Applications of Electrical Resistivity Tomography to Support Remedy Selection and Implementation

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Background/Objectives. Subsurface electrical resistivity is sensitive to pore fluid conductivity and moisture content (for the vadose zone), which are both parameters that can be related to either site characterization needs or remediation monitoring needs. Electrical resistivity tomography (ERT) provides two- or three-dimensional images of the bulk subsurface electrical conductivity distribution as either a static image or as a sequence of images in time that can track temporal changes.

Approach/Activities. ERT surveys were conducted to evaluate contamination in the vadose zone beneath former waste disposal sites using an array of electrodes installed in a grid across the ground surface. Data were collected and then inverted with the publically available E4D inversion code. The inversions produced three dimensional images of the bulk conductivity distribution. At a vadose zone treatability test site, a combination of a ground surface electrode array and linear electrode arrays installed in site boreholes was used to conduct a series of ERT surveys that tracked bulk conductivity changes induced by dissolution of injected ammonia vapor into the pore water (also inverted with the E4D code). Linear electrode arrays installed in site wells were used to conduct a series of ERT surveys for different injection solutions at an aquifer test site.

Results/Lessons Learned. Recent applications have linked this information to site characterization needs by identifying areas of contrasting conductivity in the vadose zone beneath former waste disposal sites. The conductivity pattern can show the lateral and vertical paths of contaminant migration because the residual disposed waste fluids cause the pore water to have a high-ionic-strength. These data have directly guided characterization borehole activities and have informed fate and transport models. Time-lapse ERT applications have been applied to evaluate amendment distribution in the vadose zone and groundwater and to track reaction processes that cause changes in fluid conductivity. Injection of reactive gas to treat uranium in the vadose zone was tracked in three dimensions over time to determine when the amendment had been fully distributed to the target zone. The increase in conductivity over time as reactions progressed was used to verify the reactions and identify when to install post-treatment verification boreholes. ERT has also been applied in the saturated zone and demonstrated the difference in amendment distribution for different injection solutions in a highly heterogeneous subsurface environment.