Sm-Nd isotopic chronometry of garnets from the Veporic Unit, Western Carpathians: Some Preliminary Age Results and P-T Constraints

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The Sm-Nd isotope system has been used for dating of micaschist and pegmatite garnets from the southeastern part of the Veporic unit in the Western Carpathians. The purpose of this study was to determine the timing of peak metamorphic conditions in the micaschists and the age of magmatic crystallization of pegmatite, because of relatively high closure temperature for the Sm-Nd system in garnet.

Samples

Two representative samples have been investigated. The garnet-bearing micaschist is low-Al metapelite from the southeastern part of the Veporic unit. It belongs to the staurolite + biotite + kyanite metamorphic zone (zone 3) with the highest *P-T* conditions (600-620 °C and 9–10 kbar) of Alpine metamorphism (Janák et al., 2001a). Mineral assemblage is garnet, staurolite, biotite muscovite, chlorite, plagioclase and quartz. Garnet porphyroblasts are euhedral to subhedral. They are zoned with increasing almandine and pyrope components, and decreasing spessartine, grossular as well as the Fe/(Fe+Mg) ratio from core to rim. This suggest a prograde growth during single metamorphic event.

The investigated pegmatite is a fine-grained, leucocratic rock from the quarry near Rimavská Baňa. Pegmatite garnets are small, euhedral to subhedral grains without any distinct microtextural inhomogeneities. Garnet composition is almandine and spessartine-rich. Garnet grains are compositionally homogeneous or only weakly zoned, with Mn and Fe/(Fe+Mg) ratio slightly increasing from core to rim. Pegmatite has been overprinted by metamorphism at *P-T* conditions of 550 ± 30 °C and 8 ± 1 kbar (Thöni et al, 2003), corresponding to the chloritoid + chlorite + garnet zone (zone 1) of Alpine metamorphism.

For Sm-Nd isotopic analysis, the garnets of grain size 0.15–0.45 mm and defined magnetic fraction were hand-picked using a binocular microscope. An optically pure (99.9 %) garnet concentrates, and the whole rock powders were analysed at the Institute of Geological Sciences, University of Vienna according to procedure described in Thöni (2002).

Results

The resulting garnet–whole rock isochron for the micachist yields the age of 108.8 ± 5.6 Ma, with initial $^{143}Nd/^{144}Nd$ ratio of 0.511885 ± 0.0000065. The metapelite whole rock data show strongly negative initial Nd isotopic composition ε (t) Nd of 11.9, typical for old crustal material enriched in LIL elements.

The garnet-whole rock isochron of pegmatite gave the age of 339.0 ± 7.7 Ma, with initial $^{143}Nd/^{144}Nd$ ratio of 0.512040 ± 0.000016 and ε (t) Nd of –3.1 (Thöni et al, 2003).

Microtextural observations and chemical composition of garnet from the micaschist clearly suggest that ~109 Ma age records the timing of garnet growth during the Alpine metamorphism, in the Cretaceous time. This is consistent with the data obtained from alectron microprobe dating of monazite in the micaschists, yielding ~92 Ma age (Janák et al., 2001b). The $^{40}Ar/^{39}Ar$ data obtained from *in situ* UV laser ablation of white micas (Janák et al., 2001a) constrain the timing of cooling and exhumation at ~72 Ma.

High spessartine content (42%) and the fairly homogeneous element distribution in garnet from pegmatite point to a magmatic origin of these garnets. The Sm-Nd age (339 Ma) is therefore interpreted as primary crystallization age of magmatic garnet, and probably also the age of pegmatite intrusion during the Variscan time. This implies that Alpine metamorphism at a temperature of <600 °C did not reopen the Sm-Nd isotope system in the Variscan magmatic garnet.

References

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