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ABSTRACT TITLE: Effects of pore-scale physics on uranium geochemistry in Hanford sediments

ABSTRACT: The Hanford 300 Area sediments are mainly river cobble and gravel, with sands and fines (silt + clay) variably filling the voids in between. Fines comprise only 1.78% of the total sediment mass, but hold a disproportionately large fraction of the total U. However, the coarser sediments (e.g., >2 mm), with their larger mass fraction, may serve as a long-term U release pool despite their lower U concentration. We hypothesized that slow U release at the 300 Area is partly due to low connectivity of intra-granular pores. The objectives of this project were (1) to evaluate the U distribution in 2-8 mm size sediments, (2) to determine whether low pore connectivity affects U distribution and release from Hanford 300 Area sediments, and (3) if so, to assess its implications for long-term release. Our approach integrates laboratory experiments and pore-scale network modeling. Laboratory experiments include stirred flow cell, column, and batch sorption approaches, with the resultant samples analyzed by ICP-MS instrumentation for multiple elemental concentrations in liquid samples. In addition, laser ablation (LA)-ICP-MS was conducted for elemental mapping of 2-8 mm sized basaltic clasts. Pore-scale network modeling was also abstracted into a finite difference model that accounts for low pore connectivity effects on porosity and diffusion.

This past year (operating under a no-cost extension) we:

1) Collaborated with scientists of PNNL and Florida State University (FSU) on uncertainty analysis of an elution experiment (reported last year) measuring uranium desorption from different size fractions (<75 µm, 75-500 µm, 500-2000 µm, 2-8 mm, and a <2 mm composite). Using the experimental data collected from this project, a PhD student at FSU presented analysis at the 2013 AGU Fall Meeting, and is preparing a manuscript for publication to *Water Resources Research*.
2) Extended our own analysis of the elution data to consider the effect of having a range of particle sizes, rather than a single size. This analysis generalizes our earlier work published in *Water Resources Research*.
3) Extended our finite-difference model of diffusion from porous media with low pore connectivity, to account for non-linear sorption isotherms.