REPORT ON

HYDROGEOLOGICAL STUDIES AND GEOPHYSICAL INVESTIGATIONS OF SITING FOUR (4) No. BOREHOLE FOR MECHANISATION AT AFRCAN MINERALS WORK SITE, FERENGBEYAH-TONKOLILI DISTRICT

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DECEMBER, 2010

1. INTRODUCTION

African Minerals Limited Work Site is located at Ferengbeya in the Tonkolili District of the Northern part of Sierra Leone. The authorities in charge of the Mines Site want to explore the possibility of getting good source of groundwater for both commercial and domestic use.

In the quest to search for sustainable aquifer, the authorities of the site engaged Edal Consult & Drilling Company Limited to undertake Hydrogeological Studies and geophysical investigations of four (4) No. borehole at the site.

The studies were, among others, to provide enough data and information to be used in assessing the possibility of striking fresh underground water in the alternative of a borehole at the site. This report documents the work carried out at the site between December 3, 2010 and December 4, 2010

2. BACKGROUND OF THE STUDY AREA

Background information was obtained by means of a study consisting of the acquisition of previous work (Geophysics, Drilling logs, Geo-electrical logs of the area) carried out in and around the study area, geological and Topographical Maps of the area. Based on that, a siting strategy was deployed.

Geologically, the area is composed of the Kambui Group which is Amphibolite grade Archean greenstones comprising metasediments including banded iron formation, mafic volcanics and ultramafic Schists.

Hydrogeologically, the greenstone belt of this formation is interpreted to hold good to reasonable yield prospectivity.

3. FIELD WORK

3.1 Field Reconnaissance Survey

The aim of the reconnaissance survey was to select target areas for geophysical survey. The field reconnaissance survey was undertaken together with Mr. Peter Erasmus (S.A), few hours before the survey, and the activities that were carried out involved;

- Geomorphologic survey of areas not identified during desk study but could be significant in hydrogeological studies; and
- Demarcation of area for traverse lines for geophysical survey.

3.1.1 Selection of Traverse Lines

Traverse lines were run on the basis of geomorphologic and physical features such as vegetation, stream direction as well as any significant hydrogeological features encountered in the premises. The traverse lines were perpendicular to the major strike direction of the geological formation of the area.

Four (4) traverse lines were run in the NE-SW and NW-SE direction. The rationale behind the selection of these traversing trends was to intercept the major trends of NW-SE and NE-SW fractures in the area.

3.2 Geophysical Survey

The Geophysical survey consisted mainly of Electrical Resistivity Profiling and Vertical Electrical Sounding (VES) using SAS 1000/4000 DZD 6A Multifunction Electrical meter.

3.2.1 Resistivity Profiling

Resistivity Profiling were carried out along the traverse lines using the recommended Schlumbeger configuration. Two depths of 19m and 40m were investigated, using the electrode separations of (L/2, a/2) given by 19m, 0.5m and (40m, 5.0m). The electrode separations (19m, 0.5m) and (40m, 5.0m) were assumed to probe the weathered layer and Bed rock respectively (WRRI, 1994).

3.2.2 Selection of VES Points

The profiling results were plotted on a linear scale, and preliminary interpretation was done on the field to select the best anomalous points for Vertical Electrical Sounding (VES). The VES points were restricted to areas where relatively lower apparent resistivities were recorded on the horizontal profile.

Seven (7) anomali points were selected altogether for VES on the four profile lines. The VES points are marked with inscription on pegs at the various sites.

3.2.3 Vertical Electrical Sounding (VES)

Vertical Electrical Sounding (VES) was carried out with the aim of determining the formation resistivities and the depth to bedrock, as well as finding the possibility of obtaining fracture at depth the sounding points.

The Schlumberger electrode configuration and the expanding procedure were used for the VES. Data control was ensured by plotting the VES results on the field as VES measurements were in progress. Unreasonable values that registered high standard deviation (sd) greater than unity were rejected and sounding repeated at the same spot several times until reasonable values were recorded. Changing the position of the electrodes and varying the current input ensured this.

4. DATA ANALYSIS AND INTERPRETATION

4.1 Geophysical Survey

The electrical resistivity profiling results and its corresponding response curves are presented in Fig 1A---1D, whiles the Vertical Electrical Sounding results and corresponding curves are presented in Fig 2A---2G.

4.1.1 Resistivity Profiling

The interesting feature of resistivity profiling interpretation is the identification and selection of anomalous points or zones. On the average, the measured apparent resistivity values for the (19m, 0.5m) and (40m, 5.0m) were medium-high. Values ranging between 294 ohm-m and 171368 ohm-m, and averaging 80171ohm-m were recorded.

The general medium-high resistivity values recorded in the area could indicate shallow overburden thickness and slight weathering as well as fracture development conditions in the area. The groundwater potential in this is considered reasonable to high.

The measured apparent resistivity values range between 294 ohm-m and 17,1368 ohm-m with a mean of 80171 ohm-m for the (19m, 0.5m) separation. For the (40m, 5.0m) separation, the measured apparent resistivity values were in the range of 398 ohm-m and 5715ohm-m with a mean of 3438ohm-m. In general, high resistivity values were recorded with the (40m, 5.0m) than the (19m, 0.5m) separation along the traverse. Well-defined anomalous points of low resistivity values were selected for Vertical Electrical Sounding.

4.1.2 Vertical Electrical Sounding (VES)

Based on the results of the resistivity profiling, the points A30, B30, B90, C50, C100, D40 and D90m were selected for VES. The VES results and response curves at the points are presented respectively in Fig 2A----2G. The interpretation was carried out using the RESIST software/ GeoVES

4.2 Selection of Promising Points

The selected points for test drilling at AML Works Site been done by considering the thickness of the various layers of the subsurface structure and their corresponding apparent resistivity from the analyses of VES results as well as the behaviour of the anomalous points during the profiling.

Table 1: The rank list of VES points in order of preference for test drilling

RANK	VES POINTS	LAYER	DEPTH (m)	THICK-NESS (m)	APPARENT RESISTIVITY (Ohm-m)	POSSIBLE WATER ZONES (m)	TEST DRIILING RANKING	MAX DRILLING DEPTH (m)
1	A30/S1	1 2 3	0.5 7 -	0.5 6.5 -	140 3200 600 -	10-20 25-35	3rd	60
2	B30/S2	1 2 3 4 5	0.5 6.0 7.0 9.0 -	0.5 5.5 1.0 2.0 -	1500 3400 500 40 800 -	10-20 30-45 55-65	1ST	70
3	B90/S3	1 2 3 4	0.6 5.6 6.6 -	0.6 5.0 1.0 -	70 2550 20 600 -	15-25 35-50	4th	60
4	C50/S4	1 2 3 4	2.0 16.0 36.0 -	2.0 14.0 20.0 -	1100 7500 5000 1400 -	35-40 55-65	5th	80
5	C100/S5	1 2 3 4	2.0 8.0 19.0 -	2.0 6.0 11.0 -	1100 815 3000 7400 -			
6	D40/S6	1 2 3 4	0.2 22.2 29.2 -	0.2 22.0 7.0 -	3000 8300 2100 80 -	30-40 50-60	6th	70
7	D90/S7	1 2 3 4	0.5 14.5 34.5 -	0.5 14.0 20.0 -	2800 7500 5000 1000 -	35-50 60-75	2nd	80

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Based on the analyses of the entire results, and in line with the aims of the study, the drawn conclusions are;

- ♣ the study area is composed of the Kambui Group
- ♣ the formation has undergone various degree of weathering which control groundwater occurrence and accumulation.
- ♣ Groundwater potential could be good - reasonable.

