Protolith and metamorphism of Moldanubian HP granulites – a geochemical perspective

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Petrogenesis of voluminous, widespread and chemically nearly uniform felsic Moldanubian HP granulites in the Variscan orogenic root of the Bohemian Massif remains controversial. Previous studies of the best exposed Blanský les Granulite Massif (BLGM) showed that it originated by ~340 Ma HP–HT metamorphism of mid-Ordovician–Silurian [1] acid metaigneous rocks of Saxothuringian provenance [2]. Such refractory protoliths would suffer only limited chemical modification (mainly loss of U, Th, and Cs [2,3]).

Carefully selected samples from rare relict (S1) felsic–intermediate BLGM granulites help to constrain the peak mineral assemblage (Grs-rich Grt, Ky, mesoperthite) giving pressures of ~20–23 kbar (GASP barometry), higher than any previous estimates ([4] for review) and, together with geothermometric data from the same domain (~ 950 °C, see also [5]) support the early eclogite-facies history.

The other samples show small-scale mineral disequilibria (several mineral generations, zoning in mineral grains and various reactions related to HT decompression), contain large proportion of pre-Variscan (>400 Ma) inherited Zrn, preserve ~470 Ma Rb–Sr whole-rock errorchrons and show largely undepleted whole-rock geochemical signatures. This implies only a limited melt participation at the peak conditions [2,3].

We propose that the felsic Saxothuringian crust rich in heat-producing elements was deeply subducted [6,7] and relaminated to the base of the Moldanubian crust. After thermal incubation, rheological weakening with a limited partial melting triggered gravitational instability and ascent of the orogenic lower crust [3,8]. The mantle contaminated by the passage of the crustal material produced characteristic K-rich magmas with crust-like Sr–Nd–Pb isotopic signatures, closely related with HP granulites in space and time [9].

Research funding: GAČR (P210-11-2358).

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The Selva Negra: A Favourable Setting for Alkalic Au Mineralisation

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The Selva Negra volcanic rocks are located in Chiapas State, southeastern Mexico, in a complex triple junction between the North American, Caribbean, and Cocos plates. The Chiapanecan Volcanic Arc, which hosts the Selva Negra complex, activated around 3 Ma when slab flattening in central Mexico caused volcanism on the Pacific coast to change from parallel to the Middle American Trench to approximately 30º oblique to the trench. Volcanic activity was focused along northwest-oriented faults that extend from the Caribbean and North Amercian plate boundary and likely acted as magma conduits during periods of extension.

The Selva Negra rocks occur at the northwest end of the coeval calc-alkaline arc and at the furthest point from the trench (300-330 km). They comprise widespread alkaline and LILE-erniched monzodiorite to diorite intrusions with a crystallization age of ~1.0 Ma (zircon U-Pb), trachyandesite volcanic rocks and rare basalt flows. The radiogenic isotope data suggest that the ascending magmas interacted with the thick crust (~50 km) through MASH processes. The Selva Negra rocks likely resulted from a combination of low degree partial melts of a heterogeneous mantle enriched in LILE and LREE and crustal contamination.

Alkaline magmatism is commonly associated with Au-rich deposits and several key geological parameters are favourable for their formation including rifted arc terranes, back-arc sites, extensional and post-subduction settings are [1, 2, 3]. In the case of the Selva Negra, slab flattening and the complex triple junction has refocused the magmatism 30º oblique to the trench allowing low degree partial melts and alkaline intrusions to occur at the furthest extension inland and creating a favourable setting for mineralising intrusions. Au-rich mineralisation has been intersected within the Selva Negra but remains largely underexplored.

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DOI:10.1180/minmag.2013.077.5.10