Geochemical and geochronological arguments for heterogeneous nature and complex development of Variscan lower continental crust: Náměšť Granulite Massif (Bohemian Massif, Czech Republic)

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Felsic kyanite–garnet–ternary feldspar granulites bearing volumetrically minor, but petrogenetically important, "orogenic peridotite" fragments (garnet or spinel peridotite, pyroxenite and associated eclogite), represent a rock assemblage typical of the high-grade orogenic root of the European Variscan Belt (Gföhl Unit in the Moldanubian Zone). Understanding the tectonic and metamorphic history of these lower crustal complexes is crucial for correct interpretation of the Variscan continental collision.

In our study, whole-rock geochemical analyses were obtained for all three main lithologies of the Náměšť Granulite Massif (NGM) in the eastern part of the Gföhl Unit, namely (i) felsic Ky–Grt granulite, (ii) Spl- and Grt--bearing peridotite and (iii) Grt amphibolite enveloping the NGM. The remarkably uniform geochemical signature of the Náměšť felsic granulite displays the same compositional characteristics as other granulite massifs throughout the Moldanubian Zone. The NGM metabasite envelope corresponds to E-MORB or Within Plate Tholeiite resembling occurrences of Late Cambrian to Early Ordovician age at the eastern margin of the Bohemian Massif. The Mohelno peridotite is interpreted as a harzburgite of asthenospheric origin, only later refertilized.

The precise *in situ* (SHRIMP) U–Pb zircon dating of the felsic granulite yielded two distinct peaks in metamorphic ages, at ~353 and ~339 Ma, interpreted as timing the HP metamorphic peak and partial melting during the early stages of uplift, respectively. The Early Devonian protolith ages (~400 Ma), obtained for the Náměšť granulite, differ from ~450 Ma protoliths for other granulite bodies from the Moldanubian Zone and Saxon Granulite Massif.

The current work shows that the three studied lithologies could not have originated in a single geodynamic environment. The felsic granulites represent a subducted Early Devonian continental crust, while the tholeiitic metabasites were probably generated during Cambro–Ordovician rifting. Based on these characteristics and contrasting P–T data we adopt here a model of lower crustal relamination of the low-density continental crust below autochthonous dense mafic root of the Moldanubian Continent. The difference in HP metamorphic ages between the Náměšť granulite (~353 Ma) and the more westerly granulite massifs (~340 Ma) is interpreted in terms of diachronous emplacement and different time scale of thermal maturation of western and eastern portions of the relaminated crust. Our work also shows that the mantle was refertilized before its incorporation into the crust, a feature typical of asthenospheric mantle below slow spreading rifts. Therefore, it is very likely that the Late Devonian history recorded in the mantle fragment (constrained by the Sm–Nd age of ~370 Ma: Medaris et al., 2006) reflects heterogeneous nature of the local subcontinental mantle lithosphere related to the Devonian rifting (most likely in the back-arc position with respect to the Saxothuringian subduction) unrelated to the surrounding felsic granulites. The place of incorporation of the mantle fragment to felsic granulite is impossible to determine, but the Late Devonian age coincides well with the onset of the magmatic-arc related plutonic activity in the Teplá–Barrandian Unit (Štěnovice and Čistá plutons, as well as protolith to orthogneisses in the roof pendants of the Central Bohemian Plutonic Complex; Žák et al., 2011). In conclusion, the Mohelno peridotite represents an autochthonous heterogeneous lithospheric mantle fragment that was sampled by felsic (granulite) crust during relamination process. This mechanism can explain significant variations and P–T conditions of mantle material enclosed nowadays in individual granulite massifs of the Bohemian Massif.

References

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