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. An increase in microbial activity was observed at the site following the polyphosphate injection into the groundwater. The presence of rapidly adapting bacterial populations in sediment could strongly influence the migration/dissolution of uranium. 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 uranium dissolution in the presence of microbes and quantify dissolution rates of uranyl ions.
- Conduct biosorption experiments & evaluate the effect of bicarbonate on the mobility of dissolved uranyl ions in the subsurface.

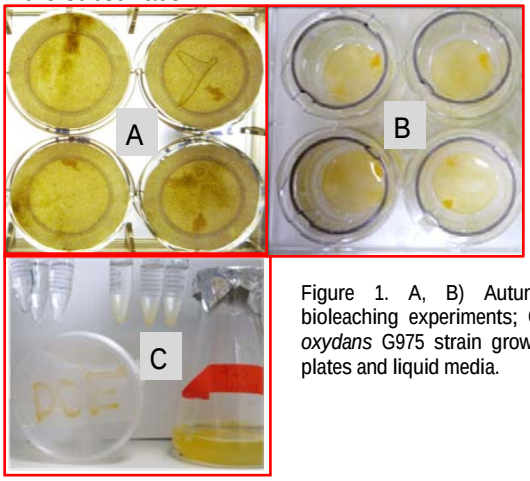

Figure 1. A, B) Autunite mineral bioleaching experiments; C) Viable *A. oxydans* G975 strain growing on agar plates and liquid media.

Benefits

- Evaluates the role of bacteria in the dissolution of uranium from autunite.
- Provides dissolution rates of autunite minerals under appropriately simulated conditions and evaluates their impact on the fate and transport of uranium in the presence of bicarbonate.
- Determines biosorption parameters and mechanisms of the process.
- Evaluates the effect of bicarbonate on bacterial viability in the presence of toxic uranyl ions.

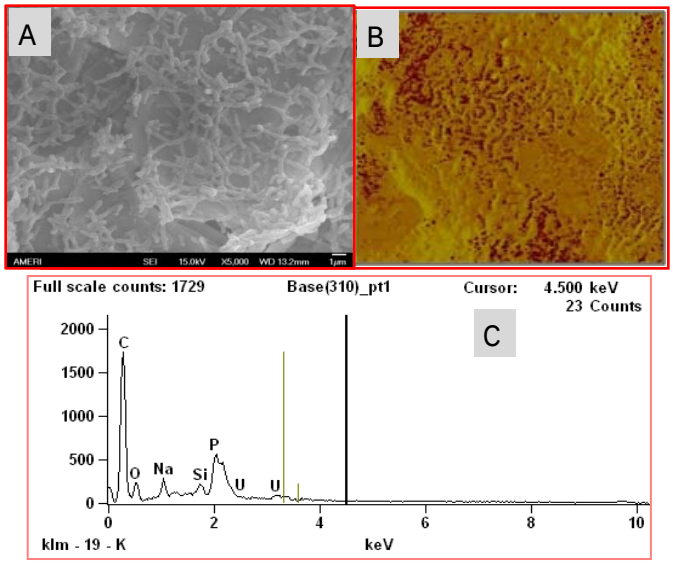

Figure 2. Microscopic analysis: A) SEM image of *Arthrobater oxydans* G975 on autunite surface; B) AFM phase image of G975 cell surface with precipitated uranium; C) EDS elemental analysis of bacterial surface.