FIU PROJECT 2 - 2012 FACT SHEET

Effects of Bicarbonate on the Microbial Dissolution of Meta-Autunite

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 process through polyphosphate injection technology.

Injections of a soluble sodium tripolyphosphate amendment into uranium-contaminated groundwater and soil have been shown to effectively sequester uranium through the formation of insoluble uranyl phosphate minerals. Polyphosphate undergoes hydrolysis in aqueous solutions to orthophosphate forms, which serve as readily available nutrients for the various micro-organisms that thrive under these specific conditions and may even lead to an increase in their growth. Microbial activities in many environmental systems are additional layers of complexity that affect U(VI) mobility. The presence of rapidly adapting bacterial populations in sediment could strongly influence the migration/dissolution of uranium by dissolution and desorption due to the secretion of protons and various ligands. Therefore, understanding the role of bacteria in phosphate remediation technology and the interactions between meta-autunite and the microbes is very important. Of particular concern, however, is the long-term stability of the sequestered uranium in the subsurface that may undergo subsequent remobilization.

Objectives

- Examine the ability of oligotrophic microbial species to influence the dissolution pathways of U (VI) present in the groundwater as stable meta-autunite.
- Conduct prescreening tests with Hanford Site soil isolates to determine bacterial viability and the tolerance of the strains towards the radionuclides.
- Evaluate changes in cell surface morphology using AFM, SEM microscopy techniques and conduct elemental analysis of the surface composition.
- Conduct dissolution experiments in batch reactors to study the influence of bicarbonate on the uranium release from autunite mineral in the presence of microbes.
- Conduct biosorption experiments & evaluate the effect of bicarbonate and Ca ions on the mobility of dissolved uranyl ions in the subsurface.

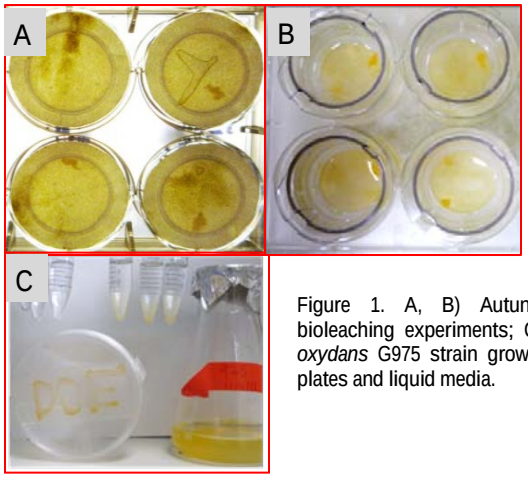

Figure 1. A, B) Autunite mineral bioleaching experiments; C) Viable *A. oxydans* G975 strain growing on agar plates and liquid media.

Benefits

- Evaluates the role of bacteria in the bio-enhanced release of U(VI) from autunite in the presence of various concentrations of bicarbonate up to 10 mM, even while not in direct contact with the mineral.
- Evaluates the effect of bicarbonate and Ca ions on the bacterial viability in the presence of toxic U^{6+} ions.
- Determines biosorption parameters and mechanisms of the process under conditions relevant to Ca-rich carbonate-bearing subsurface environments.
- The obtained K_d values can be used for further modeling purposes to predict the effect of calcium and bicarbonate ions on uranium mobility in aerobic bacteria-bearing systems.

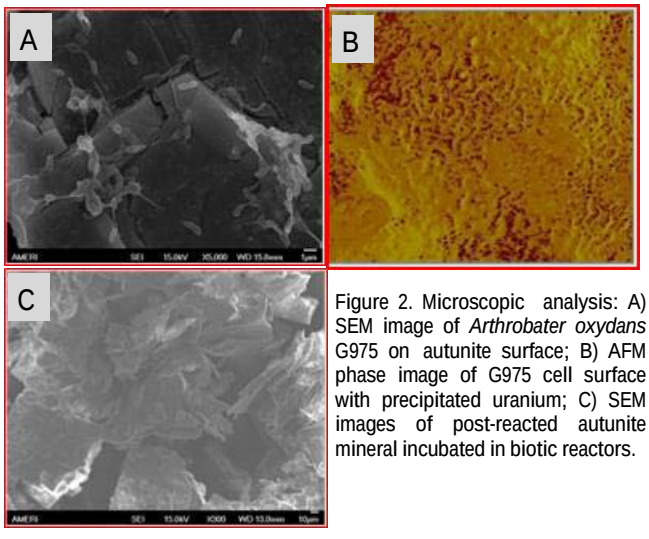

Figure 2. Microscopic analysis: A) SEM image of *Arthrobater oxydans* G975 on autunite surface; B) AFM phase image of G975 cell surface with precipitated uranium; C) SEM images of post-reacted autunite mineral incubated in biotic reactors.