American Mineralogist, Volume 100, pages 2579–2589, 2015

Effect of fluid composition on growth rate of monazite in quartzite at 1.0 GPa and 1000 °C

JOHN C. AYERS[1,*], DEREK L. BRYANT[1,2] AND KEVIN GILES[1]

[1]Department of Earth and Environmental Sciences, Vanderbilt University, Nashville, Tennessee 37235, U.S.A.
[2]Visual Risk Technologies, Inc., 210 25th Avenue North, Suite 1015, Nashville, Tennessee 37203, U.S.A.

ABSTRACT

The dependence of monazite coarsening rate on fluid composition was evaluated by performing growth experiments in a piston-cylinder apparatus at 1.0 GPa and 1000 °C. Results show that the rate of monazite coarsening in quartzite + fluid is strongly sensitive to fluid composition. Although other studies have shown that monazite solubility is higher in acidic fluid, addition of 2 m HCl to H_2O decreased the growth rate. Textural observations and modeling indicate that monazite growth in 2 m HCl occurs through a combination of Ostwald ripening and coalescence. Addition of 2 m NaCl to H_2O should have increased monazite aqueous solubility and made the fluid interconnected, but the expected increase in monazite growth rate did not occur, with monazite size distributions showing no change between 0 and 165 h and no measurable growth. Ion adsorption on the surface of monazite may have slowed the rate of monazite growth on addition of HCl and stopped growth on addition of NaCl. The strong dependence of monazite coarsening rate on fluid composition suggests that the size of crystals produced by metamorphic coarsening may not be a reliable indicator of duration of metamorphism, and that adsorption of ions on mineral surfaces may be significant even at 1000 °C.

Keywords: Monazite, mineral growth, growth kinetics, metamorphism, coarsening, textural development, Ostwald ripening