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Pre-Variscan and Variscan evolution of the eastern Saxothuringian margin: petrological, geochemical and geochronological study of the Stáre Město Belt, the Sudetes

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The Staré Město Belt (SMB) (Czech Republic, Poland) is a narrow tectonic zone that separates the Saxothuringian and Brunovistulian terranes of the Variscan Belt. New whole-rock geochemical and zircon analyses (typology; trace element composition; and U–Pb, Hf and O isotopes) provide new data on the age and provenance of the SMB, and magma generation and evolution during the late Cambrian thermal event in northern Gondwana. Moreover, thermodynamic modelling and U–Th–Pb dating on monazites, titanites, and zircons were used to reconstruct the Variscan history of the Saxothuringian–Brunovistulian boundary.

Field relationships of SMB rocks suggest joint effusions of mafic and felsic lavas of the bimodal volcanic sequence. U–Pb zircon dating from the mafic and felsic metavolcanics and from the adjacent metasedimentary rocks indicates that the studied volcano-sedimentary succession developed at ca. 495 Ma. The source areas of the sedimentary basin were dominated by Neoproterozoic and Palaeoproterozoic crystalline rocks that were presumably located near the West African Craton of Gondwana, which indicates that the entire SMB forms the eastern termination of the Saxothuringian terrane.

Whole-rock geochemistry and trace elements in zircon suggest that the formation of the bimodal sequence of the SMB took place in an active Gondwanan continental margin (arc/back arc). Oxygen isotopic compositions of zircon in metavolcanic rocks, felsic ($\delta^{18}O_{zrn}$ = 1-10.5‰) and mafic ($\delta^{18}O_{zrn}$ = 4.3-6.1‰) correlate with low εHf values ranging from -27 to 6 in zircon from felsic rocks and elevated εHf values ranging from -28 to 2 in mafic rocks, respectively. The above results point to complex (crust/mantle) sources of magma.

Our P-T-d-t reconstructions confirm the presence of two main Variscan metamorphic episodes at ca. 370-360 Ma and ca. 340 Ma that are related to the polyphase Saxothuringia/Brunovistulia collision. During the main folding stage, rocks of the upper and lower SMB units were buried to depths corresponding to 6-7 kbar, while the middle unit was extruded from depths corresponding to 10-11 kbar. The structure of the SMB (large-scale fold) was modified by dextral transpression event at 340 Ma, during which tonalite magmas were emplaced.

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