Structural and Metamorphic Evolution of the Southern Termination of the Desná Dome in the Silesian Domain

Monika KOŠULIČOVÁ, Pavla ŠTÍPSKÁ, Jakub HALODA and Karel SCHULMANN
Institute of Petrology and Structural Geology, Charles University, Albertov 6, 14200 Prague, Czech Republic

The aim of this study is to investigate the relationship between the structural and metamorphic succession of southern part of the Desná dome (Silesian domain) in order to decipher the thermal evolution during continental underthrusting and subsequent exhumation.

The Silesian domain consists of two crustal-scale boudins: the Desná dome and the Keprník dome, inherited from Devonian extension (Schulmann and Gayer, 2000). Both domes are composed of Neo-Proterozoic orthogneisses and migmatites and pre-Variscan and Devonian metasedimentary cover. The characteristic feature of the northern Silesian domain is the Variscan Barrovian metamorphism ranging from chlorite to kyanite zones, which is modified by a LP/HT overprint associated with the development of Crd-Sill-And association. Previous structural investigations in the northern part of the Silesian domain have shown pre-Variscan event and two Variscan deformations D2 and D3. The D2 deformation is interpreted to be associated with continental underthrusting and Barrovian metamorphism, while the D3 deformation is developed under various conditions due to the buttressing stage in supracrustal levels.

The studied profile in the southern termination of the Desná dome is composed predominantly of orthogneisses, quartzites, micaschists, phyllites and amphibolites. The first recognized structure is the Variscan S2 foliation, which is in the east dipping to the S under shallow angles, in the centre plunges under intermediate angles to the SE, while in the west dips under shallow angles to the NW. The S2 foliation is folded by close to isoclinal asymmetrical F3 folds with NW dipping axial planes. The fold hinges are plunging under shallow angles to the SW in the east, being subhorizontal in the centre and west. Locally, the folding leads to almost complete transposition into S3 foliation, which is dipping under intermediate to steep angles to the NW in the whole profile.

The mapping of the index minerals shows the increase in grade to the NW from the chlorite to the St-Sill zone. In order to correlate the structural and metamorphic evolution, we selected samples with suitable mineral assemblages from the west of the studied profile. Chloritoid, chlorite and muscovite form inclusions in garnet, St-Grt-Ms-Bt-Plg represents the most common matrix assemblage while sillimanite is rare. The geometrical relationship between porphyroblast inclusion trails and the external crenulation S3 allowed us to correlate the mineral growth with deformational phases. The straight inclusion trails of ilmenite and chloritoid in the garnet, and ilmenite trails within the staurolite cores, which are at high angle to the external S3 foliation, indicate the growth of chloritoid, early garnet and staurolite during the D2 phase. The curved inclusion trails in the garnet and staurolite rims and within plagioclase indicate their continuous growth during the S3 crenulation. In order to provide quantitative information about the PT evolution from the succession of assemblages and mineral chemistry, we constructed the KFMASH pseudosection with the THERMOCALC software and we used the average PT calculations. The maximum attained PT conditions correspond to ~6 kbar / 590 °C.

The structural investigation in the southern termination of the Desná dome have shown that the S2 foliations dip to the SW in the west, to the S to SE in the centre and east. This structural pattern indicates that the Variscan S2 foliations reflect non-cylindrical shape of the pre-orogenic crustal ribbon that originated during Devonian extension. The S3 foliations monotonously dip to the NW under intermediate to steep angles and can be correlated with the buttressing stage, while the hinge orientation reflects the pre-shortening non-cylindrical termination of crustal ribbon. The map-scale zonation ranging from the St-Sill to the chlorite zone is identical with the northern termination of the Desná dome and reflects generally decreasing depth of burial from the west to the east. The sequential growth of index minerals in the west of the dome shows the prograde metamorphism associated with Ctd-Chl-Ms-Grt growth followed by the growth of St-Plg during the D2 phase. Such a succession of assemblages and chemistry of the minerals indicate the continuous burial up to ~6 kbar / 570 °C during the D2 deformation. Grt-St-Plg overgrowths the S2 crenulation and local Sill growth indicate the onset of the S3 development at a depth of 6kbar under continuous heating. The S3 buttressing structures are further associated with the exhumation of the rocks, as it is indicated by the associated localized retrogression.

References

SCHULMANN K. and GAYER R., 2000. A model of an oblique developed continental accretionary wedge: NE Bohemian Massif. *J. Geol. Soc. London*, 157: 401-416.