data (Moravo-Silesian Area, Czech Republic)

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The Moravosilesian zone of the Bohemian Massif is appropriate area, where principles of morphotectonic analysis, supported by geophysical data can be applied to solve specific problems of structural-geological framework and also deformation development. The area is case due to superposition of three structural levels, corresponding to three orogenic cycles. The lowermost Pan-African (Cadomian) Brunovistulian foreland terrane (Fig. 1) determined and influenced the complex geological development of Variscan accretion wedge represented by volcano-sedimentary formations of Rheno-Hercynian foredeep and Sub-variscan foreland of coal-bearing basin. Finally, sequences of the West Carpathian foredeep and the Outer West Carpathian nappes formed the Alpine accretion wedge. Brunovistulicum (Dudek, 1980) as the oldest crustal segment (terrane, microcontinent – Grygar and Vavro, 1995) represents a foreland of both the above-mentioned accretionary wedges: the older Variscan one with generally top-to-NE kinematics and younger Alpine wedge with top-to-NW up to N thrusting.

The morphotectonic analysis is based on 3D visualization and interpretation of digital elevation models (DEM) of the above-mentioned structural levels (Pan-African, Variscan and Alpine). Analyzed digital models were compiled on basis of data from drilling and mining activities and data from geophysical seismic survey (Hubatka, 1997 in Gnojek and Hubatka 2001), but particularly from detailed digitization of topographic maps 1: 25,000 and 1: 50,000. Models were partly compiled using software Surfer 7.0 (shaded relief) and mainly by Arc View GIS 3.2 –3D Analyst module visualization capability. The results of this procedures were compared with structural analysis outcomes and also underground structural maps demonstrating some representative structural features and seam levels of Upper Silesian Coal Basin. Also brittle faults paleodynamic analysis and complex structure analysis were carried out.

All made models of particular structural levels are integrated in broader DEM model of the present relief of the Bohemian Massif and Western Carpathians system. The GTOPO30 DEM has been set up on basis of satellite radar data provided by SAR (Synthetic Aperture Radar).

The general pattern of the expressive magnetic anomalies of eastern Moravia and the Czech part of Silesia was presented in the published Magnetic map of the Czech Republic at a scale of 1: 500,000 by Šalanský (1995). The anomalous field of the study area is based on regular square grid of ΔT magnetic anomalies sized 250 m by 250 m compiled by Gnojek et al. (2000).

Almost 150 seismic profiles were measured in eastern Moravia and Silesia since 1960s to 1980s. Most of them were concentrated to the SW part of the Outer Carpathian Belt. Majority of the seismic activities were focused on the search for hydrocarbons. Interpretation of the seismic survey carried out during previous decades concentrated exclusively on the study of geological sections of sedimentary complexes occuring in the area under study overlying the Brunovistulian crystalline basement. Determination of the boundary between the sedimentary rocks and the crystalline basement (Fig. 2), which can be mostly shown fairly reliably, was the latest and the most profound task of the previous interpretation. Seismic indications of the Brunovistulian buried surface, together with the results of more than one hundred boreholes reaching the basement (see

