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Application of geophysical method to delineate contamination in waste disposal site of Ampar Tenang, Dengkil, Selangor D.E.

ABDUL RAHIM SAMSUDIN, UMAR HAMZAH, WAN ZUHAIRI WAN YAACOB, BAHAA-ELDIN ELWALI ABDEL RAHIM AND LOH YEAN SZE

School of Environment and Natural Resource Science, Faculty of Science & Technology
Universiti Kebangsaan Malaysia, Bangi, 43600, Selangor D.E.

Abstract: A geophysical survey was conducted to investigate contamination in a domestic waste-disposal site, at Ampar Tenang, Dengkil, Selangor. The objectives of the survey were to delineate and identify pathways for contaminant migration. Surface geophysical method employing 2-D DC resistivity imaging technique was used to locate potential leachate plumes. A total of six lines of 2-D resistivity images were established with three of them located on the waste pile while the other three situated outside the boundary of the dumping site. The objectives were successfully met, including delineation of buried waste and identification of the positions of contaminated subsurface soil and groundwater. In general the result of the survey shows that the resistivity value of the decomposed waste material is relatively low compared to those of the uncontaminated soil outside the dumping site. The electrically conductive anomaly on the dumping site was interpreted as leachate plumes which appears to have seeped at depth as far as 20 m below surface. Near surface low resistivity layer observed on the area east of the dumping site is interpreted to be associated with leachate runoff.

INTRODUCTION

The main environmental problem of waste dumping sites is the potential risk of groundwater pollution and subsequent influence on surface water quality. The total pollutant load to the environment is dependent on the quantity and quality of the water that percolates through the disposal site and reaches the groundwater (Bengtsson *et al.*, 1994). Waste disposal sites can seriously affect local wells and drilled holes used for public water supply and therefore, their locations must be planned and monitored carefully (Matias *et al.*, 1994).

Solid waste land disposal sites can be sources of groundwater contamination and the contamination problems are more likely to occur in humid areas, where the moisture available exceeds the ability of the waste pile to absorb water. In tropical country like Malaysia which is characterized by high rainfall, the problems of contamination are expected to occur.

Solid waste in developing countries is generally disposed of in uncontrolled open dumps. The environmental consequences of such inadequate disposal sites are often quite evident, yet necessary improvements are seldom dealt with. The most common practice for disposal of solid domestic wastes in Malaysia was depositing in open dumping areas. These areas are vulnerable to ground and surface water pollution. The seriousness of the problem is still unknown and specific detailed study is generally needed.

This paper describes results of the geoelectrical resistivity imaging carried out within and around the Ampar Tenang waste disposal site in Dengkil, Selangor. The objectives of the survey were to delineate and identify pathways for contaminant migration.

MATERIAL AND METHODS

The resistivity of the subsurface material can be measured by injecting a small current into the ground through two electrodes and the resulting voltage on the ground surface is measured at two potential electrodes. By varying the spacing between the electrodes, as well as the location of the electrodes, a 2-D electrical resistivity image of the subsurface can be obtained. The 2-D electrical imaging survey was carried out with a SAS1000 resistivity meter and Abem LUND ES464 electrode selector system. This system was connected to a total of 61 steel electrodes which were laid out on a straight line with a constant spacing via a multicore cable. The resistivity unit automatically selects the four active electrodes used for each measurement. The Wenner equal spacing electrode array was used for this survey. The measured resistivity data were interpreted using the RES2DINV inversion software (Loke and Barker, 1995). Details about the survey and interpretation method can be found in the papers by Keller and Frischknecht (1966), Griffiths *et al.* (1990), Griffiths and Barker (1993), and Loke and Barker (1996).

The resistivity of the subsurface materials depend on several factors such as the nature of the solid matrix and its porosity, as well as the type of fluids (normally water or air) which fill the pores of the rock or soil. In general, rock and dry soil have high resistivities of several hundred or thousands ohm-meter. Unconsolidated water saturated soil and clay material have relatively low resistivity values of generally below 1,000 ohm-m. The resistivity of sediments below water table is normally controlled by the resistivity of the groundwater which depend on the concentration of the electrolytes present. Fresh ground water generally have resistivity values of about 10 to 100 ohm-m.

