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Two types of metamorphic monazite with contrasting La/Nd, Th, and Y signatures in an ultrahigh-pressure metapelite from the Pohorje Mountains, Slovenia: Indications for pressure-dependent REE exchange between apatite and monazite?

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Abstract

Two monazite generations (M1; M2) were distinguished in a kyanite-garnet gneiss from the UHP terrain of the Pohorje Mountains, Slovenia. *P-T* estimates reveal a peak event at 760 °C/2.6 GPa and isothermal decompression down to 700 °C/0.6 GPa.

M1 type provides a Th-U-Pb mean date of 100 ± 6 Ma, ThO_2 contents between 3–7 wt%, Y_2O_3 values <0.3 wt%, and La/Nd ratios (1.2–1.4) that are clearly higher than for the whole-rock La/Nd (1.1). The absence of Y zoning in M1 and the lack of monazite inclusions in garnet indicate that M1 formed after the main stage of garnet growth (>1.2 MPa), probably close to the *P-T* peak.

M2 type is slightly younger than M1 (74 ± 16 Ma), and has a lower La/Nd (0.3–0.9), lower ThO_2 (0.1–5 wt%), and higher Y_2O_3 (up to 3.2 wt%). Most M2 monazites occur as tiny needles within apatite (subtype M2-a) or along apatite margins (M2-b). Parasitic growth of M2-a and -b from apatite is supported by its low ThO_2 (<1 wt%) and La/Nd (<0.5). Isolated matrix grains (M2-c) and overgrowths around M1 (M2-d) have slightly higher La/Nd (0.5–0.9) and higher ThO_2 (5 wt%) and were supplied from an apatite and M1 source. Elevated yttrium suggests that M2 formed during decompression, when garnet was consumed and Y was released.

These observations imply that at UHP conditions MREE-rich apatite coexisted with low-MREE M1 monazite and reacted during decompression to Ca-F-apatite plus MREE-rich M2 monazite. This provides strong arguments that REE-partitioning between apatite and monazite is pressure-dependent.

Keywords: Monazite, apatite, REE distribution, ultra-high pressure, Pohorje Mountains