Goldschmidt 2024 Abstract
https://doi.org/10.46427/gold2024.23303

Hydrothermal modeling of Nd, U, and Th species in carbonate bearing fluids

MARGARET E. REECE[1], ARTACHES MIGDISSOV, PHD[1], ANDREW C. STRZELECKI[1], KAT ROSE[2] AND ALEXANDER P GYSI[3]

[1]Los Alamos National Laboratory
[2]Arizona State University
[3]New Mexico Institute of Mining and Technology
Presenting Author: margaret.schmits@wsu.edu

Rare Earth Element (REE) ores are commonly found as solid solutions and are associated with enrichment in U and Th, which cause separation issues for HREE from LREE, and radioactive waste streams during their mining and processing. Thus, it is important to be able to predict conditions under which An-depleted ores are formed. U and Th are often getting incorporated in REE-bearing minerals as solid solutions, and, thus, this predictability largely depends on thermodynamic stability and phase equilibria of the latter. Consequently, in the last decade, a multitude of studies have been carried out to investigate the solubility and speciation of these elements at hydrothermal conditions.

In this study, we determine the speciation of Nd in carbonate-bearing fluids at elevated temperature (up to 500°C) through solubility techniques [1] using synthesized Nd-monazite as the reference phase. We demonstrate that the predominant aqueous complex at these conditions is the $NdCO_3OH_{aq}$ complex, formed by the congruent dissolution of the solid phase, similarly seen in systems using Nd-hydroxylbastnasite as the reference phase [2]. This thermodynamic data combined with recent studies on U- [3] and Th- [4] complexation in carbonate bearing solutions supports accurate modeling of the behavior of natural REE solid solutions in hydrothermal conditions, which will further enable the development of new exploration techniques permitting the identification and localization of REE-fractioned or Th- and U-depleted REE ore deposits.

[1] Migdisov et al. (2009) Geochim. Cosmochim. Acta 73, 7087-7109
[2] Nisbet et al. (2022) Chem. Geo. 611, 121122
[3] Kalintsev et al. (2021) Commun. Chem. 4, 120
[4] Nisbet et al. (2019) Sci. Rep. 9, 17035