

# Three dimensional resistivity model for leachate plume detection

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## Summary

Results from a series of resistivity measurements conducted on the Filborna landfill in South-western Sweden are displayed with help of a three dimensional model. The model results are interpreted with the aid of previous results from borehole analyses. Three dimensional modelling proves to be a useful tool to summarize series of resistivity profiles and to enhance interpretability. Results can be used to depict potentially leachate affected ground.

## Introduction

Due to its non-invasive character and the costs and difficulties of drilling boreholes, resistivity measurements and their imaging have become a popular investigation method for the detection of landfills and landfill leachate plumes (Bernstone and Dahlin, 1997, Cardelli et al., 2004, Rosqvist et al., 2005). Other advantages of resistivity measurements are that comparatively large areas can be covered, and that neither trace substances nor physical-chemical analyses are required. Drawbacks of resistivity measurements are the difficulties of interpreting resistivity responses without knowledge of the geological and geohydrological properties of the material investigated. What is more, usually the results are presented in two dimensions, which makes it difficult to get a wholesome picture of the ground investigated. Numerous resistivity profiles can, however, be compiled in a three dimensional model. This might enhance interpretability of, for example, the spread of anomalies in the ground, such as filling materials (waste), or the spread of a landfill leachate plume in an aquifer. In this work, the three dimensional model of a series of resistivity measurements just outside a landfill in Sweden is presented and discussed.

## Material and methods

The Filborna landfill is run by NSR (Nordvästra Skånes Renhållnings AB – regional waste management company in the northwest of Scania), and situated in the Southwest of Sweden. Besides sorting, storage and treatment of municipal and industrial waste, both household and industrial wastes have been deposited at the Filborna site. The landfill and its surroundings have been extensively investigated with both drilling of boreholes and subsequent sampling, as well as with resistivity measurements (Jönsson, 2002). Twenty resistivity profiles are included in the three dimensional model presented here (Fig. 1). 20 000 data points from resistivity profile analyses were applied with coordinates and used in the model. The model was created with the interpolation method 3-D kriging.

## Results and discussion

Large deviations in the underground are indicated by the 3-D model (Fig. 1). Blue represents values below 20  $\Omega\text{m}$ , green to orange values between 20 and 100  $\Omega\text{m}$ , and red values exceeding 100  $\Omega\text{m}$ . Areas indicated by A, B, C, and C' are interpreted separately.

Resistivity responses are dependent on the grounds geoelectrical properties, such as porosity, water content and, in particular, the porewater's electrical conductivity. What is more, resistivity is influenced by clay and mineral content.

From earlier geological surveys the depth of the bedrock and partly its properties are known. The same is true for glaciofluvial deposits on top of the bedrock. Both bedrock of loam-sandstone type and glaciofluvial deposits are expected to produce relatively high resistivity responses, due to the materials porosity and water content.

Relatively lower resistivity values can be interpreted as either clayey material or leachate pollution. Due to the results of borehole analyses and the form of the low resistivity plumes (<10  $\Omega\text{m}$ ) in the South-eastern part of the investigated area, these are interpreted as being affected by leachate.

In this project three dimensional modelling enhanced the perception and interpretability of resistivity data. Especially with repeated measurements and the conduction of time series in the future, the potential leachate plume can be further discerned from low resistivity solid materials.

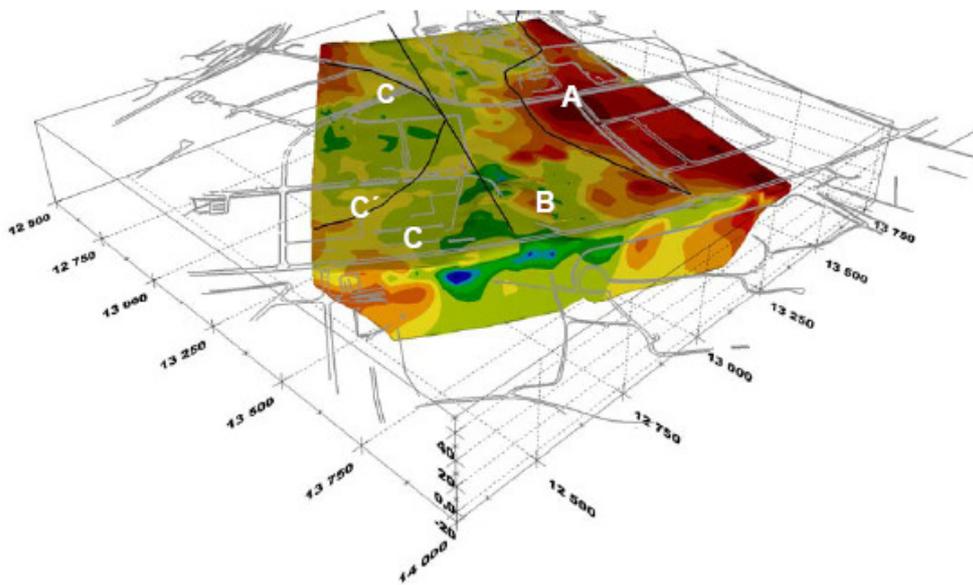


Fig 1: Three dimensional model of the area west of the Filborna landfill

## References

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