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Non-invasive monitoring of the degradation of organic contaminants: A laboratory investigation

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Degradation of organic chemicals under various fluid saturation conditions is a process highly relevant to the protection of groundwater quality. Redox potential drives the degradation of organic compounds; its variation affects the water chemistry, gas release and also the geo-electrical signature. This study explores how non-invasive measurements sensitive to geo-electrical properties provides quantitative information about the in-situ redox conditions. Our laboratory experiment focuses on the degradation of de-icing chemicals commonly used, for example, in Norwegian airports.

The experiment was conducted in a number of (1.0x0.5x0.4 m) sand boxes. Two ends of each box was contaminated with propylene glycol, an aircraft deicing fluid. Each source was placed near the water table under static hydraulic conditions. At one side of the tank, a conductor linking the contamination zone, near the water table and the unsaturated zone with a low water content, was placed to improve the degradation by facilitating the electron exchange. At the other side, degradation occurred under natural conditions.

Each box was equipped with 288 electrodes, distributed on six faces to perform 3D resistivity measurements. In addition, self-potential measurements were taken from electrodes on the sand surface. Four observation wells were installed above and below the water table to provide more information on the degradation processes. Moreover, measurements of carbon dioxide on the surface were performed as higher concentrations were expected where the pollutant degraded.

We would like to present and discuss a selection of the preliminary results of 3D electrical resistivity and self-potential techniques from our laboratory setup.