Fig. 2. Detached asymmetric south-vergent fold in Silurian rocks, footwall of the Tachlovice Fault, Lištice village near Beroun.

- detached asymmetric folds (see Fig. 2).

In general, all these small asymmetric structures indicate south-vergent tectonic movement, even though they could have been subsequently reactivated in different ways within younger tectonic phases. Our new data are in good agreement with the tectonic concept presented by Melichar and Hladil (1999).

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Early Palaeozoic Clastic Sediments Found in Boreholes from the SE Surroundings of Brno (Czech Republic)

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Several boreholes situated in the SE surroundings of Brno penetrated the Early Palaeozoic basal clastics (so-called Old Red sandstone) overlying weathered granitoids of the Brno massif. The basal clastic sediments in the Měnín-1, Němčičky-3 and Němčičky-6 boreholes were palaeontologically dated to Early Cambrian by the presence of Acritarcha (Jachowicz and Přichystal, 1997; Fatka and Vavrdová, 1998). In other boreholes, the age of the clastics was determined according to their relations to the overlying palaeontologically dated Early to Middle Devonian limestones (Skoček, 1978; Zukalová, 1976).

Nine samples of basal clastic sediments were collected for a detailed study with the aim to characterize potential petrological and geochemical differences between the Cambrian and Devonian clastics. Therefore, samples of suspected Cambrian and Devonian ages were investigated separately. The Cambrian samples were collected from the Měnín-1 and Němčičky-6 boreholes (depth 1,370 m and 2,033 m, respectively). Devonian clastics were sampled from the Měnín-1 (depth 468 m), Ždánice-14, Milešovice-1, Nikolčice-4, Uhřice-6 and Těšany-1 boreholes.

Petrology

Two types of sandstones were distinguished in the studied set according to sample petrology: well sorted quartz sandstones (limited to the Měnín-1 – depth 468 m, and Ždánice-14 boreholes) and arkosic sandstones (other samples). The arkosic sandstones consist of subangular quartz grains, angular feldspar grains (K-feldspar predominates over plagioclase) and micas (muscovite prevails over biotite). Accessory (heavy) minerals are garnet, zircon, tourmaline, apatite, rutile, pyroxene and staurolite. Zircons were studied in detail: they show idiomorphic (either dipyramidal or long prismatic) as well as oval shapes, and the size of about 100 μm.

Geochemistry

Major element characteristics of the studied clastic sediments correspond to arkoses and subarkoses according to the correlation diagram of Herron (1988). The rocks show significantly fractionated LREE and flat HREE patterns, and small negative Eu anomaly relative to chondritic lanthanide composition. They are depleted in LIL (e.g., Sr, K, Rb) and HFS elements (Ta, Nb, Zr, Hf) and moderately enriched in Y and Cr relative to UCC.

Ternary diagrams used for the determination of tectonic setting of sediment provenance (e.g., Co-Th-Zr/10 and Sc-Th--Zr/10) from Bhatia et al. (1986) document continental arc / active continental margin provenance of the studied clastics. The sediments were derived for the most part from intermediate and acid magmatic rocks as shown in the Rb vs. K diagram.

Conclusion

The source area of the Early Palaeozoic basal clastics of the sedimentary cover of the Brno massif was of the continental arc / active continental margin type, and was dominated by intermediate and acid igneous rocks. Somewhat higher contents of Yb, Lu and Cr in some samples (from boreholes Uh-6, Nik-4 and Te-1) may evidence a contribution of mafic rocks to the clastic material of the studied sediments. Micas and staurolite, identified in the clastic rocks, suggest the presence of metamorphics in the source area. Now available petrological and geochemical data on the studied set of samples do not distinguish between the "Cambrian" and "Devonian" groups of the clastics. The chemical composition of the studied samples was strongly influenced by diagenetic processes – e.g., carbonatization and kaolinitization.

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Geodynamic Evolution Stages in the Outer Carpathians

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The Magura Basin, the Dukla and Fore-Magura set of basins, the Silesian Basin, the Sub-Silesian Ridge and the Skole Basin have been distinguished in the Polish Outer Carpathians. The last three units form true Outer Carpathian realm of the Late Jurassic to Neogene age of the basin development. The Magura Basin has a different history. A part of this basin was incorporated into the Pieniny Klippen Belt, while another part shared the geodynamic history with the other Outer Carpathians unit from the Late Cretaceous onwards. The following stages of geodynamic evolution could be distinguish in the Outer Carpathians defined as above: I – synrift and postrift, formation of passive margin and basin with attenuated crust, II – collisional, development of subduction zones, partial closure of oceanic basin, development of flysch basin, III – orogenic, perhaps terrane–continent collision with the accompanying convergence of two large continents, IV – postcollisional. These stages correspond with the global sequence stratigraphy, the three supersequences encompassing one stage.

During the Late Jurassic, rifting started in the southern part of the North European Platform, and small basins were formed: the proto-Silesian Basin in the Western Carpathians and the Sinaia Basin in the Eastern Carpathians. The rifting process was accompanied by volcanic activity, which persisted until the end of the Hauterivian. The Late Jurassic – Hauterivian deposition in the Silesian Basin was controlled by syn-rift subsidence, and later (Barremian – Cenomanian) by post-rift thermal subsidence, which culminated with the Albian – Cenomanian expansion of deep-water facies.

The Cenomanian – Late Eocene collisional stage is characterized by the formation of subduction zones along the active margin, partial closure of oceanic basin and development of main flysch basins associated with rifting on the platform (passive margin) with attenuated crust. Oxic conditions generally prevailed, with characteristic appearance of red and green shales. In the foreland of the Inner Carpathian folded area, within the Outer Carpathian realm, several basins became distinctly separated. At that time, the Magura Basin was incorporated into the Outer Carpathian realm. At the end of the Turonian, the Silesian Ridge was restructured and uplifted (Poprawa et al., 2002). The uplift of the Silesian Ridge was accompanied by an increase of deposition rates in the Silesian Basin. This uplift could have been connected with the shortening of the Silesian Basin (Oszczypko, 1999) and development of the Subsilesian peripheral bulge dividing the Silesian and Skole Basins during the Santonian – Paleocene times. At the end of the Paleocene, the Carpathian basins were affected by general subsidence and sea-level rise. This general trend dominated during the Early to Middle Eocene times in the northern basins as well as in