er plots) all these rocks exhibit relatively good linear correlations.

The studied rocks show initial strontium ratios between 0.708 and 0.709, i.e. within the range characteristic for the HKCA group (Janoušek et al. 1995), see Fig. 1. Whole-rock ä^{18}O values are low (+6.8 to +7.2 ‰ SMOW), likewise in magmas with major mantle component. Oxygen thermometers yielded temperatures in the range of 470–600 °C indicating some type of subsolidus diffusional exchange of O isotopes between rock-forming minerals. However, the studied rocks seems to show no evidence of interaction with meteoric water fluids. Trace sulphur in the Klatovy granodiorite has concentration of max. 0.04 wt.% and its isotope composition falls in the range of -1.5 to -2.5 ‰ (CDT).

Taken together, the observed whole-rock geochemical variations cannot be explained by a closed-system differentiation of a single granitoid magma. Instead, several sources of different isotope compositions must have been involved. Moreover, an important role for hybridization with more mafic magma batches is assumed.

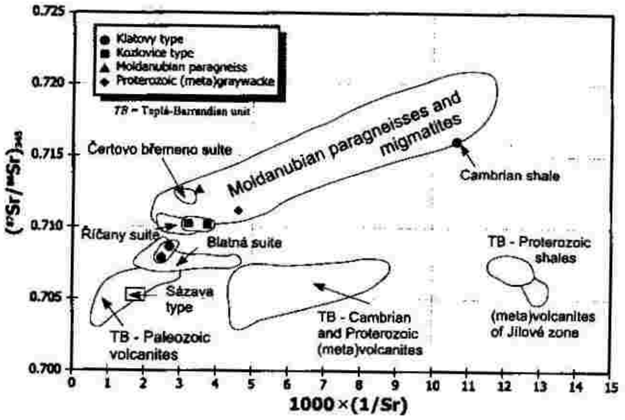

Fig. 1. A diagram of initial strontium ratio (345 Ma) vs. 1/Sr with fields for CBPC granitoids, adjacent geological units and new rock samples. Data sources are cited in Šmíd (1999).

References

DIDIER J. and BARBARIN B., 1991. The different types of enclaves in granites – Nomenclature. In: DIDIER J. and BARBARIN B. (Editors), Enclaves and Granite Petrology. Developments in Petrology 13. Elsevier, Amsterdam – New York, pp. 19-24.

HOLUB F.V., MACHART J. and MANOVÁ M., 1997. The Central Bohemian Plutonic Complex: Geology, chemical composition and genetic interpretation. *Sbor. geol. Věd, Ložisk. Geol. Mineral.*, 31: 27–51.

JANOUŠEK V., ROGERS G. and BOWES D.R., 1995. Sr–Nd isotopic constraints on the petrogenesis of the Central Bohemian Pluton, Czech Republic. *Geol. Rdsch.*, 84: 520–534.

ŠMÍD J., 1999. Geochemie a petrogeneze granitoidů klatovské apofýzy, středočeský plutonický komplex. MSc. Thesis, Charles University, Prague.

Detachment Control of Core Complex Exhumation and Back-arc Extension: Case Study from the East Slovak Basin

Ján SOTÁK[1], Adrian BIROŇ[1], Róberta PROKEŠOVÁ[2] and Ján SPIŠIAK[1]

[1] *Geological Institute, Slovak Academy of Science Bratislava, Severná 5, 974 01 Banská Bystrica, Slovak Republic*

[2] *Faculty of Natural Sciences, Matej Bel University, Tajovského 40, 974 01 Banská Bystrica, Slovak Republic*

The East Slovak Neogene Basin is also floored by the metamorphic series of the Iňačovce–Krichevo Unit (IKU). This unit appears to be the Lower Miocene core complex, exhumed jointly with back-arc extension of the East Slovak Basin. Petrological, structural and geochronological data allow to interpret the processes of core complex updoming and basin downfaulting.

The estimation of the physical conditions of metamorphism in the IKU is based on the study of mineral assemblages. The peak metamorphic conditions are documented by assemblages: (1) biotite + actinolite and/or magnesioriebeckite + chlorite + titanite + epidote (metabasalts), (2) muscovite + quartz + pyrophyllite + paragonite + intermediate Na-K micas + chloritoid (Al-metapelites), which are indicative of metamorphic temperatures between 350 and 400 °C. Co-existence of Na and Ca amphibols is considered here as a relic of earlier, higher-pressure metamorphic event (greenschist to blueschist transition zone, p » 7–8 kbar). During decompressional phase of metamorphism, normal greenschist assemblages occurred (chloritoid in metapelites and biotite in metabasalts) at a pressures <5 kbar. The youngest sediments of the IKU are represented by the Middle Eocene formations composed of black phyllites and metasandstones. Using phyllosilicate "crystallinity" and coal rank data, their degree of metamorphism corresponds to the higher anchizone or lower epizone, respectively (IC = 0.31°D2Q, ChC$_{(002)}$ = 0.26°D2Q, R$_{o\,max}$ = 5.75 %).

The IKU reveals a complex polydeformational history. Progressive deformation proceeded from (1) underthrusting – soft sediment deformation, stratal disruption and boudinage of high-competent layers, overpressured conditions, (2) underplating and deep tectonic burial – high flattening strain, F$_1$ foliation, synkinematic crystallization, intrafolial folding, diffusional mass transfer, crystalplastic deformation, (3) subcretion and intrawedge shortening – crenulation cleavage as F$_2$, transpositional foliation, high-strain zones, ultramylonites, d-type porphyroclasts, open to tight F$_2$ folds, dynamic recrystallization, etc., and (4) updoming and extensional unroofing – shear bands, SC foliation fabric, kink bands, en-echelon structures, extensive veining, cataclastic deformation, brecciation, normal faulting, etc.

