A Mechanism for Syn-Convergent Exhumation of HP Granulites in the Bohemian Massif, Czech Republic: Geochronological, Structural and Petrological Constraints

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We examined the structural and metamorphic evolution around the HP granulite belt at the NE margin of the Bohemian Massif in order to understand the mechanism of exhumation of HP rocks within the orogenic root domain.

The granulite belt and adjacent migmatitic orthogneisses show homogeneous vertical fabric developed in the thickened lower crust under HP granulite facies conditions (~18 kb/800 °C). The vertical fabric was later reworked by shear zones, which make a positive fan–like structure around the HP granulite belt. The assemblages associated to the second structure indicate its formation in the middle crust under amphibolite facies conditions (~10 kbar/700 °C). The AMS study performed on the macroscopically near-isotropic granulites and retrograde granulitic gneisses confirmed the vertical fabric and revealed the existence of a horizontal lineation associated with them. On the west- and east-dipping magnetic foliations associated with symmetric fan formation, the lineations are E-W plunging. These observations may be interpreted in terms of strain partitioning in pure shear dominated transpression, where frontal convergence is accommodated by thrust zones with their shearing direction almost perpendicular to the boundaries of the granulite belt.

Study of nearby metasedimentary belt shows similar structural succession, but developed under different conditions. First structure is vertical and associated to the assamblage ky-st-grt-bt indicating maximum burial depth of 10 kbar and 650 °C. Widespread folding resulted into subhorizontal fabric overprinting the early steep fabric. Formation of subhorizontal foliation is associated with sill-grt-bt indicating the decompression to 8 kbar at 650 °C.

These observations indicate that in the first stage of E-W compression the rocks of the root absorbed most of the pure shear deformation and thickening which resulted in the vertical N-S trending fabric developed in all crustal levels. Further shortening led to the vertical extrusion of the HP lower crustal rocks along a narrow vertical channel. Vertical extrusion results partly into lateral symmetrical thrusting of lower crustal material over adjacent middle crustal rocks. Our study shows that this type of exhumation of HP rocks is differential and may bring only small portions of HP lower crust adjacent to the middle crustal rocks, which never experienced the HP stage. We conclude that as this extrusion stage is associated with a mechanical collapse of the early vertical fabric into subhorizontal structure, the early structures responsible for the exhumation of HP rocks in similar cases are likely to be highly obliterated.

Quantitative Textural and Microstructural Study of Orthogneiss Deformed during Continental Underthrusting

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Microstructures and textures of feldspars and quartz from naturally deformed orthogneiss were investigated from a nappe pile showing inverted Barrovian metamorphic zoning at the eastern margin of the Bohemian Massif. This study was carried out through detailed microstructural and textural work combined with modelling of metamorphic equilibria using pseudosections in Thermocalc software. The PT conditions were estimated using average P-T method, which allowed to correlate microstructural and textural evolution of orthogneiss sheets with metamorphic zonation of adjacent metapelites. The quantitative textural analysis was applied to 40 orthogneiss samples from three metamorphic zones characterized by peak temperatures varying from 500 to 650 °C. The statistical microstructural analysis included study of grain-size distribution, planimetry, grain shape and grain boundaries preferred orientation and grain contact frequency analysis. The crystal preferred orientation (CPO) of all mineral phases from all metamorphic zones was determined using the EBSD in automatic and manual mode

Characteristic feature is a very low CPO of plagioclase in all studied samples showing dominant activity of <010>(001) a <010>(100) slip systems. Quartz exhibits low and intermediate fabric intensities with combined activity of rhomb<a> a rhomb<c> slips in high-grade gneisses and dominant basal