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Metamorphic formation of Sr-apatite and Sr-bearing monazite in a high-pressure rock from the Bohemian Massif

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ABSTRACT

Accessory, 10–300 μm grains of Sr-apatites with SrO contents up to 33 wt% were found in a high pressure (26 ± 3 kbar, 830 ± 30 °C), garnet-rich rock from the Bohemian Massif, Czech Republic. Furthermore, this rock contains unusual, Sr-bearing, accessory monazite (SrO up to 2 wt%). It is argued that the Sr-apatite and the Sr-bearing monazite formed as a result of plagioclase breakdown during HP metamorphism.

During a subsequent phase of near-isothermal decompression and partial retrogression of the HP paragenesis at 8 ± 2 kbar and 800–900 °C, many apatites have lost their Sr through diffusion to newly formed plagioclase, some of which accommodated SrO contents of ca. 7 wt%. At apatite/plagioclase contacts, a distribution coefficient C_{Sr}^{Pl}/C_{Sr}^{Ap} of ca. 4 was measured, implying that in plagioclase-bearing rocks (i.e., most crustal rocks), Sr-apatites have little chance to form. In the investigated rock, only apatites enclosed and shielded in unretrogressed garnet were able to preserve high Sr. Despite strong compositional differences from grain to grain, individual apatites are homogenous with respect to contents of Sr, as well as REE and Y, showing that at ca. 800 °C, rapid diffusion must have taken place.

In contrast to the apatites, monazite grains inside and outside of garnet were both equally Sr-bearing, lacking any signs of a secondary, diffusion-related Sr depletion, even in the most marginal zones. This observation, in conjunction with an occasionally preserved growth zoning, illustrates the status of monazite as a slow-diffusion mineral. Therefore, Sr-bearing monazite potentially may be an important long-term indicator of a HP history of rock units or terranes.