# DUMPSITE CHARACTERIZATION USING GEO-PHYSICAL METHODS: CASE STUDY AT WASTE DEPOSIT SITE NEAR COLOGNE CITY, GERMANY.

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## Introduction

Buried waste sites are considered as one of the most important and serious environmental problems. During the last few decades, household refuse, building debris and dangerous industrial waste were put in small gravel pits. Generally, this process has happened in an uncontrolled manner with little or no documentation and without any indication on the surface. These kinds of waste sites constitute a serious risk for the environment and can represent a main source for groundwater contamination. The investigated waste site is found in an area close to Cologne city, Germany. The study made use of two geophysical techniques; magnetic and ERT. Four 2D-ERT profiles (Fig. 4) were designed based on the results of the magnetic survey to perform the geoelectrical measurements.

## Geology of The Study Area

The geological information of the area where the waste site located was inferred from a geological cross-section passing about 1 km to the west of the site (Fig. 1). The lithology of the area includes the topmost thin surface Pleistocene/Holocene floodplain fines layer with a thickness of 2 to 3 m overlying a Pleistocene gravely sand layer with a depth of approximately 18 m to 25m. Tertiary sand, clay and brown coal layers constitute the base of the sequence. The groundwater table is on an average depth of 10 m.

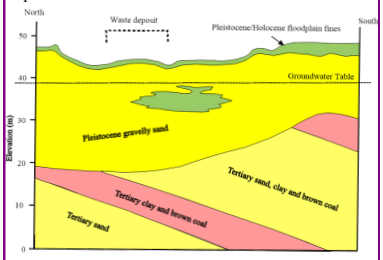


Fig (1) Geological cross-section close to the waste deposit site.

## Magnetic Survey


Fig. 2 GSM-19T Proton Magnetometers in Gradiometery configuration and base station mode.

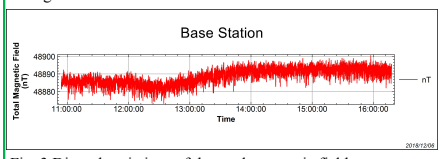


Fig. 3 Diurnal variations of the earth magnetic field.

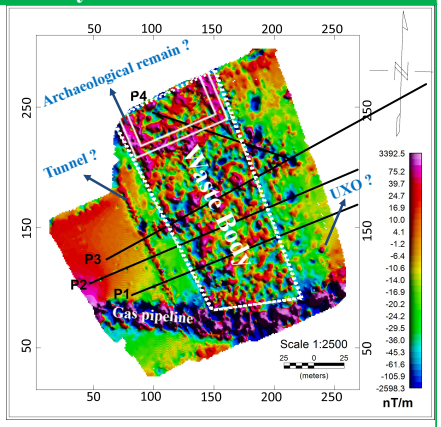


Fig. 4 RTP vertical gradient magnetic map of the study area. Black lines refer to the locations of the 2D ERT profiles.

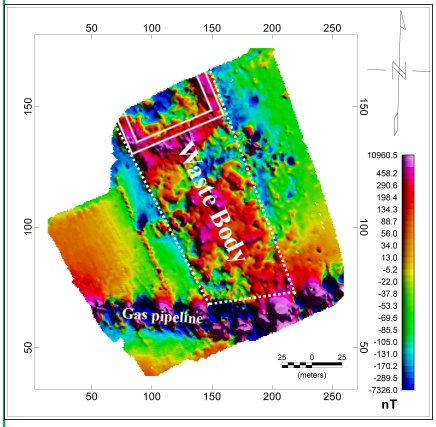


Fig. 5 RTP magnetic map of the study area (Lower sensor).

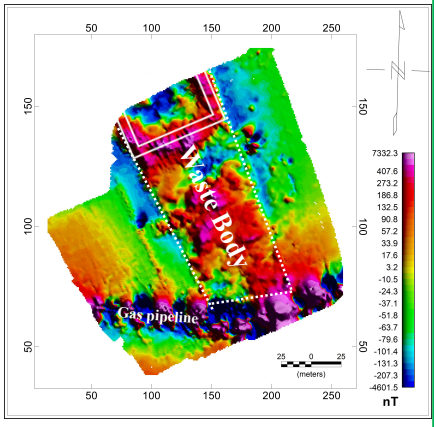


Fig. 6 RTP magnetic map of the study area (upper sensor).

## ERT Survey

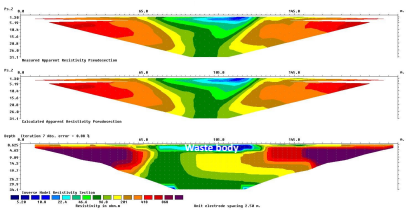


Fig. 7 2D ERT inversion results along profile P1.

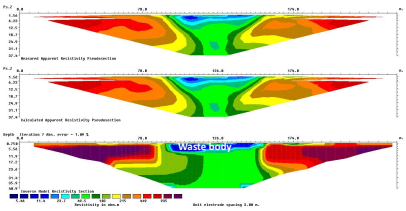


Fig. 8 2D ERT inversion results along profile P2.

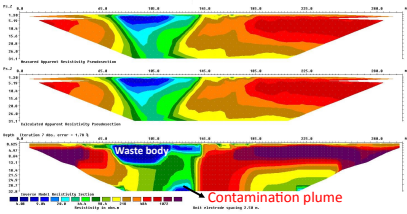


Fig. 9 2D ERT inversion results along profile P3.

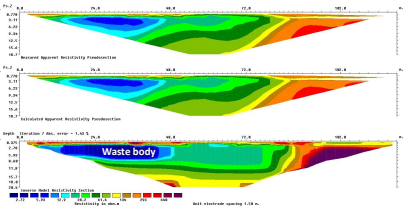


Fig. 10 2D ERT inversion results along profile P4.

***Acknowledgments:*** *The authors would like to thank the Volkswagen Foundation for funding the present project.*

## Summary and Conclusions

The present study was able to determine the geometry of the waste body within the investigated area by using the integration of magnetic and ERT geophysical methods. The magnetic results produced the utmost significant contrast between the waste ferromagnetic materials and the hosting layer. They clearly determine the horizontal boundaries of the waste deposit where its average length is 190 m and its width varies between 72 m at the southern part and 95 m at the northern part. Very high local magnetic anomalies were observed outside the waste site indicating either metallic bodies on the surface or possible bombs in the subsurface from the Second World War. The track of the gas pipe lines to the south of the landfill was also determined with high resolution. Delineation of the lateral boundaries as well as the bottom of the dump constitutes the main achievements of the ERT technique. A good coincidence between the two methods in determining the surficial boundaries of the waste site was noticed. The waste body has very low resistivity values (less than 15 Ω.m) comparing to the very highly resistive host formation (they reach more than 1100 Ω.m) which helps to image the geometry of the landfill. The application of the ERT method was success not only in identifying the base of the waste body but also in imaging the potential flow direction of contamination plumes (leachates) towards the underlying formations (See Fig. 9). The depth range to the base of the waste body is 6 m to 14 m .