

Interactions of uranium with Fe(III)-(hydr)oxides under sulfate reducing conditions

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Uranium (U) contamination is a global problem in water supply and related ecosystem health, and it is the primary radioactive metal contaminating subsurface environments at many sites and is of particular concern because of its carcinogenicity. The high solubility of its hexavalent form can result in U transport to sensitive receptors such as drinking water sources. One potential method of treating U contamination is by using natural dissimilatory metal reducing bacteria including sulfate reducing bacteria (SRB) to reduce soluble U(VI) to insoluble U(IV) (as uraninite, UO₂). This reduction can lead to *in situ* U immobilization; however, it is vital to understand the reactivity and stability of microbially-mediated uraninite. Our recent published HR-TEM, SAED, and EDS analysis data showed that SRB transformed U(VI) into colloidal uraninite with particle diameters of 3–5 nm. Further, we recently showed that under lactate-limited sulfate-reducing conditions, this biogenic uraninite can be oxidized by common Fe(III)-(hydr)oxides such as hematite, goethite, and ferrihydrite. In addition to the oxidation of biogenic uranium under biotic conditions, in this paper we review the oxidation of aqueous phase biogenic uraninite by Fe(III)-(hydr)oxides under abiotic conditions. These aqueous uraninite particles were separated from SRB using 0.2 μm membrane filter, and treated with hematite and ferrihydrite under strict anaerobic conditions. Our results suggest that Fe(III)-(hydr)oxides oxidized uraninite; however, the reactivity of biogenic uraninite was greater with ferrihydrite as compared to the more crystalline structure of hematite. Thermodynamic calculations also indicate congruent favorability of these reoxidation reactions. The results have strong implications for field application of *in situ* biological reduction of U(VI) since oxidation of bioreduced uraninite by Fe(III)-(hydr)oxides *in situ* may limit U immobilization even under reducing conditions.