5.2 Recommendation

In this regard, it is recommended that,

- ♣ test drilling could be out at **B30/S2, D90/S7, A30/S1 & C50/S4** with the others as alternative to confirm the existence of aquifer system.
- ♣ the **maximum drilling depth** at this site should be **80m** below ground level. However, the supervisor may **exceed** or go **below** this depth based on the field conditions.
- ♣ both physico-chemical and bacteriological test should be carried out on the borehole water samples from completed well.

FIG 1A: Resistivity Profiling results and corresponding responds curves along Profile A

RESISTIVITY PROFILING DATA SHEET- SCHLUMBERGER METHOD

Project: Private	Profile #: A	Length (m): 80
Date: 03-12-2010	Station interval (m): 10	Bearing: 170
Operator: Obeng	Region:	
District: Tonkolili	Community: 100 Men Camp ,AML	

A M N B

$K = \frac{AM*AN}{MN} * 3.142$ $p = K*\frac{\Delta V}{1}$

Station No.	Electrode Seperation AB/2=19m, K=1133, MN/2= 0.5m			Electrode Seperation AB/2=40m, K=495, MN/2= 5.0m		
	ΔV / 1	(ohm-m)	Remarks	ΔV / 1	(ohm-m)	Remarks
0	5.3921	6109.2		12.8	6336.0	
10	3.8611	4374.6		9.21	4559.0	
20	3.3569	3803.4		7.047	3488.3	VES
30	0.8213	930.5		1.7838	883.0	
40	2.008	2275.1		2.3887	1182.4	
50	2.2933	2598.3		2.721	1346.9	
60	2.8004	3172.9		3.042	1505.8	
70	2.774	3142.9		4.2638	2110.6	
80	3.415	3869.2		7.566	3745.2	

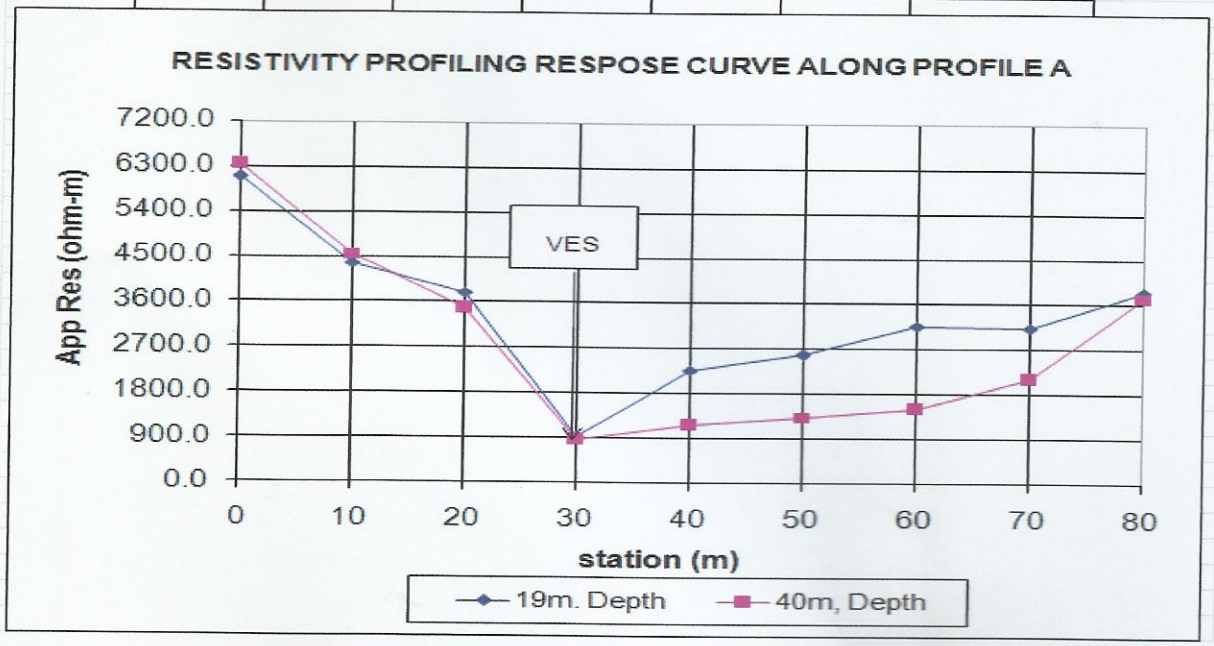


FIG 1B: Resistivity Profiling results and corresponding responds curves along Profile B

RESISTIVITY PROFILING DATA SHEET- SCHLUMBERGER METHOD

Project: Private	Profi #: B	Length (m): 110
Date: 03-12-2010	Station interval (m): 10	Bearing: 300G
Operator: I Obeng	Region:	
District: Tonkolili	COMMUNITY: AML,HawkCamp	

A M N B

$K = \frac{AM*AN}{MN} * 3.142$ $p = K*\frac{\Delta V}{1}$

Station No.	Electrode Seperation AB/2=19m, K=1133, MN/2= 0.5m ΔV 1	(ohm-m)	Remarks	Electrode Seperation AB/2=40m, K=495, MN/2= 5.0m ΔV 1	(ohm-m)	Remarks
0	1.421	1609.4		4.632	2292.8	
10	0.889	1007.2		3.927	1943.9	
20	0.631	714.9		3.601	1782.5	
30	0.557	631.1		0.595	294.7	VES
40	0.608	688.9		0.813	402.4	
50	0.774	876.9		1.362	674.2	
60	0.900	1020.2		1.412	698.8	
70	1.160	1314.3		2.483	1229.3	
80	1.488	1685.9		0.938	464.3	
90	2.0572	2330.8		0.655	324.2	
100	2.7144	3075.4		2.8857	1428.4	
110	2.8291	3205.4		4.1382	2048.4	

