Uranium isotopic systematics of the 300 Area (Hanford, WA) groundwater plume and U-contaminated sediments

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The 300 Area at the Hanford Site in Washington is situated along an ~2 km stretch of the Columbia River. Past operations in the 300 Area included the disposal of chemical and radioactive waste into a series of settling ponds and disposal trenches. This resulted in a groundwater U plume in the 300 Area, with U concentrations reaching greater than 100 ppb, that communicates with the Columbia River. The persistence of the groundwater U plume is likely due to replenishment by U released from contaminated sediments, influenced by dynamic water table elevation driven by highly variable Columbia River stage [1]. The 300 Area DOE Integrated Field Research Center (IFRC) was established to conduct field-scale experiments regarding U mobility in a hydrologically dynamic environment.

Here we discuss our U isotopic ($^{234}U/^{238}U$, $^{236}U/^{238}U$, $^{235}U/^{238}U$) studies of 300 Area groundwater and sediments, with a particular focus on the IFRC experimental plot. These U isotopic data provide insights into the sources and temporal dynamics of the U plume. Comparison between 300 Area groundwater and sediments suggest that groundwater U isotopic variation is in large part due to local sediment U isotopic compositions, rather than simple mixing within the plume between distinct U isotopic end-member sources. A dramatic example of this is provided by a series of groundwater samples from the IFRC array collected in spring 2009. Increases in U concentration by over a factor of 5 were observed coincident with rises of the water table into the deep vadose ('smear') zone. The U isotopic fingerprint of the high U concentration samples are mappable to the U isotopic stratigraphy of the local sediments, pinpointing a particular depth range in the 'smear' zone as the U source. This confirms that the source of the added U is in the 'smear' vadose zone, and provides constraints on its spatial location and mass balance.

[1] Zachara *et al.* (2007) PNNL Report # 17031.

Manganese carbonates formation during long-term sorption of Mn^{2+} by viable *Shewanella putrefaciens*

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Present paper explains the mechanism of Mn^{2+} long-term sorption by viable *S. putrefaciens* (continuation of the work [1]) at the following conditions: 125 and 1000 ml batches; 5, 10, 22 and 30 °C; Mn^{2+} initial concentrations = 125, 200, 750 and 1000 mg L^{-1}; bacteria concentrations = 2 and 4 g_{dw} L^{-1} and contact time - from 3 to 30 days. FTIR, EXAFS and SEM investigations demonstrated that longer than 4 days contact time leads to formation of Mn-containing precipitates. Their composition (as well as ratio, rate of formation) depends on the experimental conditions mentioned above. Some of our findings: manganese carbonates were detected in 1000 ml batches only at 10, 22 and 30 °C, Fig. 1.

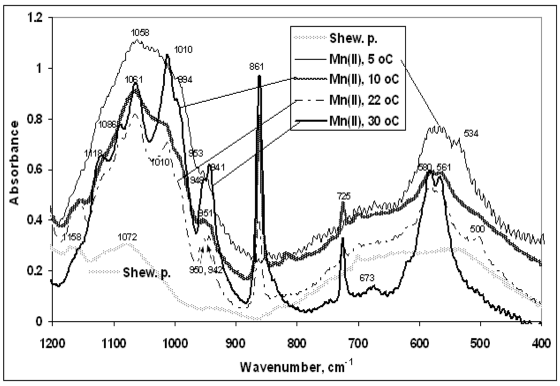

Figure 1: FTIR spectra of *S. putrefaciens* contacted to Mn^{2+} over 30 days at different temperatures.

Formation of $MnCO_3$ starts in more than 6 days, Fig. 2.

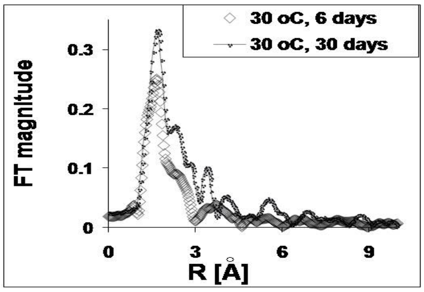

Figure 2: Radial structure functions around Mn resulting from Fourier transforms of EXAFS oscillation.

[1] Chubar *et al.* (2008) *Colloids & Surfaces B* **65**, 125–133.