



Interfacial redox reactions, X-ray absorption spectroscopy, and how they can contribute to the safety of radioactive-waste repositories

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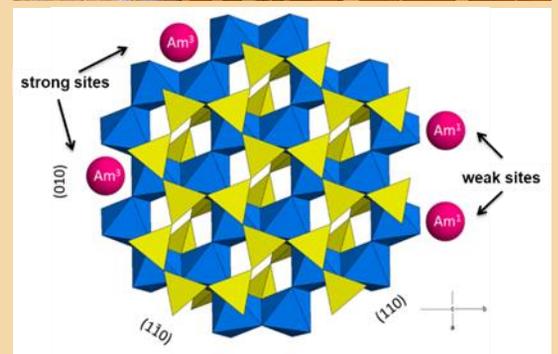
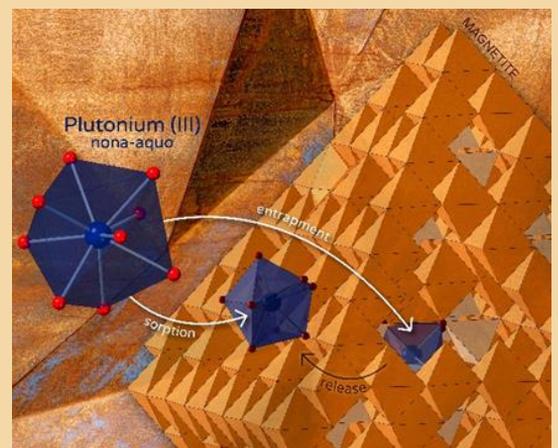
17th of September at 3pm (Virtual Seminar)

Zoom link: <https://us02web.zoom.us/j/81039628587?pwd=RINwYkkwOWxrd1ByYjZLNURqVkFRZz09>

Zoom ID: 810 3962 8587, Password: igseminar

Abstract

The safe enclosure of nuclear waste in deep-geological repositories is not only a challenge for engineers to build it, but also for geoscientist to predict that the eventually forming leaks do not lead to a contamination of the biosphere – and this for a period of up to one million years, as dictated by the slow decay of long-lived radionuclides. A precise, molecular-scale understanding of the retention processes at water/mineral interfaces is one of the fundamental requirements to improve the prediction of radionuclide migration by (reactive) transport models. These processes include physical and chemical sorption, and structural incorporation by existing or neoforming mineral phases. Interfacial redox reactions with structural or sorbed Fe(II) play a pivotal role during these processes, since Fe(II) is the most ubiquitous redox agent in the deep anoxic underground, and is furthermore released in large quantities from steel canisters corroding under radiolytic H₂ production. Synchrotron-based X-ray absorption spectroscopy is best suited to elucidate such processes, since it provides information on oxidation state, bonding and short-range structure of an element at the same time, and this in situ due to the high penetration depth and element-specificity of the used synchrotron radiation. I will show selected examples for a range of metals occurring in radwaste (Tc, U, Np, Pu, Am), while the observed processes (and methods) are transferable to many other metals and metalloids of general geochemical interest.



Top: Reduction of Pu(V) to Pu(III) and subsequent sorption to and entrapment by magnetite. Bottom: Sorption of Am(III) to montmorillonite edge sites.