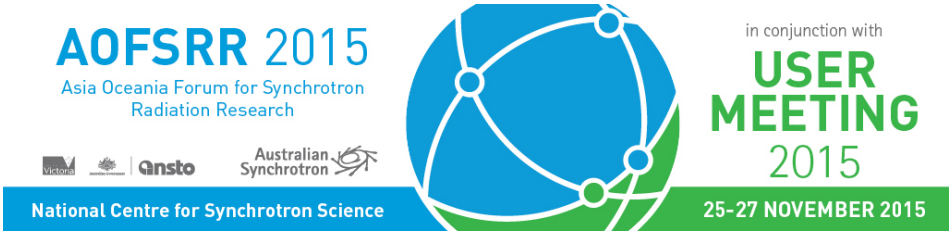

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Uranium speciation and mineralogy within an organic-rich ore deposit (Mulga Rock, WA); implications for U mobility and extraction

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Uranium (U) is internationally important as a low carbon energy source, however, its extraction and radioactive waste legacies require continuing research into the factors controlling U mobility. Uranium mobility is strongly influenced by its oxidation state: U(VI) (e.g., U(VI)-carbonate) is more soluble than U(IV), which mineralises as coffinite [USiO4] or uraninite [UO2]. By identifying the U-species present in natural systems, insights can be gained into ore formation, U extractability (e.g. in-situ leaching) and contaminated site management. The influence of U by organic matter (OM) on both uranium mobility and fixation is interesting, as within deposits higher U concentrations often coincide with OM-rich zones. Alternatively, OM may also inhibit sorption of U via formation of soluble complexes. Analytical challenges include identifying U-species within OM-rich samples. Synchrotron radiation, in particular X-ray Absorption Spectroscopy (XAS) and X-ray fluorescence microscopy (XFM), have proven advantageous in studying oxidation state and coordination. Here, we present the results of XAS analyses of Mulga Rock cores, an OM-hosted U-deposit in WA. We show that within OM, uranium is finely dispersed displaying simple monomeric structures analogous to uranyl silicate, suggesting potential for U extractability. However, where uranium is locally concentrated, coffinite predominates. Results of XFM-XANES and XRD transects also document a redox gradient of U(IV) to U(VI) across a U-pyrite boundary.

Keywords

Uranium, organic matter, mobility, XAS, XFM, Mulga Rock deposit

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