FIU PROJECT 2 - 2012 FACT SHEET

Rapid Deployment of Engineered Solutions for Environmental Problems at Hanford

FIU's Applied Research Center (ARC) is supporting the U.S. Department of Energy's Hanford Site in developing a strategy to improve the efficiency of the uranium stabilization in the subsurface.

The investigation targets uranium (U) contamination in the vadose zone (VZ) of the 200 Area that may affect potential discharges to the Columbia River via groundwater migration. Injection of reactive gases such as NH_3 is an innovative technology that targets U contamination in the VZ to reduce the potential for radionuclides mobility in subsurface. The alkaline conditions can greatly enhance the solubility of most Al- and Si-containing minerals by many orders of magnitude. The following decrease in pH will cause uranium co-precipitation during the recrystallization of minerals. Microbial activities in many environmental systems are additional layers of complexity that affect U(VI) mobility in the subsurface. In nature, a variety of bacteria may enhance the mobility of heavy metals or radionuclides by dissolution and desorption due to the secretion of protons and various ligands. This project investigates the bacterial effect on U(VI) release from the autunite mineral ($Ca[(UO_2)(PO_4)]_2 \cdot 3H_2O$) to provide a more comprehensive understanding of the important microbiological processes affecting autunite stability and uranium mobility within subsurface bicarbonate-bearing environments.

Objectives

- Evaluate the role of major pore water constituents such as Al, Si, bicarbonate and Ca on the formation of U(VI)-bearing precipitates.
- Conduct mineralogical and morphological characterization of U(VI)-bearing precipitates by means of XRD, SEM-EDS, FTIR in combination with thermodynamic modeling.
- Examine the effect of pH, temperature and bicarbonate ions on the solubility of U(VI)-bearing to evaluate the migration potential of radionuclides.
- Examine the ability of oligotrophic microbial species to influence the dissolution pathways of U (VI) present in the groundwater as stable meta-autunite.
- Conduct biosorption experiments & evaluate the effect of bicarbonate and Ca ions on the mobility of dissolved uranyl ions in the subsurface.

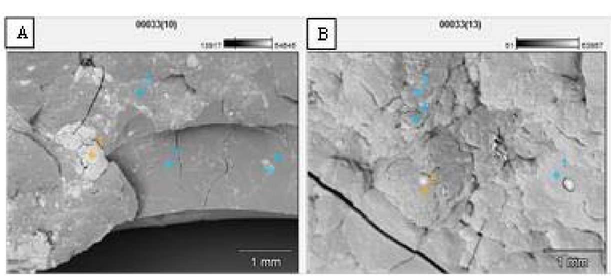

Figure 1. SEM images of uranium bearing percipitates A) 3 mM HCO3, B) 50 mM HCO3.

Benefits

- Determines the effect of various Si, Al, Ca, and bicarbonate concentrations on the removal of U(VI) in the alkaline conditions.
- Yields information on the formation and solubility behavior of U(VI)-bearing precipitates under environmentally relevant Hanford Site VZ conditions.
- Evaluates the structural characteristics of U-bearing precipitates via solid phase characterization using XRD, SEM/EDS, and FTIR.
- Evaluates the role of bacteria in the bio-enhanced release of U(VI) from autunite even while not in direct contact with the mineral.
- Determines biosorption parameters of the process that can be used for further modeling purposes to predict the effect of Ca and HCO_3^- ions on U(VI) mobility in aerobic bacteria-bearing systems.

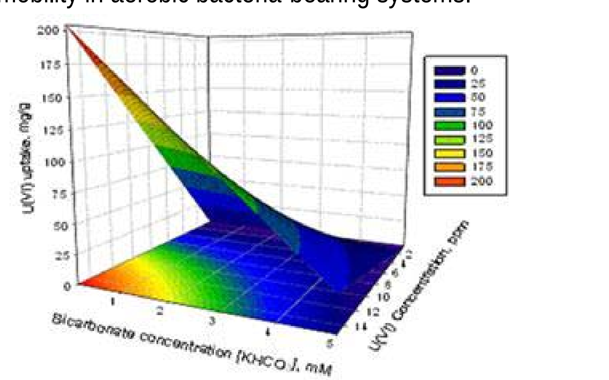

Figure 2. . Response surface model, *Arthrobacter* sp. G975 uranium uptake (mg/g) vs. U(VI) and bicarbonate concentrations at equilibrium.