

SULFURIC BLACK SHALES IN A LANDFILL – A COMBINED TIME DOMAIN SPECTRAL INDUCED POLARIZATION AND GEOCHEMICAL APPROACH TO MAP AND QUANTIFY AN ENVIRONMENTAL RISK, A CASE STUDY FROM THE OSLO GRABEN (NORWAY)

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A combined ERT-IP geophysical and geochemical survey was carried out in the Oslo graben to map the (unknown) extent and amount of black shales in a landfill. Black shales are organic mudrocks which were deposited in the early Proterozoic. Alum shale is a specific type of black shale that is particularly demanding due to its chemical composition and occurs in an up to 160 m thick layer in southern Scandinavia, among other places in the Oslo graben. It contains high concentrations of sulfuric minerals and uranium concentrations up to 200 mg/kg due to its anoxic deposition conditions (Nyland & Teigland 1984). These deposits are a potential threat to groundwater resources when exposed to oxygen and water, leading to a so-called acid rock drainage. Since the landfill is located in the biggest Norwegian groundwater basin the Norwegian Environmental Agency insisted on a risk analysis to evaluate the potential threat of this site.

In total ten ERT-IP profiles were conducted to pinpoint the subsequent drilling campaign. For our modelling of the volume we relied on the stabled algorithm from Res2Dinv (Loke, 2016) using the L1 regularization and calculation of integral chargeabilities. For more advanced modelling and a parameter study the decay data was processed in Aarhus Workbench considering L1 and L2 regularization and different waveforms in the range of 1-2,4 s. Due to their abundance in the Oslo graben a better understanding is necessary to quantify the polarization properties with non-invasive methods and decrease interpretation uncertainties while optimizing the best Signal to Noise ratio under the constraints of a commercial survey. The results of the drillings and geochemical analyses verified the geophysical anomalies and it was possible to delineate the volume of black shales in the ground.