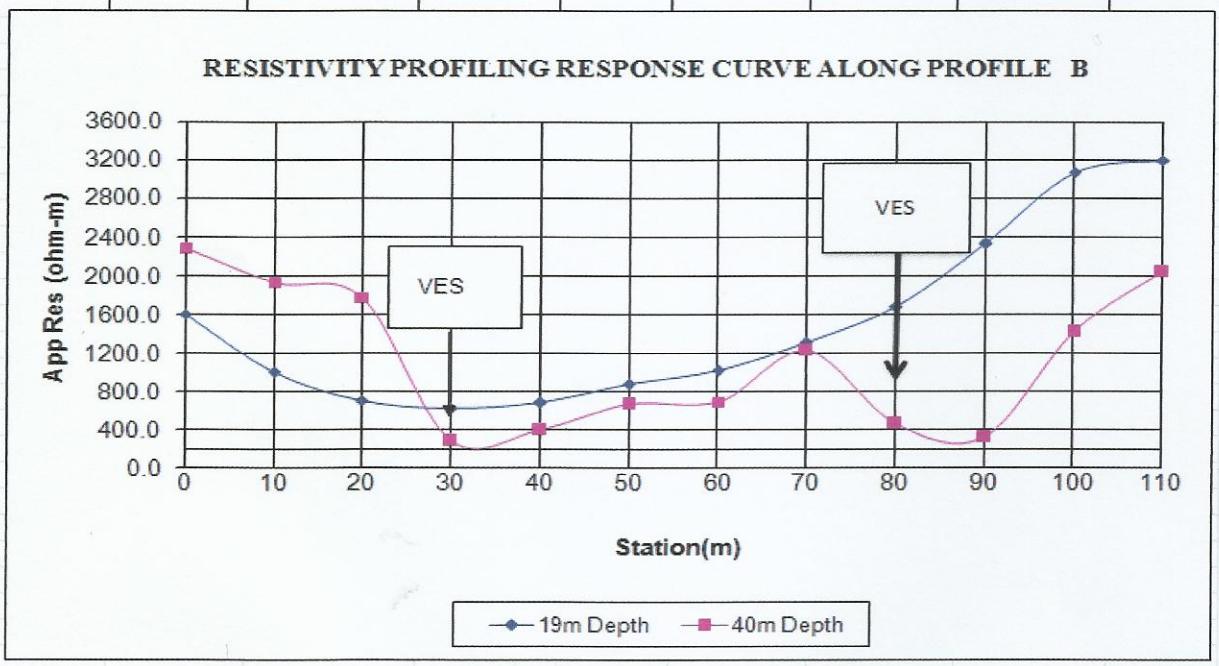


FIG 1C: Resistivity Profiling results and corresponding responds curves along Profile C

RESISTIVITY PROFILING DATA SHEET- SCHLUMBERGER METHOD

Project: Private | Profi #: C | Length (m): 110
Date: 04-12-2010 | Station interval (m): 10 | Bearing: 250G
Operator: I Obeng | Region:
District: Tonkolili | COMMUNITY: AML, Near River

A M N B

$K = \frac{AM*AN}{MN} * 3.142$ $\rho = K*\frac{\Delta V}{1}$

Station No.	Electrode Seperation AB/2=19m, K=1133, MN/2= 0.5m ΔV 1	(ohm-m)	Remarks	Electrode Seperation AB/2=40m, K=495, MN/2= 5.0m ΔV 1	(ohm-m)	Remarks
0	7.554	8558.7		14.302	7079.5	
10	5.310	6016.2		12.611	6242.4	
20	4.909	5562.2		12.300	6088.6	VES
30	4.591	5201.6		10.212	5054.8	
40	3.855	4367.7		9.065	4487.1	
50	2.388	2705.8		7.875	3898.0	
60	2.430	2753.6		8.848	4379.7	VES
70	2.190	2481.4		8.152	4035.1	
80	1.704	1930.4		6.689	3311.2	
90	1.5527	1759.2		6.2748	3106.0	
100	1.28	1450.2		5.215	2581.4	VES
110	1.3948	1580.3		5.112	2530.4	

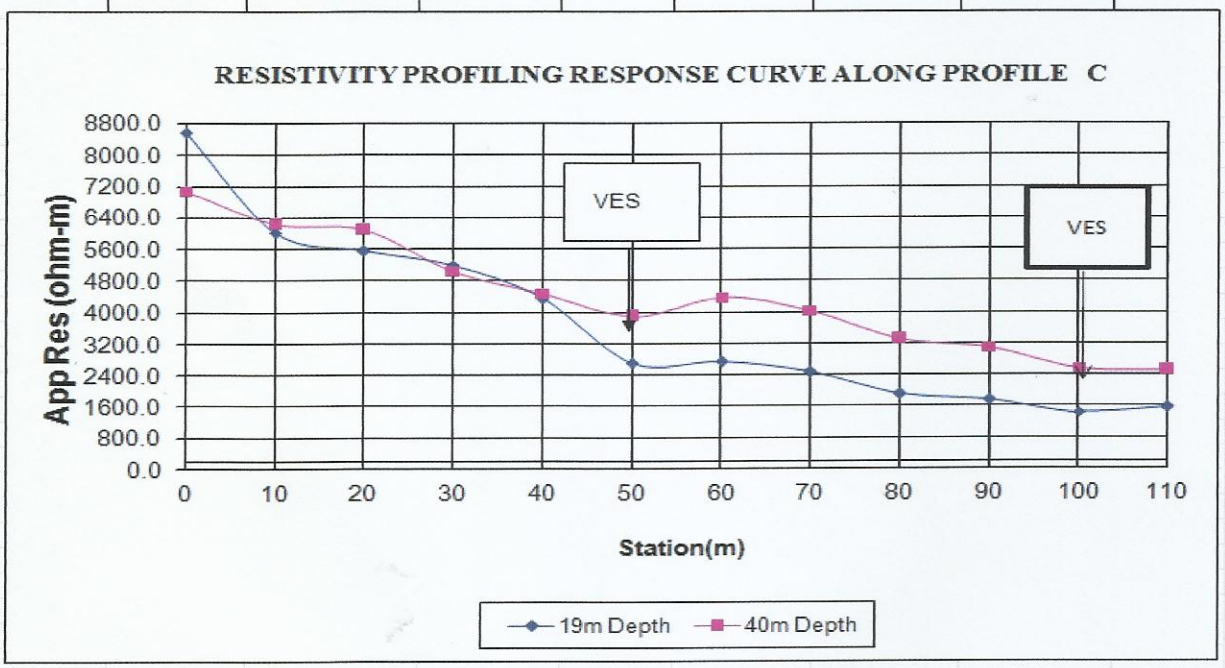


FIG 1D: Resistivity Profiling results and corresponding responds curves along Profile D

RESISTIVITY PROFILING DATA SHEET- SCHLUMBERGER METHOD

Project: Private | Profi #: D | Length (m): 100
Date: 04-12-2010 | Station interval (m): 10 | Bearing: 070G
Operator: I Obeng | Region:
District: Tonkolili | COMMUNITY: AML, Container Pad

