

# Experimental determination of $\text{UO}_2^{2+}$ sorption and reduction at mineral surfaces

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When uranium occurs in the oxidation state +VI (as uranyl,  $\text{UO}_2^{2+}$ ), which is the more soluble form, in natural groundwater, its mobility can be reduced by sorption to mineral surfaces. Since adsorption is often a reversible process, reduction of uranyl to form sparingly soluble uraninite ( $\text{UO}_2(\text{s})$ ) would be more efficient for long-term immobilisation. Such reduction is known to take place by structural ferrous iron in minerals [1,2].

Since granite is the proposed host rock for radioactive waste in Sweden, we investigate the effect of Fe(II)-containing minerals frequently occurring in granitic rocks on the uranyl immobilization. The interaction of Fe(II) minerals biotite, pyrite, and magnetite and similar, but Fe(II)-free minerals (phlogopite, galena, and hematite), with uranyl was determined under near natural conditions (pH 6, anoxic) in batch experiments. The amount of uranyl added to the different mineral suspensions was varied (1 – 1000  $\mu\text{M}$ ) to enable investigations of different surface processes (adsorption and surface precipitation of U(VI) or reduction of U(VI) to U(IV)).

In order to get information on the time scale to reach equilibrium, U concentrations were determined in subsamples collected at certain time intervals over a period of altogether one month. Afterwards the minerals were analysed by X-ray photoelectron spectroscopy (XPS) to get information on the redox state of U and by extended X-ray absorption fine structure (EXAFS) spectroscopy to determine the type and number of the atoms surrounding the adsorbing U atom as well as the radial distances to those atoms [1,2]. Thus, the processes responsible for U retention by different minerals are both characterized and quantified in this study.

## References

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