SKARNS OF THE BOHEMIAN MASSIF: ORIGIN IN CLOSED OR OPEN SYSTEMS?

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Skarn bodies, some mined in the past for magnetite ore, occur in metamorphosed units of the Bohemian Massif (in the Moldanubian Zone, Lugicum, and Saxothuringicum). They were metamorphosed together with their host rocks (gneisses). Because of a very complex metamorphic history of these geological units, it is difficult to determine, whether the skarn precursors were part of the sedimentary series (with which they underwent all the metamorphic events — e.g. Zoubek, 1946; Pertold & Pouba, 1982; Pertoldová et al., 1987), or whether they originated during later events, as contact skarns, in association with metagranitoids or migmatites (e.g., Koutek, 1950; Němec, 1979).

We have studied several skarn bodies in the Moldanubian Zone *sensu lato* (Vlastějovice, Pernštejn, Slatina, Rešice). They are mainly gar–cpx bearing rocks, with later amphibole, epidote, garnet, chlorite, ± magnetite, quartz and plagioclase. Metagranites or migmatites (Gföhl type) invade skarn bodies at Vlastějovice, Rešice and Slatina. Clinopyroxene and garnet compositions vary among and within the localities. Most frequent is ferrosalite; salite and hedenbergite are common. Garnet compositions vary among gros–alm–andr end members.

Polyphase development of cpx–gar skarns is apparent. The mineral composition and calculated temperatures correspond to the amphibolite facies at Pernštejn (~650 °C) and Vlastějovice (from ~530 to 750 °C). In Rešice and Slatina, the clinopyroxene with Jd contents up to 20 %, sphene with Al_2O_3 ~8 wt. % and some metamorphic textures (anorthite + clinopyroxene symplectites after garnet, and lower Al titanite + plagioclase after titanite) show that the mineral assemblages originally equilibrated under the eclogite or high-pressure granulite facies (with calculated T up to 850 °C) conditions.

Magnetite mineralization seems to be of various types. In the main magnetite body in Vlastějovice, magnetite and quartz are younger than the skarn silicates. Intergranular magnetite (TiO_2 3–17 wt. %) and plagioclase at Slatina are also younger than garnet and clinopyroxene. Magnetite in a massive layer at Rešice, probably contemporaneous with silicates, is rich in Al_2O_3 (1.5–6.0 wt. %).

Oxygen isotopes show near equilibrium fractionation between garnet and clinopyroxene at Slatina, Rešice and Pernštejn, and magnetite at the last two localities, with calculated T = 660 and 670 ^{o}C, respectively. There are differences between localities in $\delta^{18}O$ values, and even between skarn types (layers). The Vlastějovice skarn (the largest of all studied) shows greatest isotopic variability and also disequilibrium in some gar–cpx pairs.

The REE fractionated between garnet and clinopyroxene in individual samples (with garnet being enriched and clinopyroxene depleted in HREE), most completely in the granulite–eclogite facies localities of Slatina and Rešice. Positive Eu anomalies are common at all localities, except Vlastějovice. However, the REE contents were different in individual samples within the same locality, and also among localities.

The preliminary Sm–Nd isotopic data on the Slatina sample (garnet, clinopyroxene and whole rock) indicate an Early Hercynian age of the metamorphic climax (~ 370 Ma). For the whole rock, the low ε_{Nd}^{370} value (-6.4) and high two-stage T_{DM}^{Nd} model age (1.58 Ma) point to a long crustal residence of its source.

Varying major-element, minor-element, REE, and $\delta^{18}O$ values in individual parts (layers) of skarn bodies point to a closed-system behaviour during the metamorphic peak. Skarn assemblages are older than the Gföhl gneiss (migmatite). There are no intrusives known to associate with the suggested contact metasomatic origin of the Moldanubian skarns. Instead, sedimentary-exhalative origin followed by a closed-system metamorphism remains a viable possibility.