Chronological constraints on the Palaeozoic geodynamic evolution of the Variscan orogenic root system: Moldanubian Zone of the Bohemian Massif

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Key lithological and metamorphic units for the pre- and syncollisional evolution of the late Variscan orogenic root in the southeastern Bohemian Massif were dated using U-Pb and Pb-Pb zircon geochronology in combination with whole-rock Nd isotopic systematics in order to establish a chronological frame for the geodynamic evolution of this lower, middle to upper crustal complexes. The samples include strongly metamorphosed and intensely deformed felsic volcanic rocks, orthogneisses, granulites, and granites. Sampling was performed along critical cross-sections covering eastern and central part of the Variscan root system, for which reliable structural and petrological data exist. This new database of geochronological, structural and PT data allow us to propose a new geodynamic model of kinematical and thermomechanical evolution of eastern termination of Variscan system.

Four major results lead to a considerably modified evolution for the Variscan orogenic root at the eastern border of the Bohemian Massif:

(1) The oldest rocks occur at the eastern section of the orogenic root and are rarely Neo-Proterozoic but dominantly Ordovician to Silurian in age. The Ordovician magmatic activity is a dominant process reworking Moldanubian crustal section.

(2) Emplacement ages of rocks for the lower crustal Gföhl unit (orthogneiss and felsic granulites) provide strong evidence for Devonian melting of lower crust. The age range of 50 to 100 Ma between early Palaeozoic thermal rejuvenation of continental crust and Devonian HT processes is probably responsible for the extreme weakness of the lithosphere which can therefore easily be thickened.

(3) Exhumation of lower crustal rocks (felsic granulites 18–16 kbar) to mid-crustal levels (12 to 8 kbar) within thickened root occurred at 340 to 350 Ma along several out of sequence deep seated thrusts. It was deduced from dating, detailed petrology and structural geology work carried out on decompression melts. This exhumation process is synconvergent and was essentially controlled by the shape of indenting Brunovistulian foreland farther to the east.

(4) Dating of early calc-alkaline granitoids show that this compressive event occurred synchronously in both infra- and suprastructure of thickened orogenic root far to the west. We argue that 340 Ma is a major mechanical event when horizontal stresses were effectively transmitted across the whole thickened crust.

(5) Late Carboniferous wrenching parallel to the continental margin and to the Elbe Zone and normal shearing resulted in supracrustal reactivation of major crustal interfaces that could be dated by the emplacement age of a durbachite sill at 325–330 Ma and syntectonic granodiorites and granites at 330–327 Ma. Extensional collapse of suprastructure and exhumation of deeply buried rocks to the surface occurred contemporaneously.

We discuss the contribution of far field stresses transmitted by remote subduction zones and movements of lithospheric plates from Ordovician to Late Carboniferous as well as the role body forces of orogenic root system on kinematic and dynamic evolution of Variscan belt.