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Experimental studies of REE release rates during apatite dissolution from pH 3 to 7

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Rare earth elements (REE) release rates were measured during the open-system dissolution of natural apatite at 25 °C, 3 < pH < 7, and at ionic strengths ranging from 0.001 to 0.02 mol/kg. All inlet solutions were Ca, REE, and P free. In agreement with previous studies, apatite dissolution rates, determined from outlet solution Ca and Sr concentrations, decrease monotonically with increasing pH. While Ca and Sr are always released stoichiometrically, REE are increasingly retained with increasing pH. Speciation calculations indicate that when REE are retained in the solid phase the outlet fluids are supersaturated with respect to both amorphous and crystalline Monazite. During some long-term dissolution experiments chemical conditions change at later stages of the experiments. The dynamic equilibrium between apatite dissolution and possible precipitation and re-dissolution of secondary REEPO_{4*}nH2O_(s) is discussed. The rapid dissolution and precipitation observed in this study suggests this process may play an important role in controlling surface water REE signatures.