Abstract

Tectonometamorphic processes in external zones of the Bohemian Massif during Lower Palaeozoic were studied in this work. The studied areas cover the northeastern part of the Saxothuringian Domain (Krkonoše-Jizera Massif) and the Letovice Complex located between the western margin of the Moravian Zone and the eastern edge of the Moldanubian Domain. Evolution of both these units was influenced by Early Palaeozoic rifting and Devonian-Carboniferous Variscan orogenesis. In the Saxothuringian Domain, Variscan processes were connected with subduction of the Saxothuringian ocean below the easterly exposed core of the Bohemian Massif and resulted in the development of high-pressure low-temperature metamorphism.

Thermodynamic modelling of metamorphic evolution in metapelites from the Krkonoše-Jizera Massif suggests that these rocks record peak pressure conditions of ≥18–19 kbar at 460–520°C followed by isothermal decompression to pressures of 10.5–13.5 kbar and final decompression to <8.5 kbar and <480°C. The calculated peak *P–T* conditions indicate a high-pressure/low-temperature apparent thermal gradient of ~ 7–7.5 °C km^{-1}. Laser ablation inductively coupled plasma mass spectrometry (ICP-MS) isotopic dating and electron microprobe chemical dating of monazite give ages of 330 ±10 Ma and 328 ±6 Ma, respectively, which is interpreted as the timing of a peak pressure to early decompression stage. The observed metamorphic record and timing of metamorphism in the studied metapelites show striking similarities with the evolution of the central and southwestern parts of the Saxothuringian Domain and suggest a common tectonic evolution along the entire eastern flank of the Saxothuringian Domain during the Devonian–Carboniferous periods.

The succession of structures observed in the Krkonoše-Jizera Massif suggests influence of two major deformation events. The high-pressure metamorphic stage was associated with an early ESE-oriented underthrusting of the Saxothuringian passive margin, which led to the development of D1 fabric. The D1 fabric remained active also during exhumation and subsequent late stage of the ESE–WNW compression led to imbrication of the granitoid basement and overlying nappe pile, and to folding of exhumed thrust sheets. Superimposed N–S oriented D2 compression caused post-metamorphic folding of the nappe pile characterized by the development of an intense D2 cleavage in the southern part of the Krkonoše–Jizera Massif and decreasing intensity of reworking towards the north.

The pre-Variscan evolution of the Saxothuringian crust has been associated with its rifting from the northern Gondwana margin. Rifting process was accompanied by intrusion of numerous Cambrian–Ordovician plutons and development of thick sedimentary sequences, which were along the eastern flank of the Saxothuringian Domain intensely deformed during Variscan collision. Detrital zircon populations in metaquartzite samples from the southern part of the Krkonoše–Jizera Massif, analysed by laser ablation ICP-MS, suggest a Late Cambrian maximum age of the sedimentary protolith and probable origin of detritus from the erosion of Cambrian–Ordovician granitoids and their Neoproterozoic (meta)sedimentary or magmatic country rocks. The age spectra confirm the interpretation that the exposed basement, dominated by Neoproterozoic–Cambrian–Ordovician granitoids was overthrust during Devonian–Carboniferous subduction-collision process by nappes composed of metamorphosed equivalents of the uppermost Cambrian–Devonian passive margin sedimentary formations. Acquired data also support the interpretation that the Saxothuringian Neoproterozoic basement has an affinity to the West African Craton of the north-western margin of Gondwana.

The Letovice Complex on the eastern margin of the Bohemian Massif is composed of metamorphosed mid-ocean ridge basalts with trondhjemitic sheets together with gabbroic and ultrabasic bodies. Laser ablation ICP-MS dating of magmatic zircons from amphibolite and trondhjemite yielded concordia ages of 530 ± 6 Ma and 529 ± 7 Ma, which are interpreted as

dating intrusions of the Early Cambrian protoliths of the studied rocks. Based on this age as well as whole-rock geochemical and Nd isotopic data, the Letovice Complex is interpreted as a vestige of an incipient oceanic basin developing on attenuated continental crust. The most likely geotectonic setting was a post-Cadomian extensional regime at the northern margin of Gondwana that marked the onset of its break-up.