The value of DCIP geophysical surveys for contaminated site investigations

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Geophysical methods are increasingly being used in contaminant hydrogeology to map lithology, hydraulic properties, and contaminant plumes with a high ionic strength. Advances in the Direct Current resistivity and Induced Polarization (DCIP) method allow the collection of high resolution three dimensional (3D) data sets. The DC resistivity can describe both soil properties and the water electrical conductivity, while the IP can describe the lithology and give information on hydrogeological properties.

The aim of the study was to investigate a large contaminant plume discharging to a stream from an old factory site by combining traditional geological, hydrological, and contaminant concentration data with DCIP surveys. The plume consisted of xenobiotic organic compounds and inorganics. The study assesses benefits and limitations of DCIP geophysics for contaminated site investigations.

A 3D geological model was developed from borehole logs and DCIP data as framework for the complex transport pathways near the meandering stream. IP data were useful in indicating the continuity and the changes in thickness of local clay layers between the borehole logs. The geological model was employed to develop a groundwater flow model describing groundwater flows to the stream. The hydraulic conductivity distribution was based on IP data, slug tests and grain size analysis. The distribution of contaminant concentrations revealed two chemically distinct plumes, separated by a clay layer, with different transport paths to the stream. The DC resistivity was useful in mapping ionic compounds, but also organic compounds whose spatial distribution coincided with the ionic compounds. A conceptual model describing the contaminant plume was developed, and it matched well with contaminant concentrations in stream water and below the streambed.

Surface DCIP surveys supported the characterization of the spatial variability in geology, hydraulic conductivity and contaminant concentration. Though DCIP data interpretation required additional borehole data, the DCIP survey reduced the number of boreholes required and helped design field campaigns. The results suggest DCIP surveys are useful and inexpensive tools, which has potential as an integrated part of contaminated site investigations.