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Solubility of xenotime in a 2 *M* HCl aqueous fluid from 1.2 to 2.6 GPa and 300 to 500 °C

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Abstract

Constraining mass transfer of the rare earth elements (REE) and high field strength elements (HFSE) from subducted oceanic crust and metasediments to the mantle wedge is fundamental toward interpreting processes that affect trace element mobility in subduction zone environments. Experimental studies of the partitioning of trace elements involving aqueous fluids at *P-T* conditions appropriate for slab-mantle wedge conditions are complicated by the difficulties in retrieving the fluid. Here we present the results from an application of an in situ technique that permits quantitative determination of element concentrations in aqueous fluid at geologically relevant supercritical conditions. We focus on pressures and temperatures appropriate for devolatilization-induced element transfer in subduction zone environments, and conditions obtained during regional metamorphism. In this study, we used a hydrothermal diamond-anvil cell (HDAC) and in situ synchrotron X-ray fluorescence (SXRF) to quantify the concentration of Y, an important trace element often used as a proxy for the heavy REE in geologic systems, in a xenotime-saturated 2 *M* HCl-aqueous fluid at 1.19 to 2.6 GPa and 300–500 °C. At these pressures and temperatures the solubility of yttrium ranges from 2400 to 2850 ppm. We find that the concentration of Y decreases with increasing fluid density. These new data, combined with published data generated from experiments done at lower pressure, in fluids of nearly identical composition and also NaCl-H_2O fluids, constrain the effects of pressure and temperature on the ability of aqueous fluid containing Cl to scavenge and transport Y and, by analogy, the HREE. Although the physical properties of Y are similar to the high field strength elements, Y exhibits geochemical behavior that is analogous to the heavy rare earth elements (HREE).

Keywords: Synchrotron, subduction, aqueous fluid, metasomatism, fluid transfer, hydrothermal diamond-anvil cell, xenotime, rare earth elements, yttrium