A M N B

$K = \frac{AM*AN}{MN} * 3.142$ $p = K*\frac{\Delta V}{1}$

Station No.	Electrode Seperation AB/2=19m, K=1133, MN/2= 0.5m ΔV 1	(ohm-m)	Remarks	Electrode Seperation AB/2=40m, K=495, MN/2= 5.0m ΔV 1	(ohm-m)	Remarks
0	15.127	17138.9		15.559	7701.7	
10	14.015	15879.0		15.884	7862.6	
20	12.801	14503.7		15.022	7435.9	
30	12.490	14151.2		14.413	7134.4	
40	6.990	7919.8		12.934	6402.3	VES
50	11.203	12693.0		17.972	8896.1	
60	10.562	11966.7		21.758	10770.2	
70	11.309	12813.4		20.435	10115.3	
80	10.963	12421.1		19.553	9678.7	
90	3.6323	4115.4		10.132	5015.3	VES
100	10.033	11367.4		13.025	6447.4	

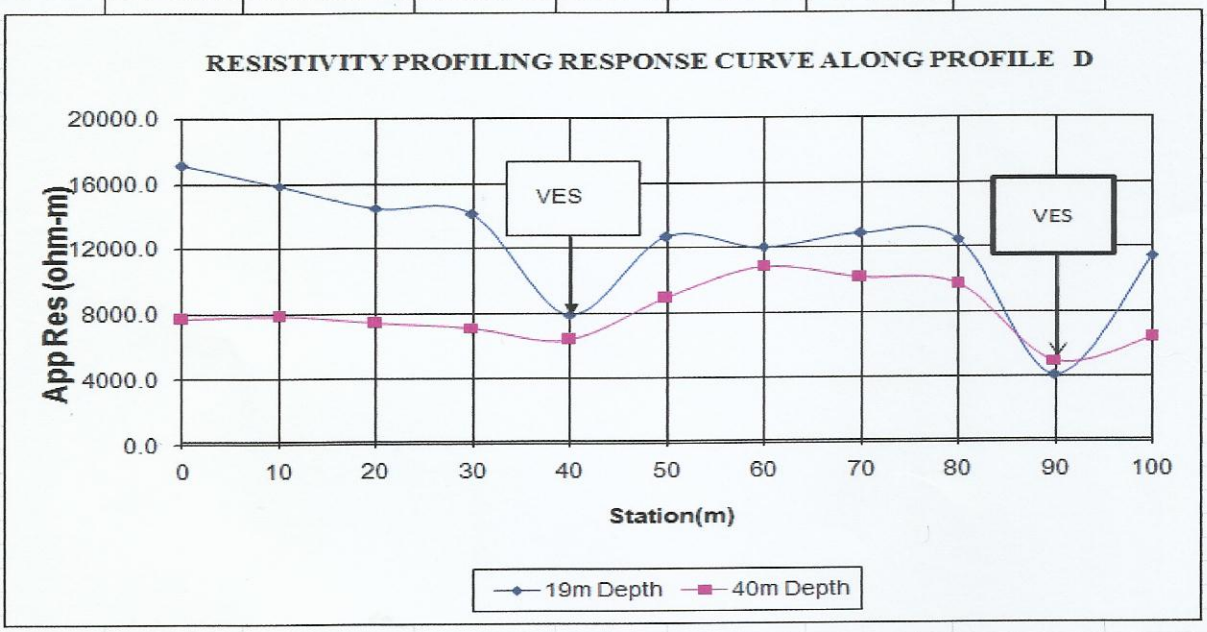


FIG 2A: SCHLUMBERGER VES & MODEL AT THE POINT A30/S1

100 Men Camp, AML - A30/S1

Client : AML	Community : 100 Men Camp, AML
Project : Private	Sounding Number : A30/S1
District : Tonkolili	Coordinates East : 02.017.27
Date : 03-12-2010	Coordinates North : 99.500.89
Field Operator : Obeng	GPS Datum :
Interpreted by : Obeng	Azimuth : 170

Schlumberger Array VES Field Data

AB/2 (m)	MN(m) 1.0 (MN-1)	MN(m) 10 (MN-2)	MN(m) 30 (MN-3)	ΔV I (MN-1)	ΔV I (MN-2)	ΔV I (MN-3)	ρ (ohm-m) (MN-1)	ρ (ohm-m) (MN-2)	ρ (ohm-m) (MN-3)
1.0	2.4			102.7000			242.0		
2.0	11.8			44.9100			529.1		
3.0	27.5			19.1220			525.6		
4.0	49.5			30.8110			1524.5		
5.0	77.8			10.1150			786.5		
6.0	112			7.2800			817.6		
8.0	200			5.6090			1123.4		
10.0	313			3.5820			1122.5		
15.0	706	63		1.3621	33.1510		961.7	2082.9	
20.0	1,256	118		0.8130	17.0410		1021.0	2007.6	
25.0	1,963	188		0.6230	10.6470		1222.8	2006.9	
30.0	2,827	275		0.4390	6.0961		1240.9	1675.8	
35.0	3,848	377		0.2011	3.7120		773.8	1399.4	
40.0	5,026	495		0.1170	1.7830		588.0	882.2	
50.0		778			0.9972			775.4	
60.0		1,123			0.7161			804.3	
70.0		1,532			0.5373			822.9	
80.0									
100.0									
125.0									
150.0									
175.0									
200.0									

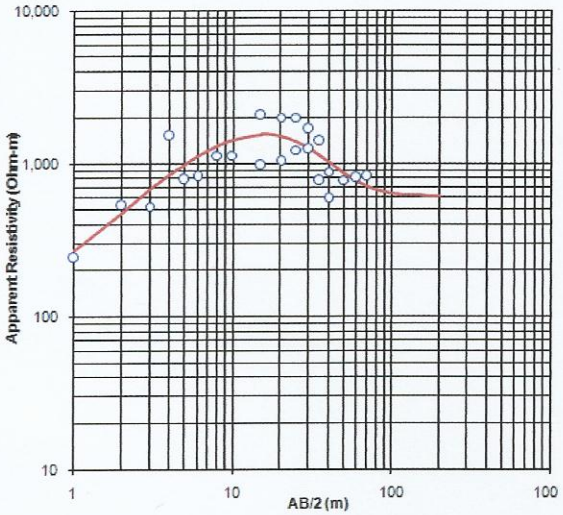
Client : AML
Project : Private
District : Tonkolili
Date : 03-12-2010
Field Operator : Obeng
Interpreted by : Obeng

Community : 100 Men Camp, AML
Sounding Number : A30/S1
Coordinates East : 02.017.27
Coordinates North : 99.500.89
GPS Datum :
Azimuth : 170

100 Men Camp, AML - A30/S1

GeoVES 1.3
MS Excel based modelling of Vertical Electrical Soundings in the Schlumberger Array using Gosh linear filters

