

## Neptunium redox cycling – An XAS study

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Microbial mediated reactions in the geosphere can affect the solubility of redox sensitive radionuclides and understanding these processes is essential for the safe management of radioactive wastes. Neptunium, an alpha emitting transuranic element, is of particular importance due to its long half-life, high radiotoxicity, and relatively high solubility as Np (V)O<sub>2</sub><sup>+</sup> under oxic conditions. Here, we describe experiments where Np (V) was added to oxic sediment microcosms and anaerobically incubated. Enhanced Np removal to sediments occurred during development of microbially-mediated metal reduction and X-ray absorption spectroscopy showed this was due to reduction to poorly soluble Np (IV), with Np possibly associated with Mn/Fe bearing mineral phase (s). In subsequent reoxidation experiments with air and nitrate, sediment associated Np (IV) was found to be resistant to oxidative remobilization across a range of treatments. This study highlights the potential for indigenous microbial communities to critically control transuranic element solubility in environments relevant to the global nuclear legacy.

## Toward a model framework for evaluating the long-term capacity of soils to sequester carbon

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Soil carbon (C) data that we have compiled from several different chronosequences spanning a wide range of moisture conditions (MAP from 150 to 5000 mm yr<sup>-1</sup>) allow for a robust analysis of the relationship between soil state factors and temporal patterns of soil C storage. This analysis reveals a general pattern of steady increases in C storage during early stages of soil development to a maximum value at intermediate soil ages, followed by moderate declines in older soils. This temporal trajectory can be attributed to changes in organo-mineral interactions resulting from the initial weathering of primary minerals to meta-stable, poorly crystalline intermediates and, subsequently, to crystalline secondary minerals. This pattern highlights the importance of shifts in the dominant mechanisms of organo-mineral interactions over time, and suggests that soil water cycling may drive these changes because the flux of water through soils controls both the weathering of soil minerals and the input, transport, and loss of the organic matter. Therefore, we expect soil water flux to be an important parameter for simulating long-term soil C dynamics. To test this hypothesis, we explored the potential to use a reactive transport framework to simulate soil C storage over soil development timescales. Specifically, we incorporated several different mechanisms of organo-mineral stabilization into an existing reactive transport model. We then tested the ability of this model to reproduce soil C stocks measured in chronosequences from the western United States.