Integrated Geophysical Detection of DNAPL Source Zones

Cleanup
CU-1090

Background:

Location of the dense non-aqueous phase liquids (DNAPL) sources and reliable estimates of their masses are crucial for cost-effective cleanup. No currently available method can define the subsurface distribution of chlorinated solvent DNAPLs accurately and efficiently. This research effort will address this limitation through the development of DNAPL detection technology.

Objective:

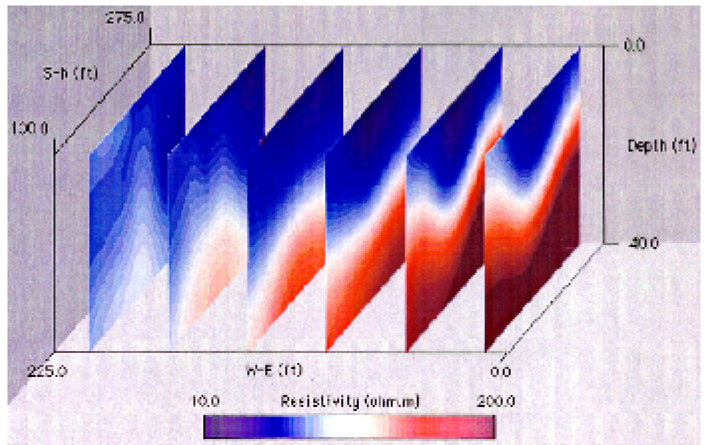
The objective of this project is to provide cost-effective three-dimensional (3-D) geophysical imaging of the geological control on DNAPL distribution and migration at different spatial resolutions.

Summary of Process/Technology:

Specifically, the project intends to develop a three-fold approach to the characterization of physical heterogeneity controlling DNAPL migration and the ultimate imaging of DNAPL distribution in the subsurface. Joint 3-D tomographic inversion of surface seismic refraction and electrical resistivity data will be characterized to broadly delineate subsurface geology. Joint two- and three-dimensional crosshole tomography using downhole seismic and electrical sources and sensors in permanent 4-inch wells and/or temporary 2-inch boring will also be characterized. The same downhole electrical sensors will then be utilized to perform IP (induced polarized) tomography to image DNAPLs with the geological constraints from the above two steps. This three-fold approach will provide new cost-effective, minimally invasive technologies for 3-D geophysical imaging of DNAPL without producing any secondary waste.

Benefit:

The results of this research development will include computer software, downhole seismic and electrical instruments, and case histories focused on Department of Defense (DoD) and Department of Energy (DOE) sites. The direct benefit of this integrated package is the unique capability to produce high-resolution 3-D images of geological structures and DNAPLs in the subsurface. Collecting field data and conducting 3-D computer tomographic imaging for monitoring DNAPL migration can be completed in real time. When this approach becomes available, it can facilitate the design of new treatment and remediation technologies. Based on the DNAPL distribution image and its geological controls, it can also help improve risk assessment and estimate the realistic cost for remediation alternatives.



An example of the geophysical imaging using resistivity

Accomplishments:

In FY 1999, the project performed a two-dimensional joint tomography field test at DOE's Savannah River Site in South Carolina, developed 3-D complex-resistivity tomography software, acquired software for 3-D seismic-refraction tomography, acquired a geophone string that can be used in a small-diameter cone-penetrometer (CPT) well, partially developed the seismic source that will be used in conjunction with the CPT, assessed two complex-resistivity measurement systems in the lab, performed laboratory tests of the nonlinear continuum regression (NLCR) response of soil samples to DNAPL from four DOE/DoD sites, and performed a field test of the NLCR at the former DOE Pinellas Site in Florida.

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