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Carboniferous Mg-K magmatic rocks in the Variscan Vosges Mts: age, petrogenesis and heat source

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Mg-K magmatism intruded the Variscan Vosges Mts (NE France) during early Visean Mg-K magmatism (345-335 Ma). These Mg-K granites crop out in the Central and Southern Vosges Mts (CVMg-K and SVMg-K, Moldanubian unit). Mg-K granites intrude also the Northern variscan Vosges Mts (NVMg-K, Saxothuringian unit) around 310 Ma.

These Mg-K associations are characterized by K-feldspar megacrysts and augitic clinopyroxene, actinolitic amphibole and biotite. XMg in biotite remains rather constant and the REE content decreases, according to increasing SiO_2. This trend characterises Mg-K associations where the REE content is controlled by mineral fractionation rather than differentiation of a melt. The high contents in Cr and Ni point to derivation from a mantle source. However, trace elements patterns show strong enrichment in Light Rare Earth Elements, elevated concentrations of U, Th and Large Ion Lithophile Elements. Primitive mantle-normalized trace-elements patterns highlight a difference between the three associations: CVMg-K association is characterized by a pronounced negative Sr anomaly, whereas SVMg-K and NVMg-K association shows a pronounced negative P anomaly. This geochemical discrimination fits with 143Nd/144Nd and 87Sr/86Sr values.

Janoušek & Holub (2007) with Schulmann et al. (2009) proposed that the Moldanubian Mg–K magmas in the Bohemian Massif could have been generated in the context of the Andean type subduction. Closure of the Saxothuringian Ocean and crustal collision led ultimately to underplating of the Moldanubian Domain by mostly felsic metaigneous rocks of the Saxothuringian provenance and contamination of the local lithospheric mantle. Partial melting of contaminated and/or metasomatized lithospheric mantle was explained by asthenospheric mantle upwelling following slab break-off (Janoušek & Holub 2007).

Recently, Lexa et al. (2011) modelled an influence of in-situ radiogenic heat production in felsic metaigneous rocks of Saxothuringian provenance underplated at about the Moho depth under a thickened Moldanubian continental crust (Bohemian Massif). They proposed that, after a thermal incubation of 10–15 Ma, the subducted continental crust released fluids and partial melts which contaminated and enriched the adjacent lithospheric mantle, adding lithophile elements including the radiogenic elements (U, Th and K). It was argued that this produced enough thermal energy for high-temperature metamorphism and, at the same time, to heat the metasomatized lithospheric mantle producing Mg–K magmas.

The new petrological, geochemical and isotopic data of Vosgian Mg-K rocks highlight the existence of three groups of Mg-K intrusions in the Variscan orogeny which might be related to the nature of the source of the magmas e.g. an enriched mantle-derived magma contaminated by different melted crustal material.

A geodynamic scenario, where radiogenic heat is produced by subducted continental crust under a mantle wedge beneath an upper continental plate, is proposed to explain petrological, geochemical and isotopic differences of Vosgian Mg-K rocks. CV-, SV- and NV-MgK were generated in the same TP conditions from different protoliths respectively Neoproterozoic, Ordovician and Devonian according to age of inherited zircon.