ST (2,378×10^{-6} [SI], suggesting I-type character of this granitoid); KGD (520×10^{-6} [SI] – suggesting S-type granites); LG (144×10^{-6} [SI]) and OG (140×10^{-6} [SI]). Bulk magnetic susceptibility of Mesozoic rocks ranges according to the variable rock type from −12 to 334×10^{-6} [SI].

The planar magnetic fabric prevails over the linear in all investigated rock types. Generally, the degrees of magnetic lineation as well as these of magnetic foliation are relatively low in the majority of granitic samples. The highest values with average of 1.043 (lineation degree) respectively 1.055 (foliation degree) are displayed by ST; the KGD and LG have these values slightly lower. The obvious macroscopic planar fabric of OG is reflected in concordant orientation and the greater degree (mean of 1.107) of magnetic foliation. The degrees of magnetic lineation as those of magnetic foliation in the Mesozoic rocks differ according to the rock type and deformational grade – from 1.004 to 1.142 by lineation, respectively from 1.002 to 1.175 by foliation.

Even though, due to local tectonic structures, the orientations of magnetic lineation as well as these of foliation slightly vary also within the localities in the individual geological unit, there is marked difference in the predominant orientations between different rock types. Lineation of ST moderately plunges to ESE; of KGD to the E up to NE; of LG vary between W and SW; of OG between NE and SE and lineations of Mesozoic are oriented to the NNE, or more rarely to the SSW. Dips of magnetic foliations are low to moderate; only in OG they are steeper. The predominant directions of the magnetic foliation dips are these: in ST to the N up to NE; in KGD vary between SE and NE, in LG between W and NW; in OG to the SE and in the Mesozoic cover prevail the orientation of magnetic foliation dips to the NE.

In some Mesozoic localities (in the Tatricum as well as in the nappes) the magnetic fabrics and observed macroscopic bedding are conformable, but mostly the marked divergence between them was detected, indicating the deformational overprint of magnetic structure.

Present AMS investigations reveal different magnetic fabrics in individual granite types what support an idea of multistage – pulse character of the Ľubochňa massif of the Veľká Fatra Mts. inferred from field, petrological and geochemical studies. The magnetic fabric of Mesozoic rocks from the Veľká Fatra Mts. showed difference not only within different units (e.g. cover unit, Krížna nappe and Choč nappe) but also within various domains of the same unit. However, there were observed only slight Alpine overprint of the magnetic fabric of the Hercynian granite rocks near the principal faults. We can suggest dextral character of young Alpine movement at N-S Ľubochňa fault in spite of limited data. Indeed, the results of AMS study display rather inhomogeneous character with independent domains within granitic basement and Mesozoic units. It is evident that this magnetic fabric is not consequence of Neogene deformation only, but also records the multistage evolution including the Hercynian, Paleo-Alpine and Neo-Alpine periods.

References

GREGOROVÁ D., HROUDA F. and KOHÚT M., 2003a: Magnetic susceptibility and geochemistry of Variscan West Carpathian granites: implications for tectonic setting. *Phys. Chem. Earth*, 28: 729-734.

GREGOROVÁ D., HROUDA F. and KOHÚT M., 2003b: The Magnetic Fabric of the Veľká Fatra Mts. granitic pluton – A Pilot AMS Study. *Geolines*, 16: 34-35.

HROUDA F., PLAŠIENKA D. and GREGOROVÁ D., 2002. Assumed Neogene deformation in the Central Western Carpathians as inferred from magnetic anisotropy investigations. *EGS Stephan Mueller Spec. Publ. Series*, Vol. 1: 195-211.

JELÍNEK V. and POKORNÝ J., 1997. Some new concepts in technology of transformer bridges for measuring susceptibility anisotropy of rocks. *Phys. Chem. Earth*, 22: 179-181.

KOHÚT M., 1992. The Veľká Fatra granitoid pluton – an example of a Variscan zoned body in the Western Carpathians. In: J. VOZÁR (Editor), The Paleozoic geodynamic domains of the Western Carpathians, Eastern Alps & Dinarides. GÚDŠ Bratislava, Spec. Vol. IGCP-276, 79-92.

KOHÚT M. TODT W. JANÁK M. and POLLER U., 1997. Thermochronometry of the Variscan basement exhumation in the Veľká Fatra Mts., (Western Carpathians, Slovakia). EUG 9, Strasbourg, *J. Conf. Abs.*, 2, (1): p. 494.

POLLER U., TODT W., KOHÚT M. and JANÁK M., 2000. Geochemical and Isotopic Characteristics of the Granitoids from the Velka Fatra (W-Carpathians) in Combination with U-Pb Ion-Microprobe and TIMS Single Zircon Dating. *J. Conf. Abs.*, 5, (2): p. 811.

