Cross-borehole electrical resistivity tomography for monitoring in-situ chemical oxidation remediation: Large-scale project at Kærgård Plantation, Denmark.

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Kærgård Plantation is one of the largest polluted sites in Denmark, with over 300.000 tons of pharmaceutical waste dumped in the sand dunes between 1956 and 1973. This site is located near the west coast of Denmark, in otherwise pristine nature.

An initial experiment aiming at cleaning up the plantation, was carried out in 2018, involving in-situ chemical oxidation remediation at a demo site covering 40 m^2. To monitor the spread of the oxidation agent, we used cross-borehole electrical resistivity tomography (ERT). Following the success of the initial experiment, a full-scale remediation monitoring project was implemented over an area of 700 m^2 in December 2019. This time, 30 boreholes, carrying 32 ring electrodes each, were installed, with an average distance of 6 m between boreholes.

New technical and scientific challenges arose with the full-scale project, from the production and installation of electrode boreholes to the data acquisition, processing, and inversion of large resistivity datasets. The oxidation agent was injected over a three-week period in December 2019, with geophysical data collection each day. Data analysis could not be reduced to a few 2D inverse problems, due to the different injection times for a given 2D transect.

We present the acquisition protocol and data handling workflow developed to handle such a dense array of information (more than one million data points per measurement round). By using both vertical and horizontal transects, we also show how time-lapse inversions clearly delineate the spread of the oxidation agent and pinpoint zones with limited spreading.

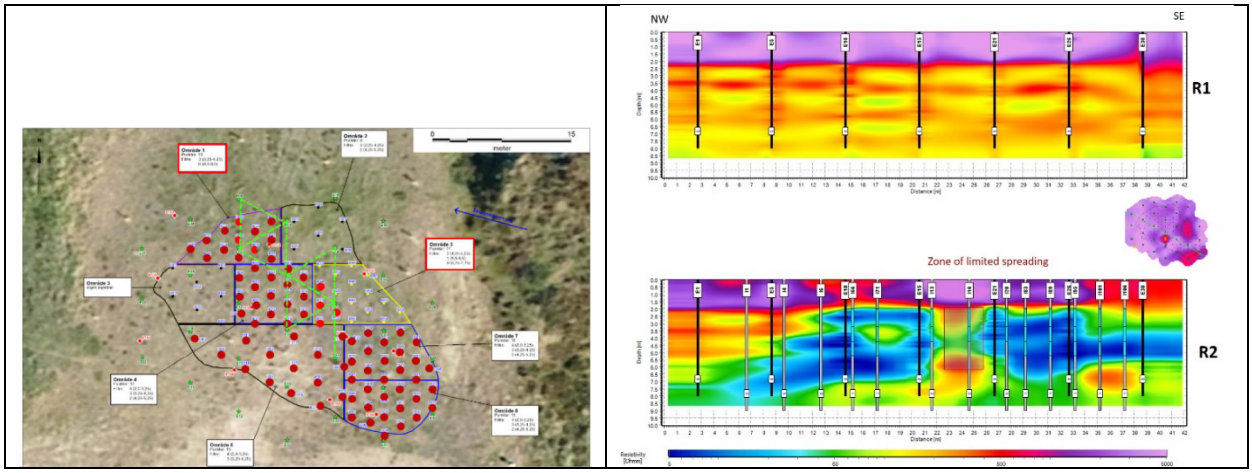

Figure caption: Left showing aerial view of the full-scale site. Right: NW-SE before and after injection. Electrode boreholes and injection wells are also shown.