RESULTS AND DISCUSSION

A total of six lines of 2-D resistivity images were established with three of them located on the waste pile while the other three situated outside the boundary of the waste disposal site (Fig. 1). Figure 2 shows the inversed resistivity models of the three resistivity lines (Profiles 1, 5 and 6) measured on the top of the waste pile. The resistivity image of profile 1 shows that the decomposed waste with highly conductive leachate has resistivity less than 2.5 ohm-m. The electrically conductive anomaly on the dumping site was interpreted as leachate plumes which appears to have seeped through the underground soil at depth as far as 20 m below surface (Profile 5). The 2-D image of the resistivity also shows that the thickness of the decomposing waste is slightly more than 10 meters (Profile 6) and this agrees well with the actual height of the waste pile observed in the field.

Three other resistivity sections (Fig. 3) were measured around areas outside the boundary of the waste disposal site. The northern and western areas of the waste disposal sites are bounded by man-made drain. The 2-D resistivity sections show that, in general the soil surrounding the dumpsite has relatively high values (Profiles 2 and 3)

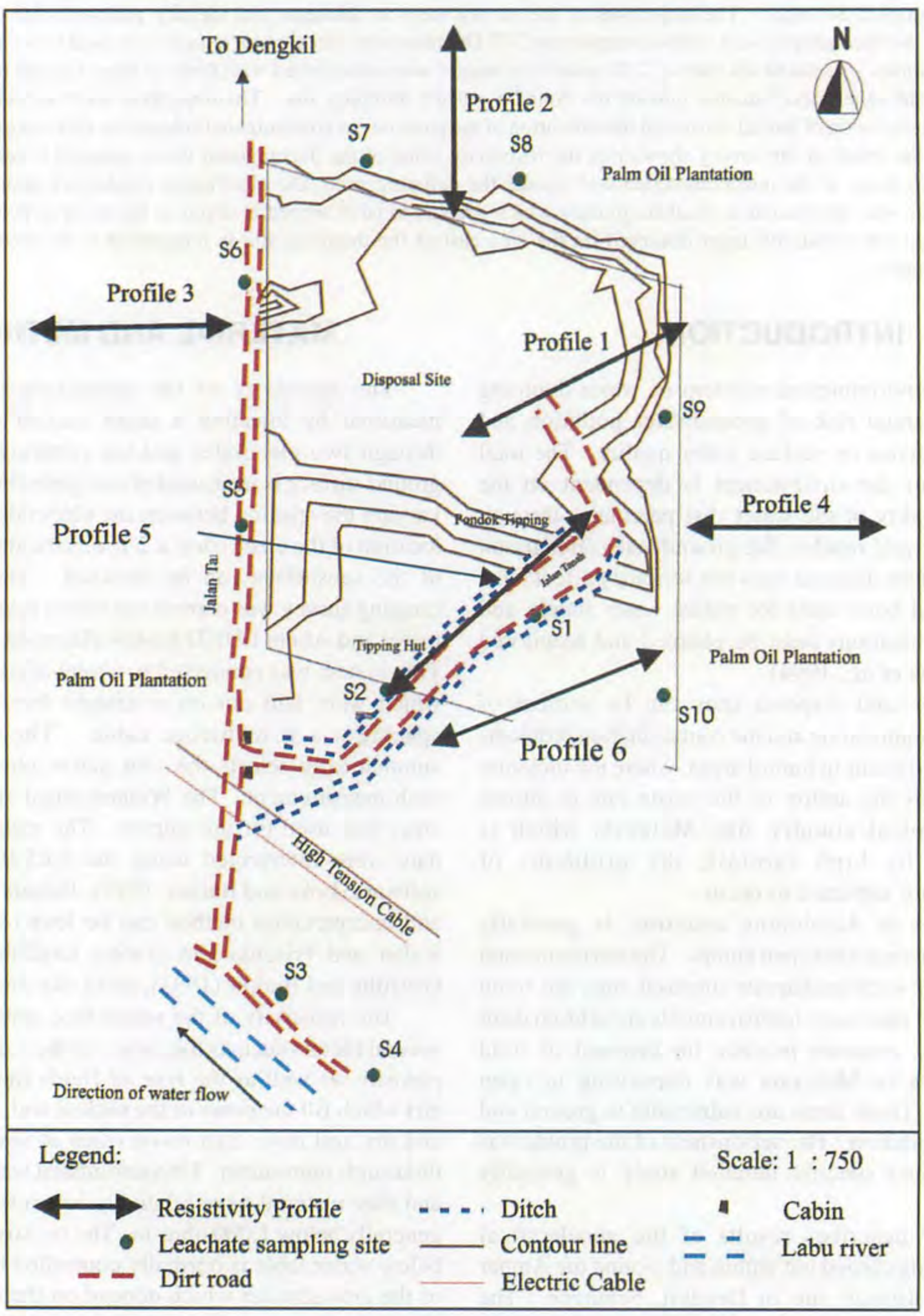

Figure 1. Map showing location of the waste disposal site, resistivity profiles and leachate sampling sites.

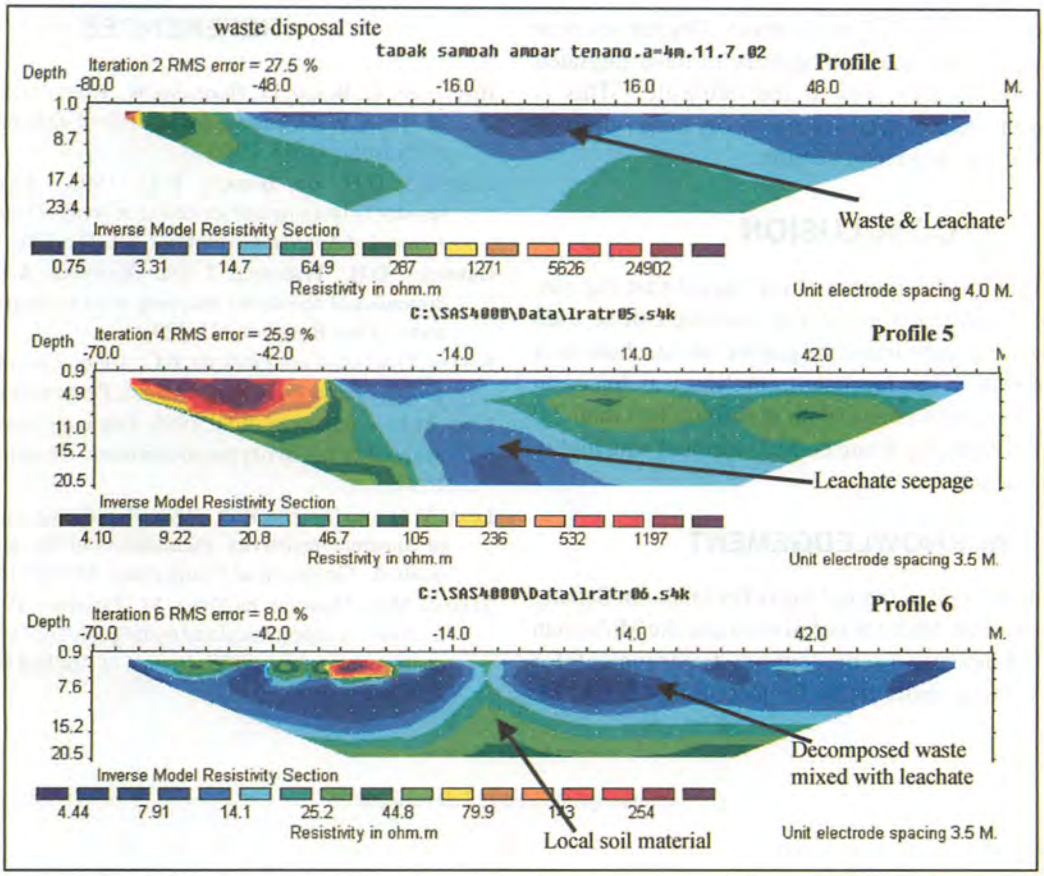

Figure 2. 2-D resistivity inversed models for profiles 1, 5 and 6 measured within the waste disposal site.

