In Situ Immobilization of ^{99}Tc at the Hanford Site by Stimulation of Subsurface Microbiota

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Microorganisms, either directly or indirectly, can alter the oxidation states of uranium and technetium resulting in their precipitation as sparingly soluble solid phases. This process, in concept, can render these contaminants immobile for long time periods. Previous and ongoing NABIR research has established the basic biogeochemical principles underlying the direct and/or Fe(II)-facilitated reduction of ^{99}Tc by microbes. The objective of this project is to evaluate the applicability of these principles to the problem of groundwater contamination by ^{99}Tc at the Hanford Site. Technetium-99 is a radionuclide that contributes significantly to estimates of future human health risk at Hanford because of its longevity and mobility in the subsurface environment. It exists at high concentrations (up to 30,000 pCi/L) in the central areas of the site where the groundwater table is deep, and is predicted to move to the Columbia River within the next decade. It also has been observed at lower concentrations (600 pCi/L) in shallow groundwater near the river in the 100 H area. This project focuses on laboratory studies to establish the existence and metabolic requirements of microorganisms native to Hanford sediments that are capable of directly or indirectly mediating $Tc(VII)O_4^{2-}$ reduction. If lab-scale experiments are successful, biostimulation tests using a single-well push-pull approach will be used to evaluate the viability of in situ reduction of ^{99}Tc by native microorganisms (in collaboration with Jack Istok, Oregon State University), and a field-scale biostimulation experiment will be designed. This project will determine if bioremediation of ^{99}Tc is feasible and ultimately may lead to low-cost reduction of risk from ^{99}Tc at the Hanford Site.

Currently, we are performing initial experiments on samples of the Ringold Formation recently collected from a saturated subsurface zone contaminated with U and Tc. Sediment samples have been used in microcosm experiments and microbial enrichments to probe for the presence of microorganisms capable of reducing TcO_4^{2-} or Mn and Fe. Microcosms have been amended with various electron donors including acetate, lactate, formate, or glucose with and without nitrogen and phosphorous amendment. Metal-reducing activity will be monitored in these microcosms over time and those exhibiting activity will be used to establish microbial enrichments for the specific type of metal-reducing activity identified. Samples of the Hanford Formation from the subsurface of 100 H Area will be collected later this year for use in biostimulation experiments.