Data		Model		
AB/2 (m)	Measured Apparent Resistivity (Ohm-m)	Modelled Apparent Resistivity (Ohm-m)	Model Error	Included in Model (1=yes)
1.0	242.0	265	526	1
2.0	529.1	480	2,442	1
3.0	525.6	674	21,933	1
4.0	1524.5	841	466,823	1
5.0	786.5	985	39,310	1
6.0	817.6	1,107	83,802	1
8.0	1123.4	1,297	30,302	1
10.0	1122.5	1,426	92,177	1
15.0	961.7	1,549	344,698	1
20.0	1021.0	1,501	230,077	1
25.0	1222.8	1,382	25,430	1
30.0	1240.9	1,249	58	1
35.0	773.8	1,124	122,926	1
40.0	588.0	1,019	185,351	1
15.0	2082.9	1,549	285,249	1
20.0	2007.6	1,501	256,973	1
25.0	2006.9	1,382	390,219	1
30.0	1675.8	1,249	182,525	1
35.0	1399.4	1,124	75,634	1
40.0	882.2	1,019	18,580	1
50.0	775.4	864	7,769	1
60.0	804.3	768	1,347	1
70.0	822.9	710	12,831	1



Model Parameters						
Model Layer	Resistivity (Ohm-m)	Resistivity Range	Thickness (m)	Thickness Range	Depth (m)	Depth Range
1	140		0.5		0.5	
2	3200		6.5		7	
3	600					
4						
5						
6						
7						
8						

Geoelectrical Model

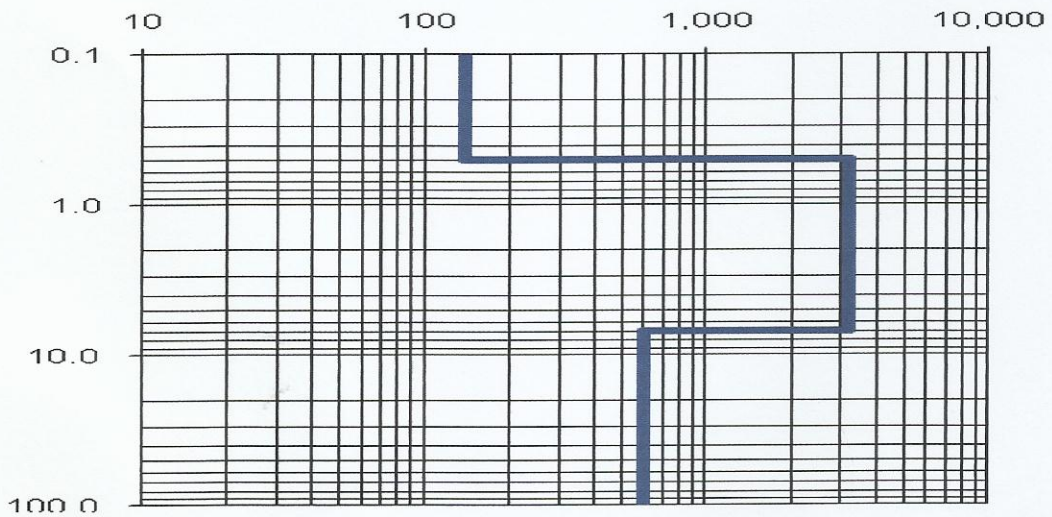


FIG 2B: SCHLUMBERGER VES & MODEL AT THE POINT B30/S2

Hawk Camp, AML - B30/S2

Client : AML	Community : Hawk Camp, AML
Project : Private	Sounding Number : B30/S2
District : Tonkolili	Coordinates East : 02.023.06
Date : 03-12-2010	Coordinates North : 09.956.14
Field Operator : Obeng	GPS Datum :
Interpreted by : Obeng	Azimuth : 300

Schlumberger Array VES Field Data

AB/2 (m)	MN(m) 1.0 (MN-1)	MN(m) 10 (MN-2)	MN(m) 30 (MN-3)	ΔV I (MN-1)	ΔV I (MN-2)	ΔV I (MN-3)	ρ (ohm-m) (MN-1)	ρ (ohm-m) (MN-2)	ρ (ohm-m) (MN-3)
1.0	2.4			698.4200			1645.6		
2.0	11.8			219.9700			2591.5		
3.0	27.5			104.9400			2884.7		
4.0	49.5			66.2550			3278.3		
5.0	77.8			40.8740			3178.1		
6.0	112			28.3040			3178.9		
8.0	200			10.5400			2110.9		
10.0	313			4.2547			1333.3		
15.0	706	63		1.0470	26.4040		739.3	1659.0	
20.0	1,256	118		0.8600	9.7055		1080.0	1143.4	
25.0	1,963	188		0.4570	4.7141		897.0	888.6	
30.0	2,827	275		0.2013	2.1390		569.0	588.0	
35.0	3,848	377		0.1170	1.0300		450.2	388.3	
40.0		495			0.5910			292.4	
50.0		778			0.5020			390.3	
60.0		1,123			0.4420			496.4	
70.0		1,532			0.5373			822.9	
80.0									
100.0									
125.0									
150.0									
175.0									
200.0									

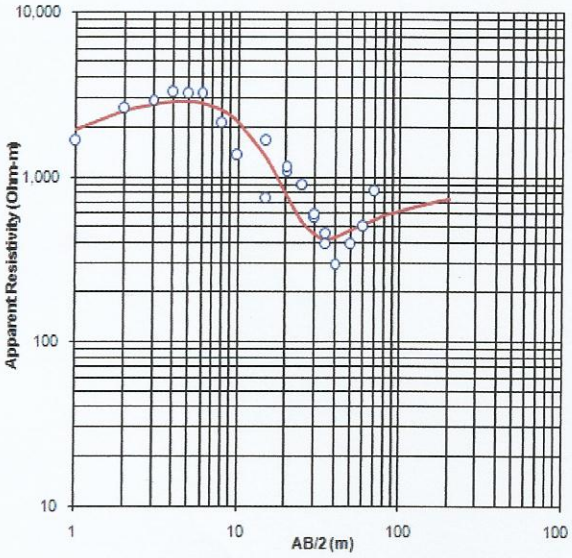
Client : AML
Project : Private
District : Tonkolili
Date : 03-12-2010
Field Operator : Obeng
Interpreted by : Obeng

Community : Hawk Camp, AML
Sounding Number : B30/S2
Coordinates East : 02.023.06
Coordinates North : 09.956.14
GPS Datum :
Azimuth : 300

Hawk Camp, AML - B30/S2

GeoVES 1.3
MS Excel based modelling of Vertical Electrical Soundings in the Schlumberger Array using Gosh linear filters

Data		Model		
AB/2 (m)	Measured Apparent Resistivity (Ohm-m)	Modelled Apparent Resistivity (Ohm-m)	Model Error	Included in Model (1=yes)
1.0	1645.6	1,946	90,434	1
2.0	2591.5	2,509	6,873	1
3.0	2884.7	2,767	13,874	1
4.0	3278.3	2,865	171,014	1
5.0	3178.1	2,866	97,548	1
6.0	3178.9	2,796	146,218	1
8.0	2110.9	2,516	164,074	1
10.0	1333.3	2,145	658,784	1
15.0	739.3	1,292	305,527	1
20.0	1060.0	783	88,519	1
25.0	897.0	541	126,536	1
30.0	569.0	447	14,954	1
35.0	450.2	423	740	1
15.0	1659.0	1,292	134,696	1
20.0	1143.4	783	130,243	1
25.0	888.6	541	120,651	1
30.0	588.0	447	19,958	1
35.0	388.3	423	1,202	1
40.0	292.4	431	19,075	1
50.0	390.3	474	6,935	1
60.0	496.4	518	455	1
70.0	822.9	554	72,413	1



