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The Solubility of Nd-fluorbastnäsite in Carbonate-Bearing Hydrothermal Solutions

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Rare earth elements (REEs) are highly sought after for their use in high-level electronics such as permanent magnets and long-lasting batteries. A large proportion of REE resources are associated with carbonate-bearing systems and are found as bastnäsite minerals: a fluorocarbonate, typically containing light to medium REEs. Evidence exists that economic concentration of REEs in natural systems is associated with contribution from hydrothermal fluids. Thus, quantitative understanding of REE mobility in these fluids, especially the mobility in carbonate-bearing solutions, is critical for development of genetic models of REE ore formation.

Recently, solubility of hydroxybastnäsite in carbonate-bearing solutions was studied up to 250 ˚C. [1] Hydroxybastnäsite however, is not a common REE ore-forming mineral – the vast majority of bastnäsites are represented by fluorobastnäsite, which differ in reactivity and thermodynamic properties. Here we report the data on the solubility of Nd-fluorobastnäsite end member up to 250 ˚C, which can provide insight on the behavior of fluorobastnäsite in hydrothermal systems.

The experiments were performed in light-weight Ti autoclaves lined with Teflon bearing a carbonate or bicarbonate enriched solution at elevated temperatures (150-250 ˚C). [2] Nd-fluorobastnäsite was synthesized hydrothermally and used as a reference phase, the phase purity was confirmed by Raman spectroscopy and X-ray diffraction before and after solubility experiments. The preliminary data suggest that the concentrations of Nd developed in solutions co-existing with fluorobastnäsite are comparable to those reported for hydroxybastnäsite, and that the determined solubility levels are sufficient for efficient mobilization and re-concentration of Nd under hydrothermal conditions.

[1] Nisbet et al. (2022) Chem. Geo. 611, 121122

[2] Migdisov et al. (2009) Geochim. Cosmochim. Acta 73, 7087-7109