A Contrast between Metamorphic and Structural Evolution of the Vír Granulite and Surrounding Rocks of the Polička Crystalline Unit

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Structural and petrological studies were concentrated on the solution of tectonothermal relations of a granulite body, which is concordant with apparently lower grade metapelites. The granulite body is composed of leucocratic granulites, sillimanite-biotite migmatites and migmatitic paragneisses. The granulite body cover is formed by metagabbros and mafic migmatites in the west and by metabasic garnet amphibolite layer in the east. Intrusive relations between the marginal gabbros and the granulite body itself can be observed there. The whole granulite-metagabbro boudin is enclosed by kyanite-staurolite mica schists in the (eastern) footwall and biotite-sillimanite mica schists structurally in the hangingwall. The covering mica schists in the hangingwall of the boudin comprise porphyritic orthogneisses and deformed leucocratic migmatites.

The granulite body is concordant with structures of the Polička crystalline unit and Moravian mica schists in the footwall. In the northern and central parts of the granulite body, foliation planes strike NW-SE and dip NE in all lithologies. Subvertical foliation planes can be observed only in the central parts of the granulite body. Further south, the foliation planes turn to strike NNW-SSE and dip subvertical in the Vír area. The NNW-SSE strike of the foliation planes extends to the south where more gentle dips to WSW predominate. Stretching lineation trends NW-SE with mostly low (20°) plunge angles towards NW. The only exception is the internal central part of the granulite body where mineral lineations are subvertical.

In the covering hangingwall metapelites further to the west, three events of deformational phases were distinguished. The main metamorphic cleavage S1 and the mineral lineation defined by Barrovian mineral paragenesis developed during phase D1. Transtensional dextral shear zones, showing kinematics with the top to the SE, developed in phase D2. During the latest D3 phase, the whole complex was refolded by a regional fold with a NE-plunging fold hinge. The fold is characterized mesoscopically by the formation of flat, NW-bending transpressional shear zones in the southern part of the antiform. The shear zones show kinematics with the top to the SSW.

The granulites show structural evolution which is concordant with the surrounding metagabbros and amphibolites and are locally interfolded together. However, the granulites also represent boudins in the intrusive gabbros. Deformation of the gabbros sometimes occurred, being formed in a solid state, and HT mylonites developed. Subhorizontal open folds and boudins with their axes parallel to the NW-SE stretching lineation developed in the granulites during the postmetamorphic event.

The metamorphic conditions were estimated by grt - bt (Ferry and Spear 1978) and hbl - plg (Holland and Blundy 1994) thermometry and grt - plg (Newton and Haselton 1981) and grt - plg - hbl (Kohn and Spear 1990) barometry. The granulite assemblage is represented by the mineral associations of grt - bt - ky, grt - ky or grt - bt. The grt - bt thermometry in granulites offers average temperature of 700 °C at an average pressure of 12 kbars. Three different mineral associations express the different protolith compositions but identical metamorphic conditions. The retrograde granulites contain grt - bt - sill mineral association. Due to the instability in the mineral paragenesis of the retrograde granulites, the grt - bt does not provide acceptable results. The metamorphic conditions involved average temperature of about 600 °C at pressures lower than 6 kbars. In the western surrounding metapelites, typical mineral associations are represented by grt - st - ky and grt - bt - sill, the surrounding metapelites of the Moravian mica schist zone contain grt - st - ky mineral assemblage. In both types of metapelites containing grt - st - ky mineral association, the couples grt - bt offer an average temperature of 600 °C at an average pressure of 6 kbars. Moreover, the dominant mineral paragenesis grt - bt - sill in the western metapelites documents a significant overprint of the older mineral associations with kyanite under higher temperatures and/or lower pressures. Temperature and pressure estimates correspond to a depth of 35 km and agree with the metamorphic conditions of the retrograde granulites. Amphibolites contain hbl-tsch.hbl - ep - chl and hbl - plg (olig-andes) - chl mineral associations. The hbl - plg thermometry and grt - plg - hbl barometry give an average temperature of 650 °C at an average pressure of 8 kbars. Metagabbros are characterized by the main mineral association of cpx (di-hed) - hbl -plg. The hbl - plg thermometry was only used and offers an average temperature of 700 °C at pressure of 8 kbars.

The temperature estimates of 700 °C under the pressure of 12 kbar are values that can be achieved at the depth of about 35 km only due to an external heat source, e.g. due to magmatic advection. A proof of that could be the presence of metagabbros as a cover, which is in a close structural contact with the granulite body. The granulite lens was probably cooled at contact with the metapelites that provided the amount of water, essential for melting of the granulites (and gabbros?) which underwent anatexis through the decompressional uplift. The cooling of the whole body started somewhere at the depth of about 30 km under pressures of about 6-8 kbars and temperatures of about 600 °C which are the metamorphic conditions of weak retrogression of the metapelites and granulites. In the middle crust, the whole complex was folded, which was enabled by considerably high temperatures during the uplift of the granulites.

References

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