The FT dating of the IKU gave significantly younger ages than the sedimentation ages. This rather narrow range (with a mean of 20.1 ± 0.9 Ma) can be considered as cooling age after the Neogene metamorphic event, which caused the total resetting of the zircon FT ages. The similarity of the white mica K/Ar ages and the range of zircon FT ages indicates a rapid cooling period in the Early Miocene. The Neogene syn-rift sediments from above the metamorphic basement suffered no significant post-depositional overprint and their zircon FT ages can be interpreted as typical cooling ages of the source regions, but not the IKU .

The East Slovak core complex occurs in the area of strike-parallel wrench zone. Therefore, the exumation of the IKU could be initiated by buoyancy and ductility of underplate rocks, updomed within the wrench zone. Since the Early Miocene, the main controlling factor of the exhumation was extensional unroofing. The extensional formation of the core complex structure is evidenced by the cataclasites developed on detachment faults. Youngest extensional detachment with cataclasites overprinted the contact of basement core complex with the Neogene sediments (cataclastic breccias were misinterpreted sometimes as basal clastic sediments). Therefore, the Neogene sediments appear to be detached during the core complex exhumation. This assumption is also supported by FT results, which provide a different type of zircon grains in Neogene syn-rift sediments having no young FT annealing typical for the core complex associations. In the seismic profiles, this detachment is expressed as a basin/basement reflector, which responds to the low-angle normal fault with roll-over growth of elevations in the Ptrukša Zone and Zemplín Unit. In this case, the East Slovak Basin was formed above extensional detachment (master fault), which gave rise as a consequence of core complex updoming accomplished by hangingwall normal faulting and subsidence.

Stratigraphic evidence and geochronological data on the IKU allow to interpret the time–temperature path. The cored rocks of the IKU were brought from the metamorphic depth (ca. 15 km) to shallow crustal level, or even to the near-surface position (their material was recycled to the Memík conglomerates). Thus, the complexes of the IKU appear to have been cooled and exhumed rapidly. The vertical displacement of the core complex started in the Upper Oligocene, with a high uplift rate and approached the zircon FT blocking temperature during the Early Miocene (~20 Ma). If the time of 30–20 Ma is assumed for the exhumation, the core complex reached the uplift rate of about 1.5 km/Ma. Such uplift rate is high, but obvious in the core complexes exhumed in the continent–continent collisional orogens.

The cooling age of the IKU is most consistent with zircon FT ages of the Rechnitz window. From this Penninic window, Dunkl and Demény (1991) reported the zircon FT data ranging from 15.1 to 18.5 Ma. Although that window is situated at the western margin of the Pannonian Basin System, the formation of both core complex structures was related to the same Early Miocene extensional period (Royden et al. 1983). The minor difference between the means of zircon FT ages in these windows could indicate some temporal shift of the main extension.

References

DUNKL I. and DEMÉNY A., 1991. Preliminary zircon fission track results in the Köszeg Penninic Unit, W. Hungary. Acta Mineralogica–Petrographica, Szeged, XXXII: 43-47.

ROYDEN L.H., HORVÁTH F. and RUMPLER J., 1983. Evolution of the Pannonian basin system: 1. Tectonics. Tectonics, 2: 63-90.

Sequence Architecture of the Central-Carpathian Paleogene Basin Inherited from Climatic, Eustatic and Tectonic Events

Ján SOTÁK[1] and Dušan STAREK[2]

[1] *Geological Institute, Slovak Academy of Science Bratislava, Sevemá 5, 974 01 Banská Bystrica, Slovak Republic*

[2] *Geological Institute, Slovak Academy of Sciences Bratislava, Dúbravská cesta 9, 842 28 Bratislava, Slovak Republic*

The Central Carpathian Paleogene Basin (CCPB) has undergone a two 3rd-order cycles of initial transgression (TA 3.5–3.6 cycles sensu Haq et al. 1988), being successively filled up during a two 2nd-order cycles of deposition (TA4 and TB1 supercycles sensu Haq et al. 1988). The initial transgression was preceded by deposition of alluvial-fan and delta-fan sediments. Later on, the fluvial and deltaic sediments of the CCPB were flooded to coastal zone and than overlain by shoreface sands and carbonate platform deposits. Upper Lutetian transgression in the CCPB (Andrusov and Köhler 1963) led to shallow-marine deposition of nummulitic banks developed in two 3rd-order cycles (Bartholdy 1997). The nummulitic cycles of the CCPB disappeared due to inverse of the Late Eocene warm climate (introduction of TA4 supercycle). Climatic changes tend to the "Terminal Eocene Event", which corresponds to global cooling and glacio-eustatic regression (Van Couvering et al. 1981). Consequently, the extensive carbonate deposition on broad, warm shallow shelves was replaced by terrigenous sedimentation on bypassed shelf areas. The sediments from above the nummulitic limestones are depleted in $CaCO_3$ and enriched in organic matter. They contain abundance of cool-water coccoliths (e.g., *Isthmolithus recurvus, Zigrablithus bijugatus*), diatom oozes (Menilites) and Globigerina-rich fauna (Globigerina Marls). A small-scale intercalation of non-calcareous black shales and Menilites with Globigerina Marls reveals a short pulse of high carbonate productivity in the period of the terminal Eocene fertility crisis (precessional cycles).

Climatic control of depositional changes in the CCPB became less significant in time of forced regression. Nevertheless, the influx of cool water into the CCPB led to carbonate depletion and anoxicity in the Šambron "Beds". The appearance of Globigerina Marls in the deep-water siliciclastic deposits (Šambron "Beds") indicates the CCD drop described from about the Eocene/Oligocene boundary (Thunell and Corliss