# Paleozoic Evolution of the Moravosilesian Basin

*Jiří KALVODA*

*Department of Geology and Paleontology, Faculty of Science, Kotlářská 2, 61137 Brno, Czech Republic*

The Brunovistulian Terrane (BT) is a fragment of northern Gondwana margin regarded as a part of Avalonian group of terranes (Kalvoda 1995). Lithological record of the Cambrian marine sediments may indicate extension and rifting connected with the fragmentation of Gondwana. It is assumed that BT was amalgamated to Baltica along the TESZ in the Lower Paleozoic and was a southern promontory of Laurussia during the Variscan Orogeny.

The Devonian extension is assumed to be connected with intraplate stresses due to the collision of the Brunovistulian promontory with Moldanubian and Armorican Superterrane. The first evidence that the continental margin is being affected by collision may be extensional faulting on the downgoing rifted continental margin. Sengör (1995) suggested that a continent may break up upon the collision with another continent creating collision-related rifts (impactogens, aulacogens, strike-slip related rifts). Orogeny leads to rifting at high angle to the compression direction and rifts form first near the collision site and propagate later away from it. As a consequence, the amount of total extension and correlatively, the magnitude of the total subsidence, is commonly greatest near the suture and decreases away from it. The Moravosilesian Basin bears features of both impactogen and strike-slip related rifting. During the rifting old basement faults of approximately NW–SE direction paralleling the Teisseyre–Tornquist Zone and Kraków–Lubliniec Zone were reactivated. Remnants of the extensional zones can be distinguished in the Nesvačilka, Jablůnka, Jablůnkov and other halfgrabens in the east, while more to the west detached sediments and their basement rocks were incorporated in the complicated mosaic of the Moravo-Silesian Shear Zone. Development of similar halfgraben basins can be traced also in southern Poland and shows a distinct S–N polarity.

The compression in the Moravosilesian foreland basin started in the Tournaisian (Moravia) while in southern Poland extension still took place. During the compression, former extensional faults were often reactivated as overthrust zones. The Variscan flysch in Moravia can be subdivided into the inner belt (including the Protivanov and partly Rozstání Formation in the Drahany Upland and the Andělská Hora and Horní Benešov Formation in the Nízký Jeseník Mountains) and outer belt (including the Myslejovice Formation in the Drahany Upland and the Moravice and Hrádek–Kyjovice Formation in the Nízký Jeseník Mountains). The inner belt was characterized by prominent dextral translation on nappe units and Brunovistulian affinity of source rocks while the outer belt shows an eastward decreasing extent of overthrusting (even passing in paraautochthonous and autochthonous units), an important role of Moldanubian source rocks and prominent S–N grain-size distribution.

The evolution of the Moravosilesian foreland basin was governed by the interaction of the Brunovistulian Terrane with Moldanubian Superterrane in the Drahany area, Armorican Superterrane in the Jeseníky area as well as with the Malopolska Terrane in the north. In this respect the evolution of the Moravosilesian foreland basin is more complex than in western Europe, where the Avalonian foreland collided with the Armorican Superterrane. The dextral translation was characteristic both for the contact with Malopolska Terrane (Kraków–Lubliniec Zone) and for the whole TESZ (Grygar and Vavro 1995). This idea is supported by the close affinity of the Devonian and Carboniferous foraminiferal fauna of the Brunovistulian Terrane with the Dnieper–Donets Basin. Consequently, the Brunovistulian Terrane may be regarded as a separate terrane within the Avalonian group of terranes showing similar tectonic position (Rhenohercynian Zone) but different paleogeographic evolution than the Eastern Avalonian Terrane in Germany. To conclude, we assume a more important role of terranes in the origin of the Middle European Variscides analogous to the evolution of the Appalachians.

## References

GRYGAR R. and VAVRO M., 1995. Evolution of Lugosilesian Orocline (North-eastern periphery of the Bohemian Massif): Kinematics of Variscan Deformation. *Journal of the Czech Geological Society*, 40, 1-2: 65-90.

KALVODA J., 1995. Devonské pánve při okraji východní Avalonie na Moravě. *Geol. výzk. Mor. Slez.. v r. 1994*, 48-50.

SENGÖR A.M.C., 1995. Sedimentation and tectonics of fossil rifts. In: C.J. BUSBY and R.V. INGERSOLL (Editors), Tectonics of sedimentary basins. Blackwell Science, Cambridge, pp. 65-112.

# Variscan Structural Evolution of the Central Part of the Krušné Hory (Erzgebirge) Mts. in the Czech Republic

*Jiří KONOPÁSEK, Karel SCHULMANN and Ondrej LEXA*

*Karlova Universita, Faculty of Science, Institute of Petroloy and Structural Geology, Albertov 6, 128 43, Praha 2, Czech Republic*

In the central part of the Krušné hory (Erzgebirge) Mountains, the para-autochthonous metasedimentary basement has been overthrust by a crustal nappe of fine- and coarse-grained orthogneisses. The thrust boundary is defined by the presence of mafic eclogites with preserved subduction-related D1 fabric. The D2 deformation is represented by thrust-related structures with westward kinematics producing main $S_2$ metamorphic foliation and $L_2$ lineation in non-eclogitic lithologies. Buttressing of the allochthonous body from the west is responsible for the development of late, large-scale $F_2$ folds with N–S-trending hinges and vertical axial planes (Měděnec and Oberwiesenthal synforms). The D3 event is associated with N–S compression leading to large-scale folding of both the autochthonous and allochthonous units. This deformation produces km-scale antiforms (Měděnec and Klínovec antiforms) and is associated with the development of the $L_3$ lineation as a result of complete reworking of the D2 fabric in the limb zones. The development of numerous D3 structures can be recognized in the basement rocks. These structures range from ductile $F_3$ folds up to brittle-ductile kink bands suggesting a decrease in temperature, and thus uplift of the whole study area during the D3. The last stage of deformation (D4) is characterised by the development of kink-band $F_4$ folds. These kink bands developed almost exclusively in those parts of the structure where D3 folding produced steep planar fabric, and their geometry suggests subvertical direction of principal compression.

