formed (e.g., Patterson et al., 1989, 1990; Shelley, 1992). The mentioned conditions might have caused the thinning of already magmatically differentiated and mixed sills, controlled by propagation (opening) of an extensional shear zone. All lithological members were thinned and stretched into straight bands with sharp boundaries, changing the mineral grain size, due to superimposed strong ductile deformation and recrystallization at medium-T conditions within a deep-crustal shear zone.

Deformation-recrystallization stages

It is possible to distinguish the next deformation-recrystallization stages in the main types of rocks:

1. Metadiorites to metagabbrodiorites
   DR1 (prograde burial, Variscan): Am1 (Mg Hbl, edenite pargasite?), Pl, Qtz, Ep-Czo, Grt, Bt1, ±Ttn
   DR2-1 (extensional exhumation, Variscan): Am2 (Ts), Pl, Grt
   DR2-2 (late Variscan? or Alpine cooling): Am2 (Act), Ab, Chl2, Bt2, Ms-Phe, ±Cld, Grs
2. layered metadiorites amphibolites (magmatic, subsolidus and solidus layering)
   DR1 (prograde, Variscan): Am1 (Mg-Hbl), Chl1, Qtz, Pl, Bt1
   Moreover, Px diopside of metahornblenditic lenses is replaced by Mg-Hbl(1).
   DR2-1 (extensional exhumation, Variscan): Am2 (Ts), Grt, Czo, Phe
   DR2-2 (late Variscan? or Alpine cooling): Am2 (Act), Ab, Ms, Bt2, Chl2, Grs, ±Cld

References

FOUNTAIN D.M., ARCULUS R., and KAY R. W., 1992. Continental Lower Crust. Elsevier, Amsterdam.

HALL A., 1996. Igneous Petrology. Longman Group Limited, Essex.

HOVORKA D., MÉRES Š. and IVAN P., 1992. Pre-Alpine Western Carpathians Mts. Basement complexes: Geochemistry, petrology, geodynamic setting. *Terra Nova abstr. Suppl.*, 4, 2: 32.

HOVORKA D. and MÉRES Š., 1993. Leptyno-amphibolite complex of the Western Carpathians: occurrences and lithology. *Mineralia Slov.*, 25: 1-9.

KRIST E., KORIKOVSKY S.P., PUTIŠ M., JANÁK M. and FARYAD S.W., 1992. Geology and petrology of metamorphic rocks of the Western Carpathian crystalline complexes. Com. Univ. Press, Bratislava.

NEUBAUER F., 1989. The "Leptinite-amphibolite complexes" – a key for correlation of mid-European Variscides? In: R.D. DALLMEYER, Tectonostratigraphic expression of terrane accretion in the circum-Atlantic Paleozoic orogens. Abstracts, Athens, Georgia, U.S.A.

PARSONS I., 1987. Origin of Igneous Layering. Reidel, Dordrecht.

PATTERSON S.R., VERNON R.H. and TOBISCH O.T., 1989. A review of criteria for identification of magmatic and tectonic foliations in granitoids. *J. Struct. Geol.*, 11(3): 349-363.

PATERSON S.R., TOBISCH O.T. and MORAND V.J., 1990. The influence of large ductile shear zones on the emlacement and deformation of the Wyangala Batholith, SE Australia. *J. Struct. Geol.*, 12(5-6): 639-650.

PERCIVAL J.A., FOUNTAIN D.M., and SALISBURY M.H., 1992. Exposed crustal cross sections as windows on the lower crust. In: D.M. FOUNTAIN, R. ARCULUS and R.W. KAY, Continental Lower Crust. Elsevier, Amsterdam.

PUTIŠ M., 1992. Variscan and Alpidic nappe structures of the Western Carpathians crystalline basement. *Geol. Carpath.*, 43(6): 369-380.

SHELLEY D., 1992. Igneous and metamorphic rocks under the microscope. Chapman and Hall, London.

