Computational and Experimental Investigations of Contaminant Plume Response to DNAPL

Source Zone Architecture and Depletion in Porous and Fractured Media

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New Technologies to Address Pertinent & Practical Questions

1) What is the role and impact of diffusion of DNAPLs across low-permeability matrices, including the rock matrix to fractured media?
2) How do DNAPLs located in low-permeability matrices affect plume release fluxes in more permeable strata and fractures?
3) Are there more cost-effective approaches for evaluating DNAPL source-zone architectures and masses than cost/uncertainty/risk trade-offs?
4) Can we improve predictive models to assist in cleanup?
5) How do DNAPL dissolution & plume migration, impacts of heterogeneities & fractures on source zone volumes of DNAPL

Numerical Experiments

1) Numerical Simulations
2) Batch & Column Experiments
3) Laboratory Experiments
4) Field Studies
5) Fracture Matrix Entry

Conduct laboratory experiments to validate the proposed computational approaches

Technical Objectives

1) Develop computational tools for predicting aqueous-phase plume response to DNAPL source-zone architectures and depletion for both porous and fractured media
2) Conduct numerical experiments to investigate the relationship between DNAPL source-zone characteristics and dissolved phase plume migration to porous and fractured media
3) Develop new methods for characterizing DNAPL source-zone characteristics by exploiting available hydraulic head and concentration data as well as signatures of mixed-source data of infiltrating solvents
4) Conduct laboratory experiments to validate the proposed computational approaches
5) Apply the techniques at a well-characterized fractured site

Entry Pressures and DNAPL Volume:

Fractures vs. Matrix

Goal: Validate data analysis environment developed in tasks 1 and 2 for a DNAPL-contaminated fractured rock site

Field Study Site

Task 1: Modification of Compflow

Task 2: Modification of Compflow

Task 3: Numerical Experiments

Task 4: Refinement of Analytical Techniques

Task 5: Batch & Column Experiments

Task 6: Lab Sandbox & Fractured Rock Block Studies

Task 7: Field Experiments

Task 8: Numerical Modeling of Lab and Field Data & Validation of New Technology

Compound Specific Isotope Analysis

Conduct laboratory experiments to validate the proposed computational approaches