Easternmost Thrust Tectonics of Czech Part of Upper Silesian Coal Basin (Variscan Accretion Wedge, Bohemian Massif, Czech Republic)

Radomír GRYGAR[1], Petr WACLAWIK[2], Jan JELÍNEK[1], Jiří PTAČEK[3] and Petr KONÍČEK[3]

[1] *Institute of Geological Engineering, VŠB-TU Ostrava, 17. listopadu, 708 33 Ostrava, Czech Republic*
[2] *ČSM Mine, Českomoravské doly a. s., 735 Stonava, Czech Republic*
[3] *OKD, DPB Paskov a. s., Rudé armády 637, 739 Paskov, Czech Republic*

The Upper Silesian Coal Basin (USCB) represent typical foreland basin located in the toe domain of the Variscan accretion wedge (Grygar and Vavro, 1995, Dopita et al., 1997, Grygar et al., 2000) of the Moravosilesian area. The Karviná sub-basin represents most eastward transverse structural depression (Grygar et al., 1989) of the USCB. The coal-bearing Karviná formation (continental molasse – Namurian A–B) is cropping out on buried Pre-Alpine basement surface. The structure style in the Karvina sub-basin is distinctly different in relation to this part of the USCB, which is located westward of the main tectonic Orlová fault-propagation fold structure (see Fig. 1). The eastward decrease of tectonic mobility and complex deformation is also evident in the internal zonality of the Karviná sub-basin, which is traditionally described as a basin with very simple tectonic pattern (so called "tafrogenic" tectonic style with dominance of normal faults – Kumpera et al. 1990, Dopita et al. 1997). Only in the western part of Karvina sub-basin (area of the Doubrava Mine and the ČSA Mine) reverse and/or thrust faults were reported, concentrated in the so-called Central Thrust Zone – CTZ (Grygar et al., 1989, Kumpera et al., 1990). Also from eastern part of the Karviná sub-basin small thrusts were described. However vertical amplitude usually does not exceed thickness of faulted seams (it means first meters). Thrusts and associated compressed structures do not occurred in stratigraphically uppermost seams (Doubrava Member) generally. However in the last decade new thrusts and compress structures were, especially in the lower seams of the Suchá and Saddle Member (due to progress in mining of deeper seams) proved by mine boreholes, advance galleries and coal faces. Its vertical amplitude exceed seem thickness and reach up-to first tens meters. Due to fact, that described structures are typical low angle thrusts, mostly passing in to intra-seam mylonitic zones, it is very difficult, in conditions of mines, to predict and construct down-dip development of individual thrusts in the seam maps. One of the special features of above mentioned thrust zone is its listric geometry and transition in to intra-seam slip faults. Propagation of thrusts in-to adjacent seams is linked also to tectonic ramps development (Mitra, 1992). These ramps could be related among others also to lithology heterogeneity, e.g. coal seam splitting, erosional channels etc.

Above mentioned features of the thrusts significantly complicate development of coal seams and mining capacity planning. Thrusts, flexures, boudinage, mylonitization, tectonic erosions and other deformation structures significantly influence individual coal face planning in negative sense, especially its orientation, dimensions and shape so as general exploitation conditions. All above mentioned negative features fundamentally complicate a mineability of the coal seams.

So far made analysis of genesis and space geometry of the Central Thrust Zone confirm our former supposition concerning increasing strain intensity so as vertical and horizontal kinematic amplitude on individual thrusts of the CTZ (Grygar et al., 1989, Ptáček, 1999). In relation to this finding it is possible to decline previous argument (e.g. Dopita and Kumpera, 1993, Dopita et al., 1997), which consider Orlová thrust-fold structure as the eastern limit of thrust and fold tectonics inside the USCB and Moravo-Silesian area as a whole. In the fact, this limit, based on our studies, corresponds to most known eastern thrusts of Central Thrust Zone in the area of the ČSM Mine, near the Polish frontier (Fig. 1).

Individual thrust deformations of the Central thrust zone are concentrate in the wide curved domain located asymmetrically in centre of transverse depression of the Karviná subbasin (see Fig. 1), which represents component of regional Ostrava-Karviná transverse depression. In situ measured slickensides on thrusts planes predominantly indicate up-dip kinematics. It means NNE-ward thrusting along northern path (flank) of the CTZ and SE-ward thrusting on southern flank (see arrows on Fig. 1). Intensity (vertical thrust amplitude) of thrusting along