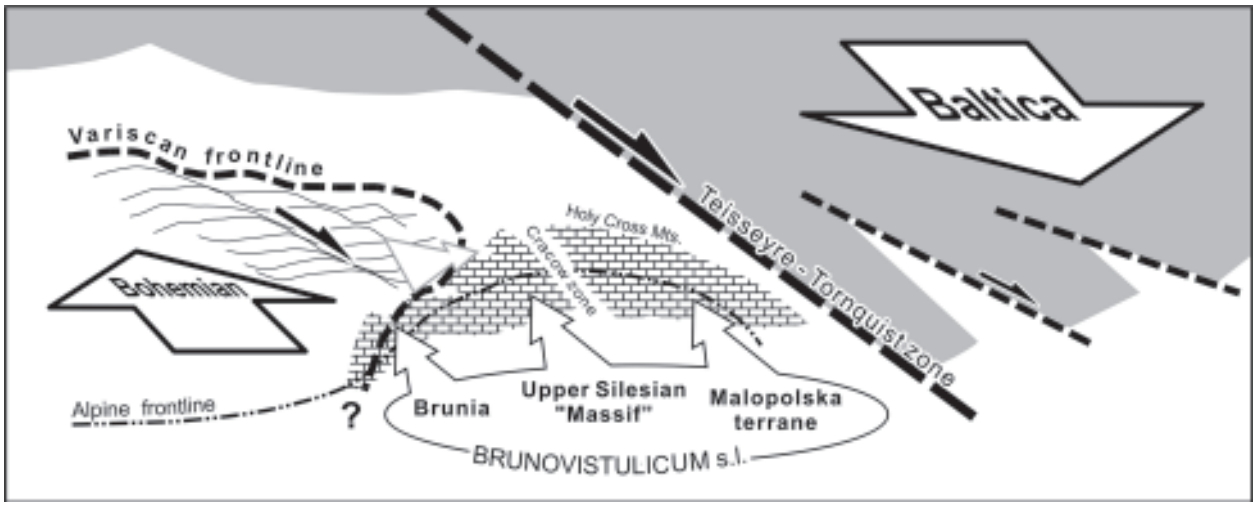

Fig. 1. Simplified scheme of tectonic position of Brunovistulicum terrane along the contact zone between Variscan and Alpine orogeny.

