Successful DNAPL Remediation Using Radio Frequency Heating and Return to Thermal Equilibrium

Alicia Kabir, P.E., (Environmental Resources Management, Boston, MA, USA)

Full-scale radio frequency (RF) heating was successfully implemented at a bedrock site impacted by residual 1,1,1-trichloroethane (TCA) dense, non-aqueous phase liquid (DNAPL). Up to 99.9% TCA removal was observed in the source area after three years of RF system operation. Active treatment was suspended in November 2006. ERM is now monitoring the bedrock aquifer as it returns to thermal equilibrium and is evaluating potential rebound of the concentrations of volatile organic compounds (VOCs) in groundwater.

This was the first ever in situ application of RF heating to treat TCA DNAPL in bedrock. In situ RF heating was employed to increase groundwater temperatures, accelerate DNAPL dissolution, and transform TCA into its daughter products through abiotic elimination and hydrolysis.

In RF heating, electromagnetic radiation is directed toward a non-conducting material (e.g., bedrock). The advantage of the RF heating process is that the heat is generated from within the material on the molecular level. Thus, RF heating does not necessarily require as detailed an understanding of hydrogeologic conditions as other remedial technologies. RF heating targets a volume of the aquifer, and its effectiveness is largely unrelated to subsurface stratigraphy and homogeneity.

Groundwater temperatures have declined steadily since system operation was suspended. Unlike other, more common remedial technologies that target DNAPL, rebound of VOC concentrations is not expected to occur with RF heating. Because RF heating is not a “contact” technology, it is expected that there to are no pockets of DNAPL within the treatment zone that have not been affected by the RF system.