Determination of Soil Overburden on Panirendawa Iron Ore Deposit for Selection of Appropriate Mining Method/s

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Abstract: Panirendawa iron deposit consists of four isolated deposits namely A, B, C and D. The deposit D has potentially high magnetite concentration according to previous data. The main objective of the study is to carry out an electrical resistivity survey to determine the overburden thickness of the deposit D using the SAS 1000 Terrameter. Vertical Electrical Sounding (VES) was carried out at ten different locations around the deposit D. A single line parallel to strike was surveyed with six points of equal depth to the bed rock and the other two lines (west to east) were parallel to the dip as depth increases. The observed data were interpreted using the IX1D Interpex software in to 1D and 2D formats to identify the underground layers/stratification with reference to the apparent resistivity values. The survey was preceded with mean depth about 6.5m of surface layer having about 1000Ωm apparent resistivity overlying on a water baring surface with a mean thickness about 35m having about 10Ωm apparent resistivity; also about 41m below, the bed rock stood with an apparent resistivity about 4450Ωm. According to present study, the most possible mining method would be underground mining.

Keywords: Magnetite, overburden, stratification, Terrameter, VES method

1. Introduction

Iron is considered as the most utilizing metal on the earth and is used in construction, oil and gas industries and products such as machinery, industrial equipment and electrical appliances etc. Thus, iron has been extensively mined throughout the world, in large quantities, to cater to the increasing demand. Hydrated iron oxide (Dela), copper-magnetite deposit (Seruwawila) and magnetite (Panirendawa) are well known iron ore deposits found in Sri Lanka. This project was carried out on Panirendawa magnetite deposit. Panirendawa is situated in the western province, about 50km north of

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Colombo. Panirendawa iron deposit consists of four isolated deposits namely A, B, C and D (Herath, 78-86). The deposit D has potentially high magnetite concentration. Panirendawa magnetic iron ore has recorded around 73.21% of Fe_2O_3 and a total tonnage more than 6million tones (Herath, 1985). The D deposit of Panirendawa iron ore was selected, because it has the highest tonnage and the lowest overburden thickness, compare to other three blocks, which make economically attractive to the deposit in Panirendawa. According to previous bore-hole data, the thickness of the magnetite deposit varies from 0.4m to 10m approximately with a depth around 45m to 120m (Herath, 1985).

The main objective of the project was to determine the soil overburden thickness of the iron ore deposit, which would be useful for the future proposal of a mining method to extract the ore body.

2. Methodology

2.1 Preliminary Investigations

A preliminary investigation and a reconnaissance survey were carried out at the vicinity of Panirendawa area to demarcate the deposit D and to get an overview of the available data in maps and reports. Based on the accessibility and practical scenario survey lines and resistivity points were selected on the deposit. A straight line of zero degree azimuth was set as the base line for six midpoints having 50m spacing between two consecutive points and four other locations were chosen scattered over the deposit. Further an overall idea was generated regarding the topography of the surrounding area by visual inspection.

2.2 Data Collection

Schlumberger Electrical Resistivity method was carried out with the deep penetration resistivity meter (ABEM Terrameter SAS 1000) which has an output sufficient for a current electrode separation of 2000m under good surveying conditions. The depth measurement was carried out using the resistivity survey method. The selected resistivity survey method is the Schlumberger configuration (Fig.1) which was recommended as the most suitable configuration for vertical resistivity survey.

The maximum electrode spacing was kept at 400m in order to get a penetration depth of around 130m. About thirty vertical electrical

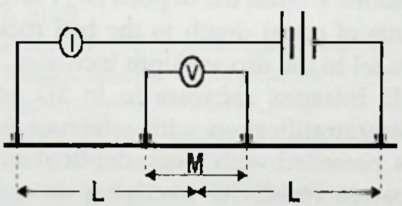

Figure 1-Schlumberger Configuration

soundings were taken at each location. The respective apparent resistivity values were recorded and interpreted in-situ for clarity and reliability of data.

2.3 Plotting and Interpretation

Resistivity data were plotted and interpreted for 1D and 2D profiles with Interpex IX1D software. Interpreted data were clarified with the use of available drill-hole and other previous project data while the water table was defined by tallying the interpreted data with dug water wells situated around the deposit.

The resistivity profiles were interpreted keeping the RMS (Root Mean Square) error less than 5 percent. The anomalous data records have neutralized by using the 'Masking' function in the Interpex software. In addition, Surfer 8.0 was used to interpret the surface topography of the area.

3. Results and Discussion

Table 1 - Average apparent resistivity values and depths

Point	Apparent Resistivity(Ωm)			Depth(m)	
	T/L	W/S	B/R	T/L	W/S
1	933.46	9.76	4441.10	6.57	40.93
2	891.86	10.52	5322.20	6.39	41.96
3	906.00	10.04	3986.00	6.80	39.58
4	898.04	9.83	5966.00	6.32	40.42
5	998.56	10.04	4795.60	6.61	41.13
6	937.09	10.58	5112.60	6.37	40.94
7	943.83	38.55	3910.20	9.00	56.04
8	1016.70	35.82	4113.50	8.37	50.28
9	1296.40	24.00	4596.10	8.36	50.73
10	1224.90	36.06	5075.20	8.81	56.11

(T/L, W/S and B/R where (Top Level), (Water Saturated area) and (Bed Rock)).