Model Parameters						
Model Layer	Resistivity (Ohm-m)	Resistivity Range	Thickness (m)	Thickness Range	Depth (m)	Depth Range
1	1500		0.5		0.5	
2	3400		5.5		6	
3	500		1		7	
4	40		2		9	
5	800					
6						
7						
8						

Geoelectrical Model

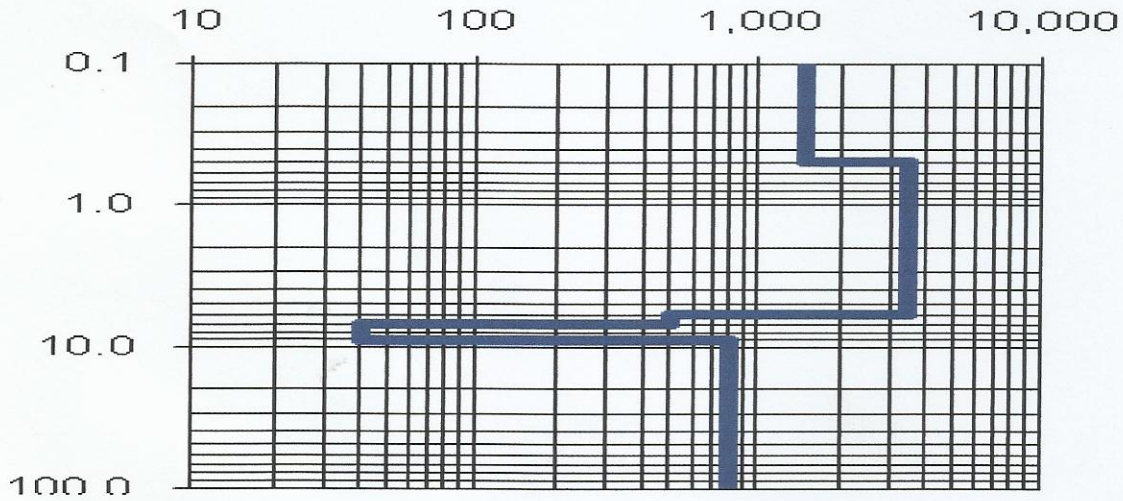


FIG 2C: SCHLUMBERGER VES & MODEL AT THE POINT B90/S3

Hawk Camp, AML - B90/S3

Client : AML	Community : Hawk Camp, AML
Project : Private	Sounding Number : B90/S3
District : Tonkolili	Coordinates East : 02.023.28
Date : 03-12-2010	Coordinates North : 09.956.71
Field Operator : Obeng	GPS Datum :
Interpreted by : Obeng	Azimuth : 300

Schlumberger Array VES Field Data

AB/2 (m)	MN(m) 1.0 (MN-1)	MN(m) 10 (MN-2)	MN(m) 30 (MN-3)	ΔV I (MN-1)	ΔV I (MN-2)	ΔV I (MN-3)	ρ (ohm-m) (MN-1)	ρ (ohm-m) (MN-2)	ρ (ohm-m) (MN-3)
1.0	2.4			34.3990			81.1		
2.0	11.8			18.0870			213.1		
3.0	27.5			11.0150			302.8		
4.0	49.5			8.8768			439.2		
5.0	77.8			6.7565			525.3		
6.0	112			4.7055			528.5		
8.0	200			3.4198			684.9		
10.0	313			2.5526			799.9		
15.0	706	63		1.1026	11.2370		778.5	706.0	
20.0	1,256	118		0.6843	5.7915		859.4	682.3	
25.0	1,963	188		0.4721	4.1956		926.6	790.9	
30.0	2,827	275		0.2740	2.6262		774.5	721.9	
35.0	3,848	377		0.1321	1.1024		508.3	415.6	
40.0		495			0.6550			324.1	
50.0		778			0.5890			458.0	
60.0		1,123			0.5120			575.0	
70.0		1,532			0.4730			724.4	
80.0									
100.0									
125.0									
150.0									
175.0									
200.0									

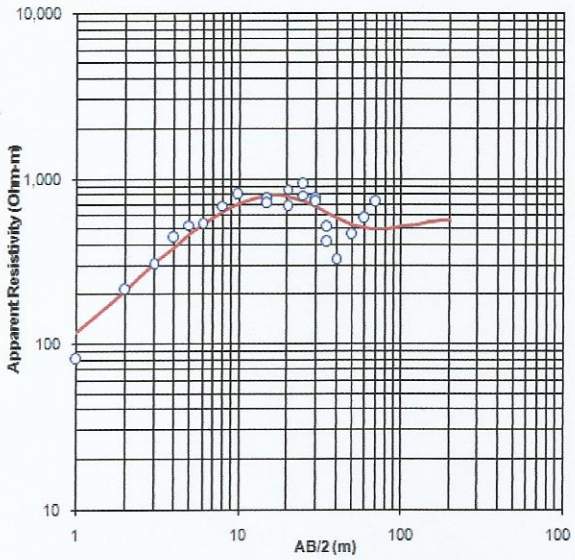
Client : AML
Project : Private
District : Tonkolili
Date : 03-12-2010
Field Operator : Obeng
Interpreted by : Obeng

Community : Hawk Camp, AML
Sounding Number : B90/S3
Coordinates East : 02.023.28
Coordinates North : 09.956.71
GPS Datum :
Azimuth : 300

Hawk Camp, AML - B90/S3

GeoVES 1.3
MS Excel based modelling of Vertical Electrical Soundings in the Schlumberger Array using Gosh linear filters

Data		Model		
AB/2 (m)	Measured Apparent Resistivity (Ohm-m)	Modelled Apparent Resistivity (Ohm-m)	Model Error	Included in Model (1=yes)
1.0	81.1	117	1,272	1
2.0	213.1	213	0	1
3.0	302.8	308	11	1
4.0	439.2	390	2,439	1
5.0	525.3	464	3,820	1
6.0	528.5	528	0	1
8.0	684.9	632	2,797	1
10.0	799.9	707	8,721	1
15.0	778.5	792	172	1
20.0	859.4	784	5,655	1
25.0	926.6	736	36,356	1
30.0	774.5	678	9,360	1
35.0	508.3	624	13,472	1
15.0	706.0	792	7,327	1
20.0	682.3	784	10,381	1
25.0	790.9	736	3,017	1
30.0	721.9	678	1,950	1
35.0	415.6	624	43,577	1
40.0	324.1	581	65,984	1
50.0	458.0	525	4,516	1
60.0	575.0	500	5,582	1
70.0	724.4	494	53,289	1