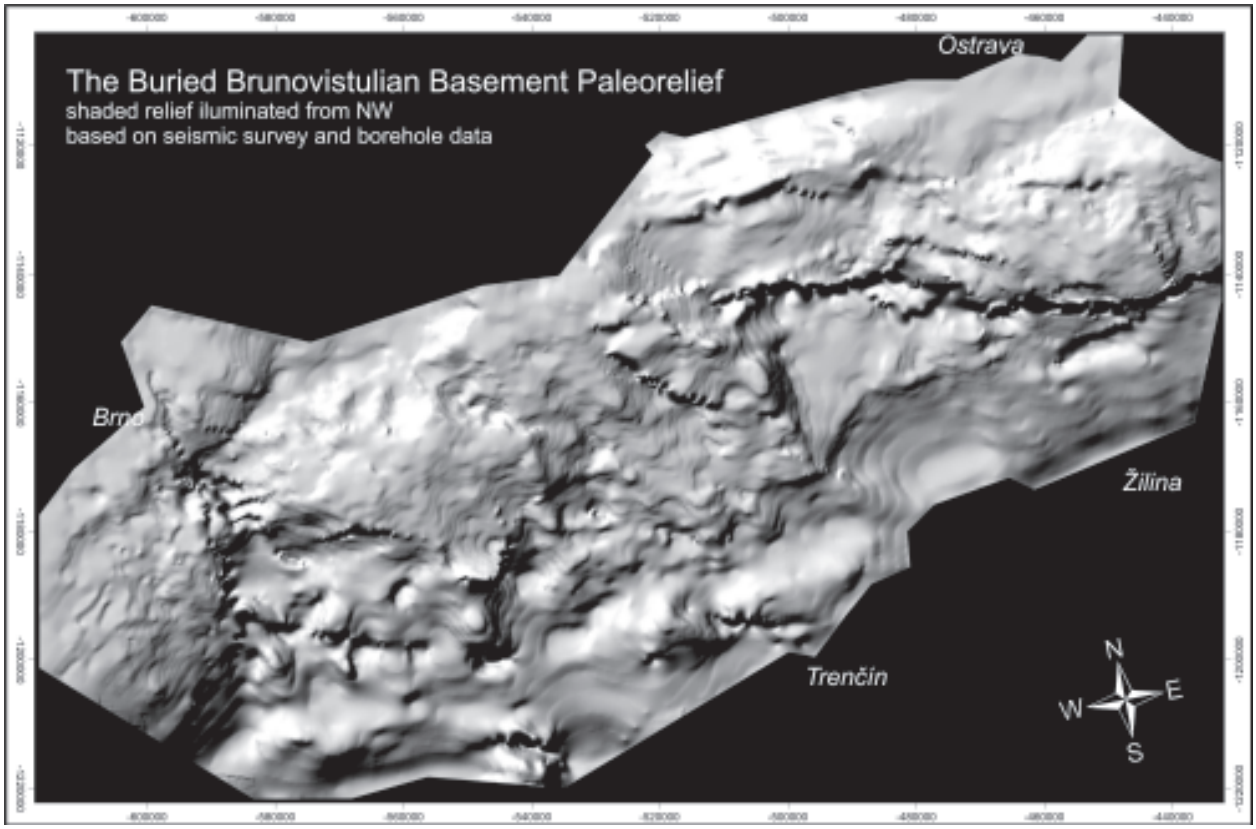

Fig. 2. Digital elevation model (shaded relief illuminated from the NW, based on geophysical and boreholes data according to Hubatka, 1997) of buried Brunovistulian (Pre-Paleozoic) basement.

Suk et al.1991), served as a base for developing the scheme of buried Brunovistulian paleorelief compiled within the project of "Geodynamic model of the relation between the Bohemian Massif and the Western Carpathians" (Hubatka in Krejčí et al., 1998).

Morphotectonic analysis using also geophysical data emphasized a fact that Brunovistulian basement is fractured and vertically differentiated by large fault zones, firstly of the so-called "Sudetic" direction (conjugated system of WNW-ESE and NW-SE striking faults). The major Sudetic tectonic zone is induced by SW morphostructural limits of Nízký Jeseník Mts. exposed part of Culm basin (sometimes termed "Upper Moravian depression boundary fault") which continues to NW as a Sudetic Inner Fault. Its SE extension to the uppermost structural level of the Outer Carpathian nappes realm is also fairly proved by our complex analysis. The discussed zone is prominently traceable in residual gravity and magnetic maps (Šalanský, 1995; Gnojek and Hubatka, 2001 etc.). This tectonic zone constitutes a boundary between two parts of Brunovistulian basement with different paleomorphology. However, this system is not so evident at NE part of the Brunovistulian domain. System of subequatorial (both conjugated strikes WNW-ESE and WSW-ENE) faults – such as Dětmarovice and Beskydy shear zones – is distinctly dominant there. Amplitude of vertical displacement decreases westward on this subequatorial system fault and thus some faults became hidden at intersection with the above-mentioned Sudetic fracture zones (striking NW-SE). The increase invertical amplitude assumes the complex dynamic rejuvenation on the equatorial faults seems to be related to the extensive thrusting of Outer Carpathian nappes over the Epi-Variscan basement and to huge tectonic loading caused by these nappes stacking.

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References

DUDEK A., 1980. The crystalline basement block of the outer Carpathians in Moravia: Bruno-Vistulicum. *Rozpr. Čs. Akad. Věd, Ř. mat. přír. Věd*, 90(8): p.85.

GNOJEK I., MUTLOVÁ A. and DĚDÁČEK K., 2000. Aeromagnetic map of the Czech Republic based on the grid of data 250m x 250 m. Ministry of Environment of Czech Republic, Geofyzika Brno.

GNOJEK I. and HUBATKA F., 2001. Structure of the Brunovistulian Unit (E part of the Czech Republic) on the basis of seismic and magnetic data. Bull. Czech Geol. Survey, 76(3): 157-168.

GRYGAR R. and VAVRO M., 1995. Evolution of Lugosilesian Orocline (North-eastern periphery of the Bohemian Massif): Kinematics of Variscan deformation. *J. Czech Geol. Soc.*, 40(1-2): 65-90.

KREJČÍ O., MÜLLER P. and FRANCŮ J., 1998. Geodynamic model of the contact of the Bohemian massif and Western Carpathians – geophysical chapter by Hubatka F., Sedlák J. and Ondra P. (1997): Geofyzikální práce na na úkolu VaV/630/1/97. (in Czech) – manuscript, Geofyzika Brno, Czech Geol. Surv. Branch Brno.

ŠALANSKÝ K., 1995. Magnetic map of the Czech Republic, 1:500,000. Czech Geol. Surv., Praha.