Metamorphic and structural record in mid-crustal channel flow, eastern margin of the Bohemian Massif

M. Racek[1,2], K. Schulmann[3], P. Štípská[3], O. Lexa[1], M. Corsini[4], M. Košuličová[2]

1 Institute of Petrology and Structural Geology, Charles University, 128 43 Praha 2, Czech Republic, martin.racek2@gmail.com
2 Czech Geological Survey, Geologická 6, 152 00 Prague, Czech Republic
3 IPGS-EOST, UMR 7516, Université de Strasbourg, 1 rue Blessig, 67084 Strasbourg, France
4 Géosciences Azur, Université de Nice-Sophia Antipolis, CNRS, IRD, 28 Av. Valrose, BP 2135, 06103 Nice, France

A mid-crustral channel-flow structure was distinguished at the eastern margin of the Bohemian massif at the contact of Moldanubian and Brunovistulian domains. The structure of the channel flow is described on the example of two regions: 1) mid-crustal rocks of Drosendorf window are surrounded by partially molten rocks of lower crustal origin and, 2) the lower crustal St. Leonhard granulite massif surrounded by migmatitic Gföhl orthogneiss and mid-crustal metasedimentary sequence of Varied group. The structural study reveals existence of two main metamorphic fabrics that are present in the whole area. Early steep foliation connected with prograde meta-morphism in mid-crustal units and exhumation of the lower crustal units is reworked by flat lying amphibolite facies fabric. The gravity survey of this area shows an existence of gravity high corresponding to Brunovistulian domain lying underneath partially molten rocks. This indicates that the whole area occur in hangingwall of rigid basement. The internal steep fabrics inside mid-crustal units are geometrically concordant with the NNE-SSW trending hidden basement – lower crust boundary. The steep and flat fabrics are interpreted as a result of kinematic continuum resulting from progression of rigid promontory against weak lower and middle crust that are both thrust over the basement in form of channel-flow containing fragments of rocks from different crustal levels. The metamorphic study of the Drosendorf window rocks reveals existence of prograde PT-path up to 700 °C and 8 kbar. The surrounding lower crustal rocks preserve mineral assemblages corresponding to peak conditions of 18 kbar and 850 °C. All the units are than overprinted in 730 °C and 7 kbar connected with the flat fabric formation. The rocks of the St. Leonhard granulite massif and adjacent partially molten amphibolites and orthogneisses with lower crustal conditions reaching 850 °C and 20 kbar are surrounded by mid-crustal rocks of Varied unit reaching peak conditions below 10 kbar in 700 °C. All the lithologies are overprinted at 750 °C and 7 kbar during the flat foliation formation. The structurally underlying Thaya and Svratka windows representing Brunia basement metamorphosed due to the thrusting of the Moldanubian rocks represent an example of Barrovian inverted metamorphism within a large-scale structure. The main foliation is associated with peak metamorphic assemblages showing increasing metamorphic grade from biotite zone in the basement to sillimanite zone at the top. This succession is interpreted as a result of basement underthrusting under the orogenic root followed by NE directed nappe stacking where higher grade nappes are thrust over lower grade rocks.

Geochronological studies were carried out in order to constrain the timing of these processes. The U-Pb ages of zircons from St. Leonhard granulite give ages of 340 Ma. The Ar-Ar ages of hornblendes and biotites from samples across the whole studied area give 340 (hbl) and 330 (bi) Ma. U-Pb ages of monazites from the structurally underlying Gföhl orthogneiss give 335 Ma. These data indicate that the main metamorphic event (340 Ma, zircons in granulite) was followed by rapid exhumation below the hbl closing temperature resulting in attachment of this unit to upper crustal lid above the zone of active flow. The monazite ages show that the underlying flow was still active at least next 5 Ma, providing enough of heat to keep its roof above the closing temperature of biotite for next 10 Ma.