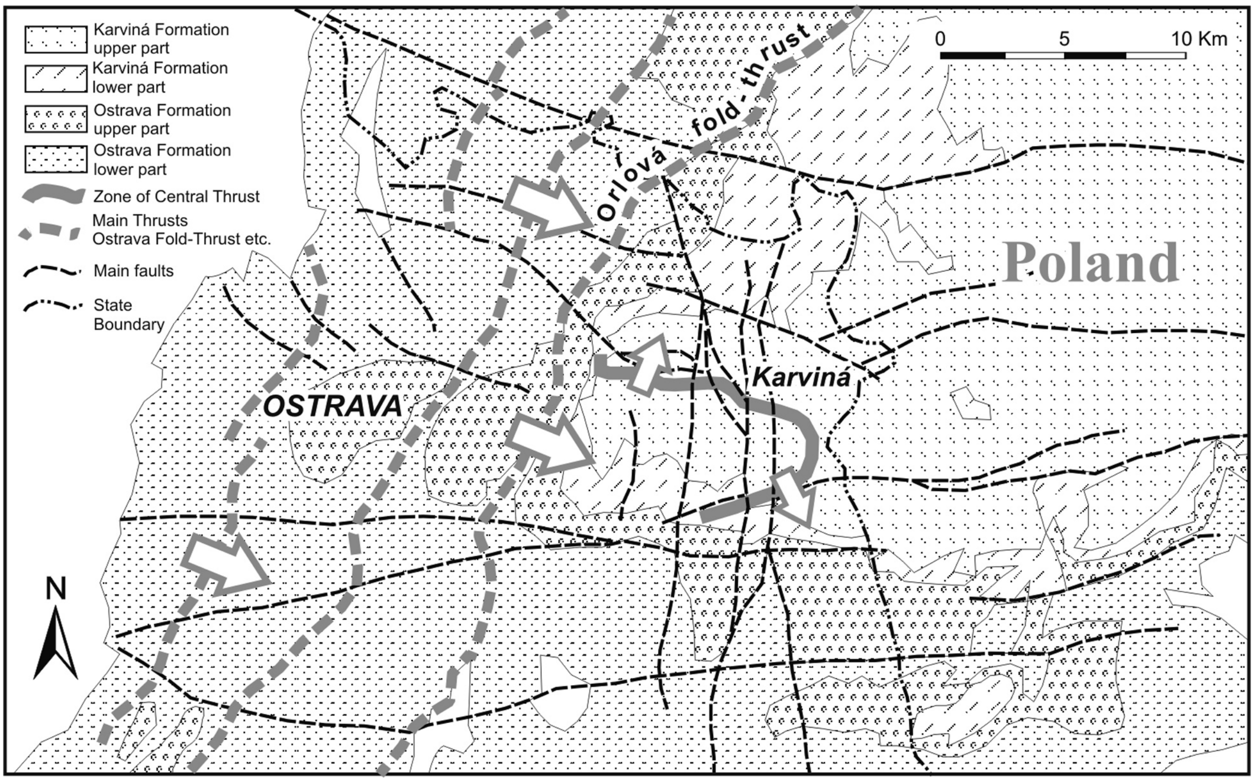

Fig. 1. Schematic structure-geological map of the Ostrava – Karviná part (Ostrava, Petřvald and Karviná subbasins and adjacent areas) of Upper Silesian Coal Basin with highlighted position of the Central thrust zone. Large arrows indicate top to east thrusting on the main fold and/or fold-thrust structures (e.g. dominant Orlová structure). Smaller arrows correspond to slickensides direction and sence of thrusting on the individual thrusts in the Central thrust zone.

the Central thrust zone is greatest on northern limb above all in its western zone (Doubrava Mine area), where vertical amplitude exceed 20–30 meters on low angle thrusts (10–30 degree). Based on the heretofore made complex structure analysis we accept working hypothesis, which simultaneously with theory of front thrusting in toe domain of the Variscan accretion wedge presuppose more intensive out-of-sequence "tectonic extrusion" of accretion wedge in to transverse structure depression (Karviná subbasin) located in the Variscan foreland. Genesis and development of described transverse depression is related to dextral transtensional/transpressional Variscan deformation regime along subequatorial tectonic domains (Grygar et al., 1989).

References

DOPITA M. and KUMPERA O., 1993. Geology of the Ostrava-Karviná coalfield, Upper Silesian Basin, Czech Republic, and its influence on mining, *Inter. J. Coal Geol.*, 23: 291-321.

DOPITA M. et al., 1997. Geologie české části hornoslezské pánve, MŽP ČR, Praha.

GRYGAR R., ADAMUSOVÁ M., DOLEŽALOVÁ J. and KALENDOVÁ J., 1989. Strukturní pozice a paleodynamický vývoj hornoslezské pánve, zvláště její karvinské části vzhledem ke genezi důlních otřesů, *Sbor. věd. prací Vysoké školy báňské v Ostravě, ř. hor. geol.*, 1: 39-84.

