Control of Biologically Active Degradation Zones by Vertical Heterogeneity: Applications in Fractured Media

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Dr. Frederick S. Colwell, Idaho National Engineering and Environmental Laboratory

Research Objectives

The U.S. Department of Energy (DOE) is faced with cleaning up wastes from reactor and weapons production activities during the latter half of this century. Many DOE sites have contaminants that are difficult to access due to depth and complex geology and are challenging to degrade using conventional methods. Fundamental, field-based research is required to understand what is needed to address complex cleanup issues such as those that exist in fracture flow environments. The key objective of this research is to determine the distribution of biologically active contaminant degradation zones in a fractured, subsurface medium with respect to vertical heterogeneities. The research will be performed on samples collected from the Test Area North (TAN) site at the Idaho National Engineering Laboratory (INEL) where a dissolved trichloroethene (TCE) plume is migrating in the Snake River Plain aquifer. To determine whether microbial degradation is spatially correlated to preferred flow paths for the contaminant and required electron donors and acceptors we will characterize the biological and abiological properties of cores and samples from multi-level samplers placed in the same borehole. We will use a combination of traditional microbiological methods (e.g., enrichments) and molecular tools to characterize the indigenous microbial communities. Collaboration with other EMSP investigators studying this site and the DOE Office of Environmental Management (EM40) which is implementing remediation will lead to more complete understanding of the biotic and abiotic processes in the subsurface at TAN. We believe that the fundamental research proposed will explain the distribution of microorganisms that can degrade TCE in the context of the geochemical and physical constraints under which these organisms function. This in turn will allow better decisions to be made with regards to the use of remedial technologies such as natural attenuation and in situ bioremediation at this geologically complex site.