Model Parameters								
Model Layer	Resistivity (Ohm-m)	Resistivity Range		Thickness (m)	Thickness Range		Depth (m)	Depth Range
1	70			0.6			0.6	
2	2550			5			5.6	
3	20			1			6.6	
4	600							
5								
6								
7								
8								

Geoelectrical Model

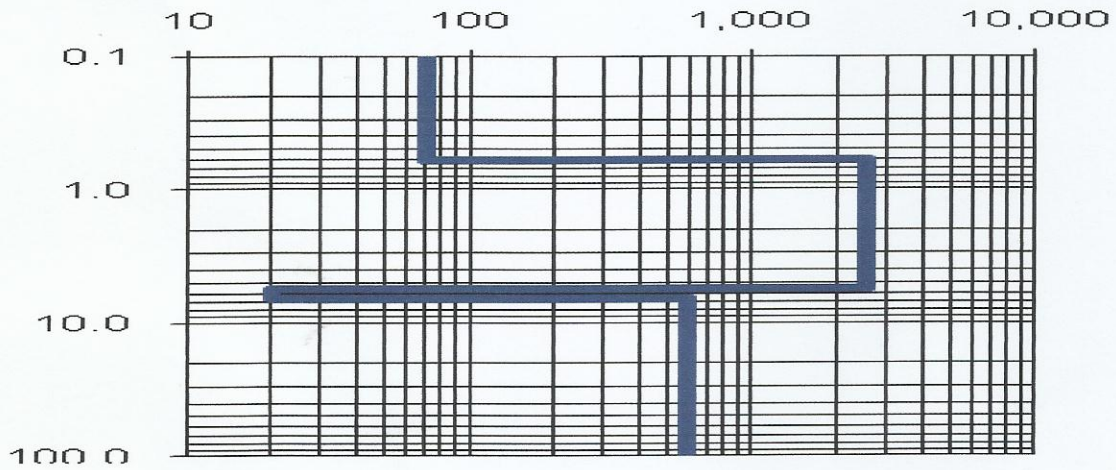


FIG 2D: SCHLUMBERGER VES & MODEL AT THE POINT C50/S4

AML, Near Tonkolili River - C50/S4

Client : AML	Community : AML, Near Tonkolili River
Project : Private	Sounding Number : C50/S4
District : Tonkolili	Coordinates East :
Date : 04-12-2010	Coordinates North :
Field Operator : Obeng	GPS Datum :
Interpreted by : Obeng	Azimuth : 250

Schlumberger Array VES Field Data

AB/2 (m)	MN(m) 1.0 (MN-1)	MN(m) 10 (MN-2)	MN(m) 30 (MN-3)	ΔV I (MN-1)	ΔV I (MN-2)	ΔV I (MN-3)	ρ (ohm-m) (MN-1)	ρ (ohm-m) (MN-2)	ρ (ohm-m) (MN-3)
1.0	2.4			426.7900			1005.6		
2.0	11.8			128.4300			1513.0		
3.0	27.5			66.1440			1818.2		
4.0	49.5			42.7590			2115.7		
5.0	77.8			29.9280			2327.0		
6.0	112			22.4790			2524.7		
8.0	200			14.2760			2859.1		
10.0	313			9.0608			2839.4		
15.0	706	63		4.5059	116.1900		3181.5	7300.4	
20.0	1,256	118		2.5776	51.4500		3237.1	6061.3	
25.0	1,963	188		1.4438	26.9020		2833.8	5070.9	
30.0	2,827	275		0.8510	18.0930		2405.5	4973.6	
35.0	3,848	377		0.5321	13.4310		2047.3	5063.4	
40.0		495			10.0330			4964.3	
50.0		778			7.8468			6101.2	
60.0		1,123			5.7878			6500.4	
70.0		1,532			3.9557			6058.3	
80.0		2,003			2.8552			5718.3	
100.0									
125.0									
150.0									
175.0									
200.0									

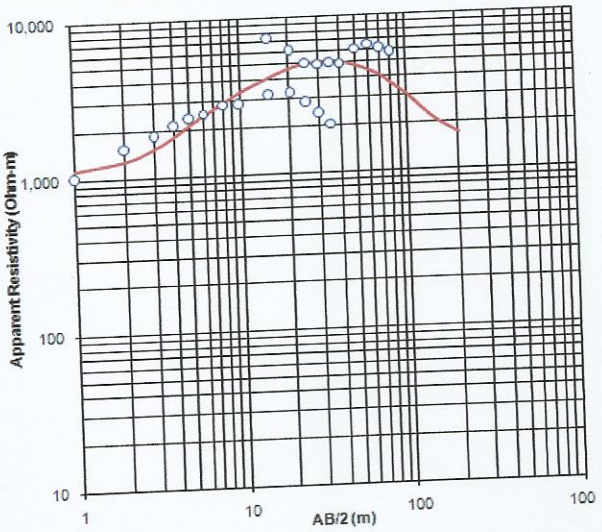
Client : AML
Project : Private
District : Tonkolili
Date : 04-12-2010
Field Operator : Obeng
Interpreted by : Obeng

Community : AML, Near Tonkolili River
Sounding Number : C50/S4
Coordinates East :
Coordinates North :
GPS Datum :
Azimuth : 250

AML, Near Tonkolili River - C50/S4

GeoVES 1.3
MS Excel based modelling of Vertical Electrical Soundings in the Schlumberger Array using Gosh linear filters

Data		Model		
AB/2 (m)	Measured Apparent Resistivity (Ohm-m)	Modelled Apparent Resistivity (Ohm-m)	Model Error	Included in Model (1=yes)
1.0	1005.6	1,139	17,693	1
2.0	1513.0	1,273	57,650	1
3.0	1818.2	1,520	88,747	1
4.0	2115.7	1,819	87,857	1
5.0	2327.0	2,125	41,013	1
6.0	2524.7	2,416	11,755	1
8.0	2859.1	2,937	6,079	1
10.0	2839.4	3,374	285,621	1
15.0	3181.5	4,171	978,831	1
20.0	3237.1	4,665	2,039,474	1
25.0	2833.8	4,952	4,487,936	1
30.0	2405.5	5,091	7,210,949	1
35.0	2047.3	5,121	9,444,683	1
15.0	7300.4	4,171	9,794,271	1
20.0	6061.3	4,665	1,949,166	1
25.0	5070.9	4,952	14,083	1
30.0	4973.6	5,091	13,742	1
35.0	5063.4	5,121	3,271	1
40.0	4964.3	5,071	11,274	1
50.0	6101.2	4,815	1,653,314	1
60.0	6500.4	4,453	4,193,678	1
70.0	6058.3	4,059	3,998,398	1
80.0	5718.3	3,677	4,167,334	1



Model Parameters						
Model Layer	Resistivity (Ohm-m)	Resistivity Range	Thickness (m)	Thickness Range	Depth (m)	Depth Range
1	1100		2		2	
2	7500		14		16	
3	5000		20		36	
4	1400					
5						
6						
7						
8						

