Title
Inorganic controls on neptnium-237 mobility in the subsurface

Objective
Neptunium-237 has a long half-life (2.14 million years) and is highly soluble in near-surface groundwater in the pentavalent oxidation state. It is identified as a subsurface contaminant of concern by the DOE. As co-precipitation of Np into minerals may be important in determining the long-term behavior of this radionuclide in the subsurface, we aim to develop a detailed understanding of the factors, including structural constraints, that impact co-precipitation of Np(V) into minerals. To achieve this aim, we have the following working objectives:

1. To develop syntheses that show incorporation of Np(V) by rock-forming minerals, and
2. To investigate the structural mechanisms through which Np(V) is incorporated
3. To facilitate a comparative investigation of the inorganic factors valid to understanding the environmental fate of Np(V)

Results/Plans
The synthesis of a variety of mineral phases has allowed us to make preliminary contaminant uptake comparisons based on the steric constraints of the mineral structures. As of March 2012, fourteen mineral phases have been synthesized for this study. These include carbonates, sulfates, nitrates, phosphates, and a borate. Stage 1, the optimization of these mineral phases, is complete.

In the second stage, the mineral phases are synthesized in the presence of actinides—uranium and neptunium, separately. As of March 2012, eight mineral phases have been synthesized in the presence of uranium and neptunium for this study. These include carbonates, sulfates, and a borate.

Methods of synthesis, including a new method for the synthesis of calcite, and characterization of the phases by ICP-MS in solid and solutions modes will be presented and discussed. We will present hypothetical models for the incorporation of Np(V) into the crystalline structures of carbonates and sulfates along with a side-by-side comparison of the neptunium uptake potential for a variety of mineral phases.

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