Using Controlled Source-Audio Frequency Domain Magnetics for Contaminated Groundwater Site Characterization: A Minimally Invasive Approach

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ABSTRACT

The challenge of obtaining accurate data on the location, shape and flowpaths of subsurface aqueous systems poses the central obstacle to the tasks of preventing and remediating groundwater contamination. It's hard to fix what you cannot see.

Unfortunately, traditional methods for characterizing contaminated groundwater sites require extensive drilling—a time-consuming and expensive process which often yields insufficient information. By contrast, the imaging procedure detailed in this presentation provides exceptionally accurate groundwater maps and models but requires significantly less drilling. As a result, this method entails fewer costs in terms of time, money and ecological disruption. The rapid and less invasive nature of this method suits it particularly well to environmental remediation projects.

This procedure, which uses Controlled Source- Audio Frequency Domain Magnetics (CS-AFDM), begins by charging the groundwater site with a low voltage, low amperage, high frequency electrical current. As the current moves through the groundwater, it emits a magnetic field whose size, shape, magnitude and direction are characteristic of the surrounding aqueous system (Biot-Savart Law). This field is then read at the surface by a specially tuned receiver. The data thus generated can be used to create both two-dimensional maps and three-dimensional models which indicate the attributes of the subsurface water network, including potential flow paths. Such information is of great value in the effort to remediate groundwater pollution.

The images created by this process highlight those locations where the electrical current has concentrated. Because electricity concentrates in areas of highest conductivity, it is reasonable to infer that either these highlighted locations contain relatively large quantities of water or that the water has a relatively high level of Total Dissolved Solids (TDS). Since TDS levels often correspond to the prevalence of contaminants, this feature of the CS-AFDM investigation enhances its suitability for the characterization of contaminated groundwater sites and the identification of pollution plumes.

This technology has recently been deployed in a variety of circumstances, from ecologically sensitive environments in northern California to complex karst terrain in the Midwest of the United States. This presentation will discuss both the science behind the methodology and the lessons learned from its recent applications.