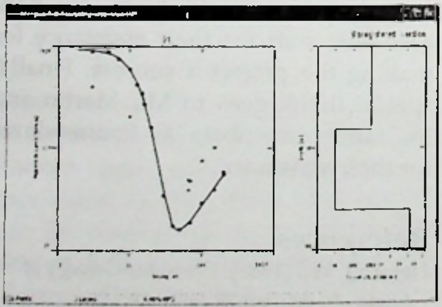

Figure 2 - 1D Curve at Point-01

At first six points, the average depth is about 40.83 m to the bed rock and about 6.51 m to the water table. The average resistivity of each layer is 927.42 Ωm, 10.13 Ωm and 4937.25 Ωm respectively for T/L, W/S and B/R. The average depth to the bed rock at points 8 and 9 is about 50.5m and at points 7 and 10, it is about 56.5m.

Some of the data points have deviated significantly from the best possible curve drawn by the Interpex software (Fig.2), mainly due to seasonal changes of weather, existing boulders in the area and hard rock fractures. Those 'Anomalous Readings' were masked to reduce the RMS error as they would account for the major portion of the RMS error of a particular graph. Some negative readings were recorded at few specific locations, which occurred due to poor electrode grounding, dried ground condition, influence of close by objects such as iron slag, steel pile, higher noise level than signal level and existence of permeable soils etc. To prevent some of those problems, the burial locations of the electrodes were soaked with salt water and more attention was given to electrode grounding. The layer interpretation was highlighted using 2D modelling. Results suggest that, 2D modeling gives promising results when VES point spacing is lower than the spacing used here.

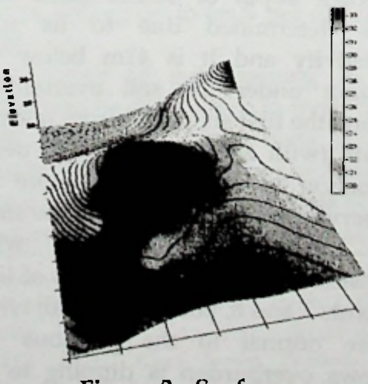

Figure 3 - Surface Topography of Deposit D

The surfer 8.0 was used to interpret the topography of the deposit D using previously surveyed elevation data (Fig.3).

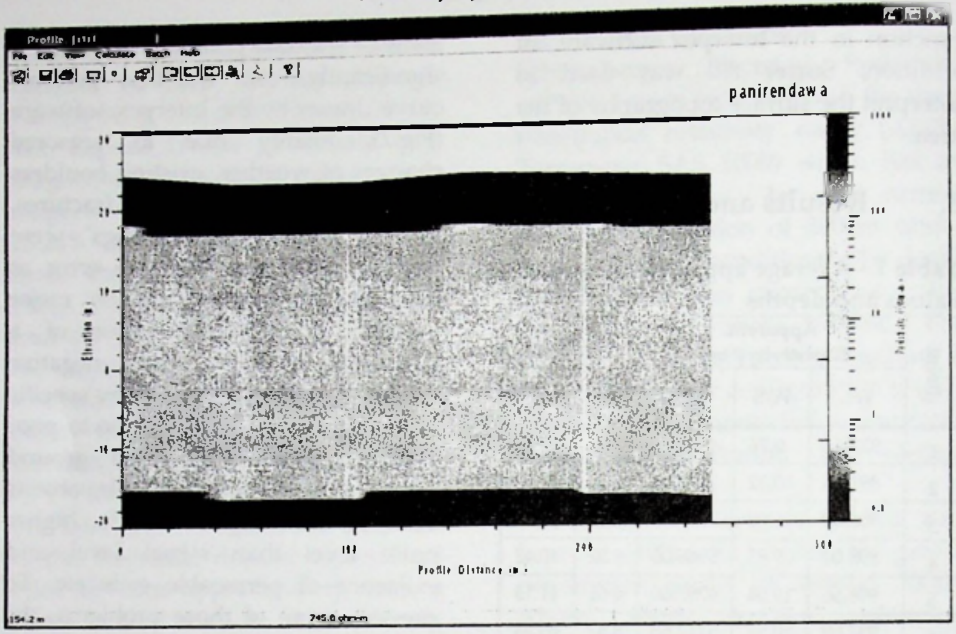

Figure 4 - 2D Plot with Point-01 to Point-06

4. Conclusions

Basic findings of the project distinguished a vertical profile of three layer model at Panirendawa iron ore deposit "D". Out of these three layers, the water table was identified at an average depth of 6.51m. Hard rock was determined due to its high resistivity and it is 41m below the surface under the soil overburden. Along the first six points from north to south (with zero azimuth), the depth variation is minimum therefore the observed line has to be along the strike of the bed rock. Also when considering the other two sets of lines (points 7 and 8, points 9 and 10) which were normal to the previous line shows overburden is dipping to the east. The bed rock follows the same orientation.

Also there is an overburden thickness about 41m. So the most applicable mining method according to the gathered data was concluded as an underground method.

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