Lithological and Sedimentological Evolution of the Cambrian in the Měnín – 1 Borehole

Helena GILÍKOVÁ[1], Jaromír LEICHMANN[2], Radek MIKULÁŠ[3] and Slavomír NEHYBA[2]

[1] *Czech Geological Survey, Leitnerova 22, 658 69 Brno, Czech Republic*
[2] *Department of Geology and Paleontology, Faculty of Science, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic*
[3] *Institute of Geology, Academy of Sciences, Rozvojová 135, 165 02 Praha 6, Czech Republic*

The Lower Paleozoic clastic sediments (so-called "old red formation") are assumed to be the oldest sedimentary formation overlaying the Precambrian Brunovistulian unit. These sediments have been originally described by the number of authors as "basal Devonian clastics" (Dvořák, 1998; Skoček, 1980 etc.). More recently, Lower Cambrian sediments were found in the boreholes Měnín 1 and Němčičky 3, Němčičky 6 (Jachowicz and Přichystal, 1997).

The Měnín borehole is situated 20 km to the south-east of Brno. The borehole is 2100m deep, the crystalline basement has not been reach. The Lower Cambrian microfossils of Acritarcha genus were identified at depth of 475–477,5 m (Jachowicz and Přichystal, 1997; Fatka et al., 1998). The sediments below the horizon with Acritarcha are considered to be of Cambrian age.

Petrological character of the studied sediments is monotonous. To the depth of 900 m grey to greenish grey fine to coarse-grained well-sorted quartzitic sandstones prevail over red to violet coloured arcosic sandstones. Below the 900 m red to violet coarse to fine-grained arcoses, greywacke sandstones with variable amounts of finer grained members were penetrated by the borehole Měnín. Three types of quartz, zoned K-feldspar, plagioclase, muscovite and biotite were observed in CL microscope. Zircon, tourmaline and apatite are common accessories. The rare cement is composed of recrystallized kaolinite or car-

bonate. The mineral composition of sediments and internal fabric of individual minerals indicates that the muscovite-biotite bearing-granites can be considered a potential source rock.

Particular lithofacies and ichnofossils were studied to understand of the original deposition environment. Studied drill cores contain features which can be interpreted as reflection of both terrestrial and marine influences. Studied deposits were most likely deposited under strong influence of fluvial environment (braided river?). Terrestrial environment was assumed by an absolute majority of previous authors (Dvořák, 1998; Skoček, 1980; Zádrapa et al., 1983 etc.). Trace fossils helped to trace the marine influences in sedimentation (Mikuláš and Nehyba, 2001). The depositional environment was in the studied case affected by the marine conditions in its marginal or distal areas (interdistributary area, braided delta ?), probably during reduced fluvial supply or channel shifting. Shallow marine condition can be assumed.

Acknowledgement

The study was kindly supported by the Research Project CEZ J07/98-1431000004.

References

DVOŘÁK J., 1998. Lower Devonian Basal Clastics - Old Red Formation, Southern Moravia, Czech Republic. *Věst. Čes. geol. Úst.*, 73(4): 271-279.

FATKA O. and VAVRDOVÁ M., 1998. Early Cambrian Acritarcha from sediments underlying the Devonian in Moravia (Měnín 1 borehole, Czech Republic). *Věst. Čes. geol. Úst.*, 73(1): 55-60.

JACHOWICZ M. and PŘICHYSTAL A., 1997. Lower Cambrian sediments in deep boreholes in south Moravia. *Věst. Čes. geol. Úst.*, 72(4): 1997.

Latest Precambrian – Carboniferous Plate Tectonics of the Circum-Carpathian Area.