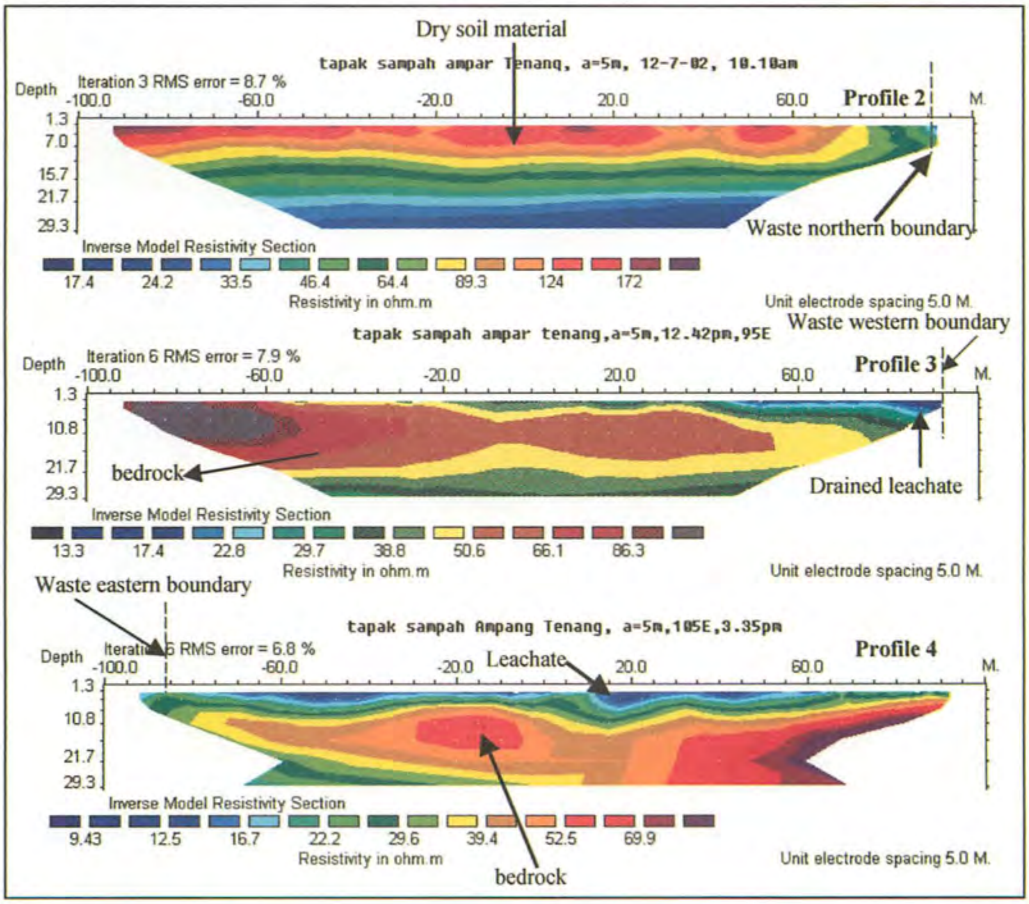

Figure 3. 2-D resistivity inversed models for profiles 2, 3&4 measured around the waste disposal site.

which suggests that it is not much affected by the leachate runoff. However the leachate appears to have migrated outside into the eastern area of the dumpsite. This is illustrated by the near surface low resistivity layer observed on Profile 4 of the resistivity section.

CONCLUSION

The results of the present study reveal that the two dimensional geoelectrical resistivity imaging can be used to investigate the subsurface migration of leachate at a suitable dumpsite. The leachate migration was traced in form of low resistivity zones (with resistivity less than 2.0 ohm.m) of decomposing waste bodies saturated with highly conductive leachate.

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