

## **Geochemical controls of mobilisation, deposition, and fractionation of REE, U, and Th in ore forming hydrothermal systems**

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One of the main problems associated with the recovery of REEs from natural ores is that some of the most abundant REE-bearing ore minerals (particularly monazite and xenotime) have high contents of U and Th, which significantly increase the REE recovery costs. On the other hand, Th itself is an important commodity, and there has long been an interest in using ThO<sub>2</sub> as an alternative nuclear fuel. As one of the primary REE-bearing ore minerals, monazite with an elevated content of Th, is also the main Th ore mineral. In other words, from the prospect of the Th mining industry, the role of Th in monazite changes from a highly problematic contaminant to a main mining commodity. Hence, development of thermodynamic models that reliably predict the formation of both U/Th-enriched and U/Th-depleted monazite(xenotime) in natural systems is crucial for the exploration or discovery of new, economically feasible, resources of REEs, and, at the same time, for fulfilling the needs of the Th-mining industry.

We have proposed a set of thermodynamic models, which provide insights on the processes controlling mobilisation, deposition, and fractionation of REE in natural hydrothermal systems [1]. New experimental data, recently collected by this team, together with new theoretical evaluations of thermodynamic properties of U aqueous species and minerals reported in the literature, permit to extend these models to U-Th-REE bearing systems. In this presentation we will report some of these models, focusing primarily on the processes occurring in sulfate- and chloride-bearing solutions (two main ligands responsible for hydrothermal transport of REE). We will also discuss the effects of U,Th/REE fractionation or co-mobilisation due to differences/similarities in aqueous speciation of these elements.

[1] Migdisov et al. (2016) Chem. Geol. 439, 13–42