Systems-based Approaches to Predict Technetium Immobilization in the Subsurface

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Technetium (Tc-99) is by-product of nuclear fission processes and has a relatively long half-life ($t_{1/2}$=212,000 years). Tc-99 is highly soluble and mobile in groundwater and is most often remediated through groundwater pump and treat systems. Complex interactions within the subsurface made clean-up efforts for Tc-99 challenging. The purpose of this work is to identify the chemical and biological reactions that occur and potentially influence the mobility of this isotope in the subsurface. In the environment a variety of bacteria play a role in reducing contaminants, such as Tc-99, to less soluble forms; however, little is understood regarding Tc-99 fate and transport in the subsurface. More importantly, it is difficult to predict or estimate the interactions and consequent impact of the complex, mixed microbial communities found in the environment. We have set up controlled batch bioreactor experiments to examine each specific organism's ability to reduce Tc-99 to less soluble forms. Specifically, known metal reducing bacteria, including *Cellulomonas* sp. strain ES6, *Anaeromyxobacter dehalogenans* strain CP-C, *Geobacter sulfurrreducens* strain PAC, *Geobacter daltonii* strain FRC-32, and *Shewanella oneidensis* strain MR1 are being evaluated for their ability to reduce Tc-99. Data collected from the experiments will allow for (a) a better understanding of the mobility of Tc-99 in the subsurface, (b)better predictions of contaminant fate and transport over time, and (c) the development of long term remediation strategies for Tc-99. Additionally, information collected will be used to develop a systems-based metabolic model with predictive capabilities; the model will be based on molecular method for detection of bacterial species variations in the Tc-99 contaminated groundwater.