The value of DCIP geophysical surveys for contaminated site investigations

Balbarini, Nicola; Rønde, Vinni Kampman; Maurya, Pradip Kumar; Møller, I.; McKnight, Ursula S.; Christiansen, A.V.; Binning, Philip John; Bjerg, Poul Løgstrup

Publication date: 2017

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
The value of DCIP geophysical surveys for contaminated site investigations

N. Balbarini, Technical University of Denmark
V. K. Rønde, Technical University of Denmark
P. K. Maurya, Aarhus University
I. Møller, Geological survey of Denmark and Greenland
U. S. McKnight, Technical University of Denmark
A. V. Christiansen, Aarhus University
P. J. Binning, Technical University of Denmark
P. L. Bjerg, Technical University of Denmark

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.