Jan GOLONKA

Jagiellonian University, Institute of Geological Sciences, Oleandry Str. 2a, 30-063 Kraków, Poland

The supercontinent Pannotia (Dalziel et al.,1994) was assembled during the latest Precambrian as a result of the Pan-African and Cadomian orogenies. Both Gondwana and Baltica were included in this supercontinent. The Cadomian orogeny in Gondwanian Europe is a continuation of the Precambrian Pan-African event. This orogeny caused deformation and magmatic events of terranes from Iberia through Armorica, Saxoturingian zone in Germany, Bohemian, Brunovistulicum and Małopolska massives, Carpathians to the Transcaucasus area (Golonka, 2000). The Baltica (Eastern Europe) might have collided with the Cadomian part of Gondwana during the Vendian time causing deformation in the Timan area and proto-Uralian area. The Pechora-Timan belt and fragments of Ural, Novaya Zemlya and Taimyr are equivalent of the Cadomian belt. The discussion about the Baltican or Gondwanian affinities of Brunovistulicum and Małopolska Terranes is perhaps irrelevant. Gondwana and Baltica formed one supercontinent, separation took place around the Precambrian-Cambrian boundary. The Cambrian could display characteristics of both Baltica and Peri-Gondwana. The MT and BV terranes could have had a the different location within Peri-Gondwanian or Avalonian realm as well as different Early Paleozoic history. Together they joined the Continent of Laurussia prior to the Variscan orogeny.

Advanced seafloor spreading occurred in the Iapetus--Tornquist ocean between Baltica and Gondwana during the Cambrian time. Baltica moved northward and rotated. The south-dipping subduction developed along the central margin of Gondwana in Late Cambrian - Early Ordovician time. It caused the onset of rifting of the Avalonian terranes (Golonka, 2000). Avalonia probably started to rift from Gondwana and move towards Baltica in the Late Tremadocian and was in a drift stage by the Llanvirnian. Avalonia was probably sutured to Baltica by the end of Ordovician or in the Early Silurian (Torsvik et al., 1996). The closure of the Tornquist Sea was dominated by a strike-slip suturing of the two continents, rather than by full-scale continent-continent collision.

Between Gondwana and Avalonia, a large longitudinal oceanic unit, known as the Rheic Ocean was formed. After the collision of Avalonia with Baltica the southward dipping subduction developed along the new margin of Gondwana. According to Stampfli et al. (2001) this subduction triggered detachment of the new Armoric or Gothic group of terranes during the Late Silurian. At the same time after the complete closure of the Iapetus Ocean, the continents of Baltica, Avalonia, and Laurentia formed the continent of Laurussia. During the Devonian Gondwana drifted northward and rotated clockwise (Golonka, 2000). The Armoric (Gothic) terranes began to arrive at the Laurussia margin during Devonian time. Early to Middle Devonian convergence is detected in the Mid-German crystalline high terrane and in the Bohemian Massif in Central Europe. Collisional activities were also detected in the Alpine-Carpathian area. The contact between Laurussia and Gothic terranes marks the onset of Hercynian orogeny. The Bohemian, Saxoturingian and Małopolska High domains (Lewandowski, 1998) moved along the strike-slip faults towards Laurussia. The Hercynian orogeny in Europe was a result of collision of several separate blocks with the Laurussia margin, followed by the involvement of Gondwana continent. Moesia, Rhodopes and the Alcapa superterrane which includes Eastern Alps, Inner Carpathian, Tisa and adjacent terranes, were sutured to the Laurasian arm of Pangea, while Adria and adjacent terranes were situated near the Gondwanian (African)arm. Late Carboniferous events were also marked in the Alps and Carpathians (Rakuš et al., 1998). The basement of most of the plates, which play important role in the Mesozoic-Cenozoic evolution of the circum-Carpathian area was formed during the Late Paleozoic collisional events. The older, Cadomian and Caledonian basement elements experienced Hercynian tectonothermal overprint.

Part of this research has been financially supported by Polish Committee of Scientific Research (KBN grants 6PO4D 0419 and 6PO4D 03212). It is also a contribution to IGCP Project 453.