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USE OF GEOPHYSICAL METHODS TO INVESTIGATE, GUIDE, AND ASSESS CONTAMINANT REMEDIATION APPROACHES

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Successful remediation techniques often require the co-occurrence of contaminants, remediation amendments, and favorable hydrological, geochemical, and microbiological initial conditions. Due to natural heterogeneity, characterizing initial conditions and monitoring remediation processes using conventional borehole analysis techniques is extremely challenging. By combining spatially extensive (but indirect) geophysical measurements with sparse (yet direct) wellbore measurements, studies have illustrated the value of using geophysical approaches to characterize hydrogeological and geochemical heterogeneity. We have recently built upon this research to explore the feasibility of using time-lapse geophysical methods to monitor remediation processes in the presence of heterogeneity.

Here, we present the results of coupled laboratory and field-based geophysical studies that we have performed in conjunction with biostimulation experiments conducted at three different DOE sites. At the Uranium-contaminated DOE Field Research Center, located at the Oak Ridge National Laboratory, radar tomographic methods were used to monitor the gaseous end products of denitrification produced during a biostimulation experiment. At the Cr(VI)-contaminated 100H Site at the DOE Hanford Reservation in Washington, time-lapse seismic and radar tomographic methods were used to image the distribution of a slow release polylactate and to monitor the changes in geochemical phase and pore fluid composition associated with a biostimulation experiment. At the Uranium-contaminated Rifle UMTRA site in Colorado, surface- and borehole-based complex resistivity techniques were used to monitor changes in mineralogy associated with both iron and sulfate reduction processes that occurred in response to biostimulation.

Comparison of hydrogeophysical characterization and biogeophysical monitoring data at all three sites highlight the spatiotemporal complexity of subsurface responses to remedial manipulations and the control of heterogeneity on the transformations. These studies indicate that the wealth of spatiotemporal information provided by geophysical methods hold great potential for guiding remediation strategies and for assessing remediation performance.