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The relative stability of monazite and huttonite at 300–900 °C and 200–1000 MPa: Metasomatism and the propagation of metastable mineral phases

DANIEL E. HARLOV,[1,*] RICHARD WIRTH,[1] AND CALLUM J. HETHERINGTON[2]

[1]GeoForschungsZentrum Potsdam, Telegrafenberg, D-14473 Potsdam, FR Germany
[2]Department of Geosciences, University of Massachusetts, 611 North Pleasant Street, Amherst, Massachusetts 01003-9297, U.S.A.

ABSTRACT

Monazite is both partially replaced and overgrown by a $ThSiO_4$ phase along grain rims in a series of experiments from 300 to 900 °C and 200 to 1000 MPa. All experiments consisted of 10 mg of 100–500 μm size, euhedral to subhedral crystals of a natural Th-free monazite-(Ce), 5 mg of $Th(NO_3)_4 \cdot 5H_2O$, 2.5 mg of SiO_2, and 5 mg of H_2O loaded into 3 mm wide, 1 or 1.3 cm long platinum capsules that were arc welded shut. Experimental conditions were: 300 °C at 200 and 500 MPa; 300, 400, 500, 600, and 700 °C at 500 MPa (cold seal hydrothermal autoclave); and 900 °C at 1000 MPa (Catz assembly; piston-cylinder press). Back-scattered electron (BSE) imaging, electron back-scattered diffraction (EBSD) analysis, and transmission electron microscopy (TEM) indicates that in the experiments from 500 to 900 °C, the $ThSiO_4$ phase took the form of monoclinic huttonite implying that huttonite, associated with monazite, could exist metastably over a much greater *P-T* range than previously thought. TEM analysis of a foil cut perpendicular to the monazite-huttonite interface from the 600 °C, 500 MPa experiment using a focused ion beam (FIB) indicates that the huttonite as well as the interface between the huttonite and monazite is characterized by fluid inclusions. High-resolution TEM analysis indicates that the huttonite-monazite interface is coherent. In the case of replacement of monazite by huttonite, fluid-aided dissolution-reprecipitation is proposed as the most likely mechanism responsible.

Keywords: Monazite, huttonite, dissolution-reprecipitation, metastability, metasomatism, EBSD, TEM, pseudomorphism