Our observations suggest three main deformation events. An early westward compression which was responsible for the emplacement of an allochthonous orthogneiss body with eclogites on its base. Following this event, the principal compression became orientated N–S producing large-scale D3 folding of both the allochthonous and autochthonous units. The final stage of structural evolution was marked by the disappearance of the horizontal D3 compression, and an increase in the role of the overburden which lead to the appearance of subvertical stresses and formation of brittle-ductile D4 structures.

# Evidence for High Exhumation Rate in Central European Variscides: U–Pb Ages of Granulite Metamorphism of Clasts Deposited in Upper Visean conglomerates

*Jana KOTKOVÁ[1] and Randall R. PARRISH[2]*

[1] *Czech Geological Survey, Klárov 3, Prague 1, Czech Republic*
[2] *NERC Isotope Geoscience Laboratory (NIGL), Keyworth, Notts, NG12 5GG, United Kingdom*

Pebbles and/or boulders of crystalline rocks occurring within post-orogenic sedimentary sequences provide a unique material for studies of geotectonic evolution of orogenic belts. Visean conglomerates of the Variscan flysch (Culm) at the eastern margin of the Bohemian Massif containing highly variable rock assemblage in pebbles provide a unique material for such studies. The most important source of magmatic and metamorphic rock pebbles is represented by several kilometers thick Myslejovice Formation in the southern part of the Drahany Upland. Its subdivision into the lower Račice Conglomerate and upper Luleč Conglomerate is based on a change in material composition.

In the Luleč Conglomerate, clasts of crystalline rocks such as granulites (Štelc 1960; Vrána and Novák 1998), durbachites (Zachovalová and Leichmann 1999) and metabasic rocks have been found. Granulite mineral assemblages evidence equilibration at variable crustal depths, always at high temperatures. Mineral assemblages and reaction textures that are analogous to the granulites exposed in the Bohemian Massif suggest that some of these rocks were exhumed along near-to-ITD (isothermal decompression) P-T path over at least 24-km depth. The age of sedimentation of conglomerates with shale intercalations in the interval 327–334 Ma (based on paleontology) constrains well the minimum age of the exhumation of crystalline rocks at the surface. Along with the age of the crystalline rock formation/metamorphism it provides basis to infer the exhumation rates of rock complexes.

Single and multigrain U–Pb dating of accessory phases from granulite and durbachite samples from the Luleč and Olšany (durbachite only) quarries was carried out in NIGL. Zircon from seven samples and monazite and rutile, when available, were dated. All zircon fractions were abraded. Garnet-bearing felsic granulite LU-A-20 (Grt-Sill-Qtz-Afs-Pl-Bt±Crd) and garnet-bearing intermediate granulite LU-A-3 (Grt-Sill-Qtz-Afs-Pl-Crd-Bt±Ms) contain uniform population of clear, lustrous, multifaceted, largely spherical zircons (size up to 200–300 mm) typical of growth during high-grade metamorphism. This zircon type prevails in Opx-bearing granulite LU-A-28 (Grt-Bt-Opx-Qtz-Afs-Pl±Crd), where also long prismatic zircon grains occur, up to 250 mm long, commonly with rounded edges. Mainly shorter prismatic up to 300–400 mm long, clear or clouded zircons are typical for felsic granulite LU6 (Grt-Qtz-Afs-Pl), garnet-rich granulite with biotite LU4 and cordierite granite/migmatite (Qtz-Afs-Pl-Crd-Bt-Grt±And±Ms). All three samples also contain small clear equant zircons (100–150 mm). Durbachite contains mainly long prismatic, larger (up to 600 mm long) and smaller, even acicular, generally transparent zircons, and subordinate flat crystals (up to 200mm), all with igneous morphology. Yellow-green clear monazite crystals from LU-A-20 and LU-A-2 and dark brown-black (opaque) elongated crystals of rutile up to 400 mm long (LU-A-20) and reddish brown translucent longer prismatic rutile crystals (LU4) were also dated.

Zircon, monazite and rutile of garnet-rich felsic granulite yielded Variscan ages, ranging between 336 and 339 Ma (zircon) and 329 ± 4 Ma (rutile). Monazites (337–330 Ma) are younger or overlap within the error with concordant rounded zircons. Rounded zircons from the intermediate granulite and various zircon types (short prismatic, oval-shaped) from the Opx-bearing granulite are largely concordant at 336 ± 2, closely corresponding to the above given data. These ages are interpreted as ages of granulite metamorphism.

High-U prismatic zircons from LU6 felsic granulite are both discordant beside 304–316 Ma, with $^{207}Pb/^{206}Pb$ ages of 332–362 Ma, difficult to interpret. Garnet-biotite-rich granulite (LU4) contains prismatic zircons showing inheritance from Precambrian and 500 Ma old sources; the zircon magmatic age is not certain based on these data. Rounded zircons slightly discor-