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Geoelectrical time-lapse analysis for improved interpretation of data in a contaminated area

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Non invasive geoelectrical studies are useful in the preliminary assessment of areas suspected to be contaminated but also in the investigation stage. Correctly adapted to the site specific situation, they are used to detect and investigate buried sources of pollution, to characterize the geology of the area, to detect the contaminated plume or to study the attenuation of pollution in case the appliance of an site-specific remediation techniques.
Despite the improved technological acquisition techniques and the optimized inversion data algorithms, interpretation of geoelectrical data in still a challenging task, especially in a contaminated hydrogeological context. Beside the soil physical properties (composition, porosity, texture, etc.), moisture content and chemical composition of the pollutant are also influencing the measured parameter.
Apparent electrical resistivity method was use in an area located near an Oil Refinery. Electrical measurements performed on profiles (transverse and along the direction of water flow -according to hydrological data) revealed the presence of contaminants by means of high resistivity anomalies.
Using the same acquisition technique (Schlumberger array, same VES points, injection - AB - and voltage - MN - lines extension), measurements were repeated during time, along the same profiles. On the resulted electrical sections from 2006 to 2013, a dynamic situation regarding the pollution plume was observed.
Time – lapse analysis, based on the calculation of resistivity differences between sets of data acquired along the same profile was applied, and data interpretation was made using the resulted sections. Significant variation between data sets (> 17% of apparent resistivity normalized differences) observed along the main profile were mainly ranging from the near surface (1.5 m) to an approximated depth (AB/2) of 10m.
Using the time-lapse method, changes in the lateral and in depth extension of polluted areas could be observed and quantified. This type of data processing revealed also an anomalous situation beneath VES #11 station, observed as a low resistivity anomaly. Changes in local apparent resistivity extended in depth to an AB/2 of 50m (maximum depth of investigation reached in this study). It was interpreted as a consequence of changes in soil porosity and humidity, caused by a fault.

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