

Solubility and speciation of HFSE/REE in high temperature fluids

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Despite the continuously growing demand for rare metals, the role of high temperature fluids in the formation of HFSE and REE economic enrichments in magmatic-hydrothermal systems (e.g., Bayan Obo, China; Thor Lake, Canada; Brockman/Hastings, Australia) remains poorly understood. For instance, current knowledge of those fluids' composition and the control it exerts on HFSE/REE remobilization and deposition mainly relies on *at posteriori* petrological reconstruction and only few fluid inclusions or experimental studies are available [1,2]. Available experimental data are furthermore limited to temperature below 300-400 °C and the controls on HFSE/REE uptake during fluid exsolution from the parental magmatic intrusion remains virtually unknown.

Here, we will present X-ray absorption measurements (XAS) that have been conducted in a high temperature hydrothermal autoclave [3] to investigate the solubility and speciation of Gd, Er and Yb in (F, P, Cl)-bearing fluids up to ~ 500 °C and 50-80 MPa. The experimental results show that (M,H)REE solubility decreases systematically with increasing temperature, at least for Cl concentrations up to ~ 4 wt%. Furthermore, both the addition of P and pH increase are found to favor the precipitation of the REE [4]. Thus, both P leaching and pH buffering by interaction with host rocks may be critical processes in the genesis of economic rare metal deposits.

In order to further extend our understanding of the early magmatic-hydrothermal evolution of rare metal deposits, additional diamond-anvil cell experiments conducted to assess Zr, Nd and Yb speciation and fluid-melt partitioning up to ~800 °C and 2-5 GPa [5] will be further used to discuss how pressure, temperature and different ligands may favor HFSE/REE hydrothermal mobilization from the peralkaline or carbonatic intrusions.

References: [1]Linnen et al., 2014. Treatise Geoch. 13, 543-568. [2]Migdisov and Williams-Jones, 2014. Mineral. Deposita 49, 987-997. [3]Testemale et al., 2005. Rev. Sci. Instr. 76, 043905-1-5. [4]Louvel et al., 2015. Chem. Geol. 417, 228-237. [5]Louvel et al., 2013. GCA. 104, 281-299.