GRYGAR R., JELÍNEK J., PTÁČEK J. and WELSER P., 2000. Fault-propagation Folds and Thrust Structures of the Apical Domain of the Variscan Accretion Wedge (Moravosilesian Zone, Bohemian Massif), *Geolines*, 10: 24-25.

KUMPERA O., ADAMUSOVÁ M. and KALENDOVÁ J., 1990. Zlomová stavba centrální části karvinské oblasti hornoslezské pánve, *Sbor. věd. prací Vysoké školy báňské v Ostravě, ř. hor. geol.*, 36, 1, 3-29.

KUMPERA O. and MARTINEC P., 1995. The development of the Carboniferous accretionary edge in the Moravian-Sielsian Paleozoic Basin, *J. Czech Geol. Soc.*, 40: 47-64.

MITRA S., 1992. Balanced structural interpretation in fold and thrust belts. In: S. MITRA and G.W. FISCHER (Editors), Structural geology of fold and thrust belts, The John Hopkins University Press, pp. 51-91.

PTÁČEK J., 1999. Význam strukturně-tektonických faktorů pro nebezpečí vzniku otřesů v ostravsko-karvinské uhelné pánvi, Ph.D. Thesis, VŠB-TU Ostrava, Ostrava, Czech Republic.

Recent Tectonic Activity and Orientations of the Principal Stresses in the Jeseníky Region

Josef HAVÍŘ[1] and Petr ŠPAČEK[1]

[1] Institute of Physics of the Earth, Masaryk University, Tvrdého 12, 602 00, Brno, Czech Republic

The weak seismo-tectonic activity occurs in the NE part of the Bohemian Massif. In the period of years 2001–2003 the detailed monitoring of this natural seismic activity was carried out using temporal local seismic network Dlouhé Stráně and other seismological stations operated by IPE in the eastern part of the Czech Republic (Sýkorová et al., 2004). Seven microearthquakes yielded well defined P-onset polarities at five or six stations with good spatial distribution which allowed the focal mechanisms to be computed. These microearthquakes were located into four separated areas in the Jeseníky region (NW of Bruntál, NNE of Šternberk, NW of Šumperk and NNE of Uničov). For each event such focal mechanism solution was accepted which had the smallest deviation between the observed and calculated SH/P amplitude ratios. Number of allowed polarity errors was set to zero.

In spite of different locations of events, the focal mechanism data set is more or less homogeneous. Each analysed mechanism consists of steep or moderately dipping WNW-ESE to NW-SE nodal plane (dextral hypothetical movement) and of another steep NNE-SSW to NE-SW (sinistral hypothetical movement) nodal plane. Only one nodal plane represents a real movement along a real fault plane and only its kinematics has to correspond to stress condition. But it is impossible to recognize the real fault without any additional information. The WNW-ESE to NW-SE nodal planes correspond well to WNW-ESE and NW-SE trending systems of "sudetic" faults. Also NNE-SSW trending faults, hypothetically corresponding to NNE-SSW to NE-SW nodal planes, occur in the northeastern part of the Bohemian Massif. NNE-SSW trending thrusts were formed already during Variscan orogeny in the Jeseníky region (Grygar and Vavro, 1995, Kumpera, 1983). The Alpine (Neogene) reactivation of these thrusts is known from the northeastern margin of the Bohemian Massif near the front of the West Carpathian nappes (Havíř, 2002, Krejčí et al., 2002). Thus, the real movements along both the WNW-ESE to NW-SE nodal planes and NNE-SSW to NE-SW nodal planes are possible and have to be taken into account during stress analysis.

The computed focal mechanism data were used for stress analysis. The numerical grid method was applied, all possible reduced stress tensors (excepting uniaxial compression and uniaxial extension) were tested against data and acceptable tensors which satisfy the limits were selected. The axis of maximum extension σ_3 is subhorizontal or only gently dipping and it is oriented in the direction ENE-WSW (azimuth of best solutions and/or eigenvectors is about 60–70°). The orientation of maximum compression σ_1 is NNW-SSE (azimuth of best solutions and/or eigenvectors is about 150–160°). Also axis of maximum compression is probably subhorizontal or only gently dipping. The discussed results of stress analysis correspond well with published orientations of horizontal stresses measured using breakouts (Peška, 1992) and hydrofracturing method (Staš et al., 1997) in the Czech part of the Upper Silesian Basin. Similar stress fields were found also in other regions of the Bohemian Massif (Havíř, 2000, Peška, 1992, Reinecker and Lenhardt, 1999).

All NNE-SSW to NE-SW nodal planes fit the found stress field. On the other hand, the sub-set of the steep NNE-SSW to NE-SW nodal planes is heterogeneous and some of these planes