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Title of Abstract: * Fingerprinting the Hydrothermal Mobility of Rare Earth Elements (REEs) in Ore Deposits from the Stability of Monazite-(Ce)

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Societal demand for critical metals used in the high-tech and green industries has led to an increased interest in REEs associated with ore deposits. Hydrothermal mineralization of monazite (CePO_4) in various REE deposits can display significant variations in REE mineralogy and rock chemistry. Monazite displays textural and REE compositional variations, such as those observed in the giant Bayan Obo REE deposit in China and in the Pea Ridge iron-oxide-apatite (IOA) deposit in Missouri. The coupling of compositional variations of monazite with thermodynamic modeling of fluid-rock interaction processes may provide a useful vectoring tool in these ore deposits. However, interpreting these geochemical fingerprints requires building an internally consistent thermodynamic dataset for REE minerals and their relevant aqueous complexes.

In this study, a series of hydrothermal solubility experiments were carried out using synthetic monazite crystals (i.e., LaPO_4 , PrPO_4 , NdPO_4 , and EuPO_4) to assess the consistency of reported mineral calorimetric data and the thermodynamic data of the aqueous REE complexes. The solubility experiments were conducted in aqueous HClO_4 - H_3PO_4 -bearing solutions at temperatures between 100° and 250°C and at saturated water vapor pressure. Equilibrium constants (K_{50}) for the dissolution reaction of monazite end members were retrieved as a function of temperature and extrapolated to standard conditions of 25°C and 1 bar. Results indicate significant differences between the new solubility data and those reported in the literature. We demonstrate the impact of these new thermodynamic data in a series of fluid-rock interaction models using the GEMS code package (<http://gems.web.psi.ch>) and the MINES thermodynamic database (<http://tdb.mines.edu>). The simulated monazite stability can be correlated to field observations and allows for the prediction of the behavior of REE in hydrothermal fluids and their association to alteration observed in ore deposits.

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