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Review of the Ph.D. thesis

Tracing of the pre-exhumation history of strongly re-equilibrated high-ultrahigh pressure rocks in a collision orogeny

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General opinion:

The thesis is a well-written and carefully prepared work presenting the results of petrological investigations of strongly re-equilibrated high- to ultrahigh pressure rocks in the Bohemian Massif. Special attempt has been paid to reconstruct their pre-exhumation history based on the inclusions in high-pressure minerals, thermodynamic modelling and chemical composition of garnet including trace elements.

The thesis work consists of short introduction, five chapters with the articles published in international journals (J.Petrology, Lithos, Gondwana Research) and final part of conclusions. In two papers, applicant is the first author and in the rest he is a co-author. summarise the major results. Such Ph.D. thesis is fully in line with a modern, high-quality work.

Part II is focused on the distribution of major and trace elements in garnet from felsic granulites in the Kutná Hora Complex. Results show that the trace elements in garnet exhibit a complex distribution that is preserved as a result of the much slower diffusivities of yttrium and REE than major elements. This study brings important information about distribution of those elements in garnet from poly-metamorphosed terranes with initial high-pressure stage and high-temperature overprint.

Part III is focused on the prograde mineral inclusions and preservation of compositional zoning in garnets from felsic granulites and embedded layers of eclogite facies rocks in the Rychleby Mountains (East Sudetes). Study of major and trace elements zoning in garnet and thermodynamic modelling revealed an initial eclogite facies metamorphic stage in the investigated granulites. Rychleby granulites are therefore correlated with other HP-UHP granulites in the Moldanubian Zone.

Part IV deals with eclogites and clinopyroxenites, which form layers and boudins in garnet peridotites from two areas in the Moldanubian Zone. In addition to complex compositional zoning, garnets from hosting eclogites and clinopyroxenites. Garnets from eclogites and clinopyroxenite preserve inclusions of hydrous phases and alkali silicate minerals which suggest that the ultramafic and mafic bodies have been derived from lithospheric mantle wedge and were transformed into garnet pyroxenites and eclogites during subduction.

Part V is a petrological study of eclogites that occur together with serpentinites within amphibolite facies gneiss in the Moldanubian Zone of the Bohemian Massif. The distribution of eclogites and their P-T conditions together with age data are interpreted in favour of the Variscan suture preserved south-east of the Teplá-Barrandian Block.

Part VI deals with leucocratic metagabbro and amphibolite from a mafic-ultramafic body within migmatite and granulite in the Kutná Hora Complex. Based on the calculated P-T conditions and age data, both the mafic-ultramafic body and surrounding granulite shared the same exhumation path from their middle-lower crustal position at the end of Variscan

orogeny. The coincidence of mafic–ultramafic intrusives and granulite–amphibolite facies metamorphism is explained by lithospheric upwelling beneath the Moldanubian Zone that occurred due to slab break-off during the final stages of subduction of the Moldanubian plate beneath the Teplá Barrandian Block. The model also addresses questions about the preservation of minerals and/or their compositions from the early metamorphic history of the rocks subjected to ultradeep subduction and subsequent granulite facies metamorphism.

Strong aspects:

It is a compact work combining modern petrological methods supported by proper geological background. Several aspects, like the microtextures, phase equilibria modelling, geothermobarometry, major and trace elements mobility are well understood. Petrological aspects are based on microprobe analyses and pseudosections modeling which allowed to determine the compositions of all principal minerals and P-T conditions of metamorphism. Tectonic interpretations are made in a context of the Variscan evolution of the Bohemian Massif, which may challenge the traditional models.

Weak aspects:

Uncertainties in determination of P-T conditions by thermodynamic modelling.
Compositional isopleths of garnet: calculated isopleths do not match the measured ones (part II, Fig. 7b, 8b). The estimated P-T paths can be biased.

Genetic interpretation of inclusions is not unambiguous, e.g. part III, Fig. 4b: zoisite after lawsonite ?, part IV, Fig. 2d,e. : prograde vs. retrograde?, melt ?

Protolith of felsic granulites ? Perhaps geochemistry could be helpful but it is absent in this work.

Geodynamic implications: Part V, page 134 „Based on their analogy in lithology, P-T regime and ages of metamorphism of HP–UHP rocks, we assume that the Moldanubian suture was responsible for the formation and exhumation of these rocks both in the Moldanubian and Saxothuringian zones. Present position of HP–UHPM rocks in the Saxothuringian Zone could be the result of tectonic transport after their exhumation to crustal levels”. On the other hand, some authors assume that the HP–UHPM rocks in the Moldanubian Zone came from the Saxothuringian Zone by underplating the Teplá–Barrandian Block !

I see no fundamental weaknesses of this work and believe that above stated inconsistencies will be clarified.

Conclusion

I suggest to the scientific committee to accept this thesis work and award the Ph.D. degree to Mgr.Radim Jedlička.

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