

Complexation behaviour of uranyl in sulfate-bearing solutions at elevated temperatures up to 250°C

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Rare-Earth Element (REE) ore deposits, particularly those associated with syenites, granites and pegmatites are often associated with uranium and thorium-bearing accessory phases with some accommodating both REEs and actinides. This close association between the lanthanides and actinides imposes difficulties on the exploitation and processing of these deposits as the disposal of radioactive actinide-enriched waste material becomes a major concern.

Abundant work has recently been conducted to characterise the complexation behaviour of REEs at hydrothermal conditions. This work has identified sulphate and chloride ions as the most important ligands for transporting REEs^[1]. Conversely, the study of actinide complexation at these conditions is still in its infancy with models based on extrapolations of room temperature experiments e.g. Vopálka et al. (2010)^[2]

By understanding both the complexation behaviour of actinides and REEs we may be able to identify sets of conditions that may lead to preferential mobilisation or concentration of REEs rather than actinides and perhaps lead to the formation of relatively 'clean' REE deposits i.e. containing minimal actinides. Additionally, understanding actinide complexation and mobility at elevated temperatures will permit better predictions of how these elements may move in nuclear waste repositories where radiogenic heat and leaks could lead to mobilisation at high temperatures.

In this study we present the results of a UV-Vis spectroscopic study aimed at determining the stability of aqueous uranyl sulphate complexes at 100 bar from 25°C to 250°C. We have additionally made comparisons between current knowledge of REE complexation behavior and our data in an effort to identify conditions that may favour mobility of either actinides or lanthanides.

[1] Migdisov, A., Williams-Jones, A.E., Brugger, J., Caporuscio, F.A. (2016) *Chemical Geology* **429**, 13-42

[2] Vopálka, D., Štamberg, K., Motl, A., Drtinová, B. (2010) *J. Radioanal. Nucl. Chem.* **286**, 681-686