SERDP Strategic Environmental Research and Development Program

Mass Transfer from Entrapped DNAPL Sources Undergoing Remediation: Characterization Methods And Prediction Tools

Cleanup
CU-1294

Background:

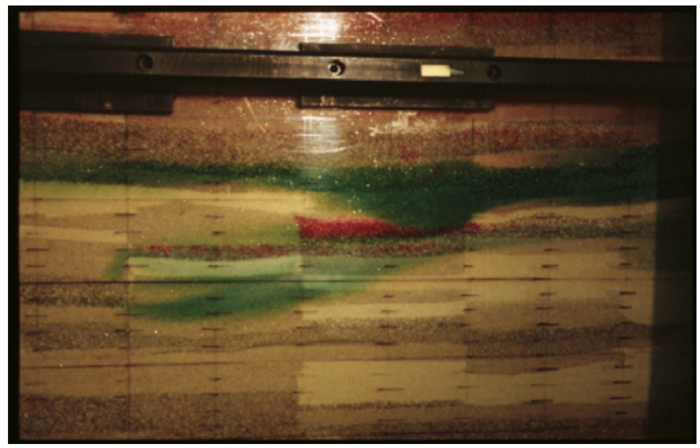
Release of volatile chlorinated solvents in the form of dense nonaqueous phase liquids (DNAPLs) to the environment has resulted in soil and groundwater contamination at many government and private sites. The presence of DNAPLs is particularly prevalent at Department of Defense (DoD) installations and Department of Energy (DOE) facilities. The low aqueous solubility and complexity of movement and entrapment resulting from aquifer heterogeneity cause DNAPLs to persist as long-term, sources of contamination. Because of the long-term costs associated with pump-and-treat schemes, interest has increased in the application of aggressive free-phase removal technologies. However, properly validated tools are not available to make decisions on which technology is most effective at a specific site and how long such treatment methods should be implemented to reduce risk to human health and the ecological environment. There is a need for improved knowledge on the effects of treatment on the mass transfer from entrapped DNAPL sources undergoing remediation. Prediction tools and site characterization methods are needed to make decisions on managing sites and to conduct cost/benefit analysis.

Objective:

The technical objectives of this project are to understand, quantify, and model the process of mass transfer from source zones in heterogeneous aquifers where DNAPLs are undergoing physical, chemical and biological transformation during remediation.

Summary of Process/Technology:

As the methodologies to investigate characterization and prediction involve DNAPL sources that undergo physical, chemical and biological transformation, it is necessary to understand the tracer interaction and mass transfer during remediation under controlled conditions. Hence, the approach combines batch and bench-scale experimentation and controlled experiments in intermediate-scale laboratory soil tanks. First, the hypothesis that the tracer partitioning and mass transfer coefficients change during chemical and biological transformations will be tested. Transformations associated with bio-treatment, surfactant enhanced dissolution, and chemical oxidation will be studied and quantified. The data generated in columns and in two-dimensional test cells will be used to develop methods to up-scale the "point-scale" mass transfer coefficients to multi-dimensional flow conditions encountered in the field. Experiments conducted in large soil tanks will generate an accurate data set to obtain insight into tracer behavior and mass transfer in heterogeneous systems with complex DNAPL entrapment architecture. In the final phase of the study, data from the tank experiments will be used to validate numerical modeling tools and up-scaling methodologies. Two exiting multiphase flow and transport numerical codes will be used. Necessary modifications to these codes will be made to enable their use as decision tools.



Aqueous Phase Bypassing in DNAPL Source Zone Due to Reduced Relative Permeability.

Benefit:

The basic scientific knowledge gained in this research and the developed prediction tools and site characterization methods will help the DoD to make decisions on managing sites and to conduct cost/benefit analysis on the selection and implementation of different treatment technologies.

Accomplishments:

This project began in FY 2002. Accomplishments will be noted upon completion of the project. For information on the project's status, see the **timeline of tasks and deliverables**.

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