Geoelectrical Model

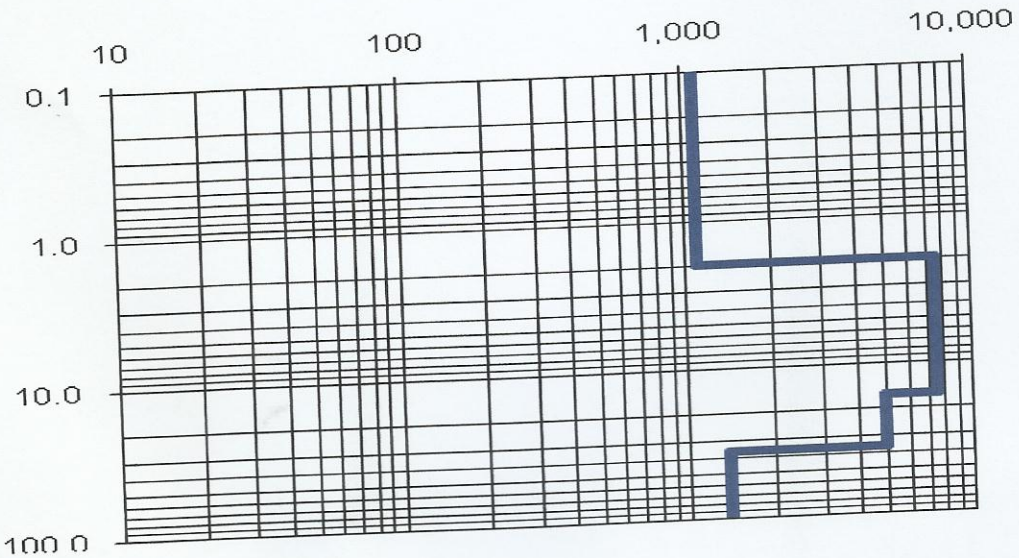


FIG 2E: SCHLUMBERGER VES & MODEL AT THE POINT C100/S5

AML,Near Tonkolili River - C100/S5

Client : AML	Community : AML,Near Tonkolili River
Project : Private	Sounding Number : C100/S5
District : Tonkolili	Coordinates East :
Date : 04-12-2010	Coordinates North :
Field Operator : Obeng	GPS Datum :
Interpreted by : Obeng	Azimuth : 250

Schlumberger Array VES Field Data

AB/2 (m)	MN(m) 1.0 (MN-1)	MN(m) 10 (MN-2)	MN(m) 30 (MN-3)	ΔV I (MN-1)	ΔV I (MN-2)	ΔV I (MN-3)	ρ (ohm-m) (MN-1)	ρ (ohm-m) (MN-2)	ρ (ohm-m) (MN-3)
1.0	2.4			439.8100			1036.3		
2.0	11.8			96.6830			1139.0		
3.0	27.5			36.8740			1013.6		
4.0	49.5			18.8900			934.7		
5.0	77.8			11.4370			889.3		
6.0	112			8.1150			911.4		
8.0	200			5.8473			1171.1		
10.0	313			2.0741			650.0		
15.0	706	63		1.4091	25.5840		994.9	1607.5	
20.0	1,256	118		1.0210	14.6650		1282.2	1727.7	
25.0	1,963	188		0.8172	10.3240		1603.9	1946.0	
30.0	2,827	275		0.5619	7.6134		1588.3	2092.8	
35.0	3,848	377		0.5321	6.6045		2047.3	2489.8	
40.0		495			5.1014			2524.2	
50.0		778			4.2910			3336.4	
60.0		1,123			3.2010			3595.1	
70.0		1,532			2.9330			4492.0	
80.0									
100.0									
125.0									
150.0									
175.0									
200.0									

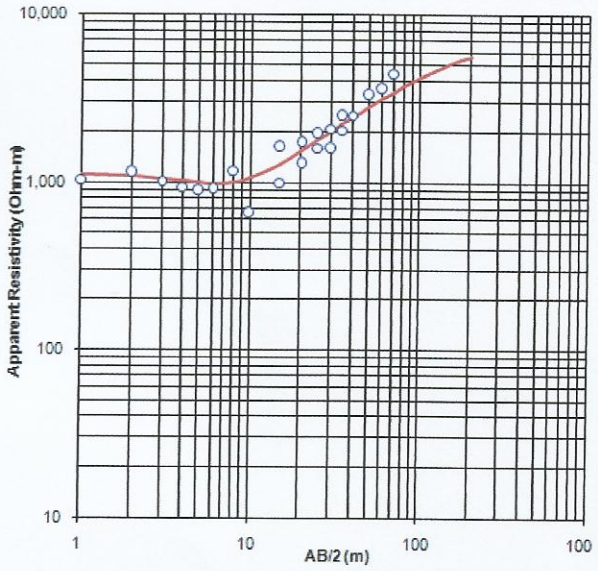
Client : AML
Project : Private
District : Tonkolili
Date : 04-12-2010
Field Operator : Obeng
Interpreted by : Obeng

Community : AML,Near Tonkolili River
Sounding Number : C100/S5
Coordinates East :
Coordinates North :
GPS Datum :
Azimuth : 250

AML,Near Tonkolili River - C100/S5

GeoVES 1.3
MS Excel based modelling of Vertical Electrical Soundings in the Schlumberger Array using Gosh linear filters

Data		Model		
AB/2 (m)	Measured Apparent Resistivity (Ohm-m)	Modelled Apparent Resistivity (Ohm-m)	Model Error	Included in Model (1=yes)
1.0	1036.3	1,099	3,940	1
2.0	1139.0	1,081	3,387	1
3.0	1013.6	1,048	1,213	1
4.0	934.7	1,017	6,775	1
5.0	889.3	996	11,310	1
6.0	911.4	987	5,736	1
8.0	1171.1	1,006	27,153	1
10.0	650.0	1,062	169,462	1
15.0	994.9	1,277	79,619	1
20.0	1282.2	1,525	58,780	1
25.0	1603.9	1,770	27,579	1
30.0	1588.3	2,005	173,476	1
35.0	2047.3	2,227	32,428	1
15.0	1607.5	1,277	109,160	1
20.0	1727.7	1,525	41,212	1
25.0	1946.0	1,770	30,988	1
30.0	2092.8	2,005	7,752	1
35.0	2469.8	2,227	68,863	1
40.0	2524.2	2,438	7,446	1
50.0	3336.4	2,824	262,153	1
60.0	3595.1	3,169	181,216	1
70.0	4492.0	3,478	1,028,235	1



Model Parameters						
Model Layer	Resistivity (Ohm-m)	Resistivity Range	Thickness (m)	Thickness Range	Depth (m)	Depth Range
1	1100		2		2	
2	815		6		8	
3	3000		11		19	
4	7400					
5						
6						
7						
8						

Geoelectrical Model

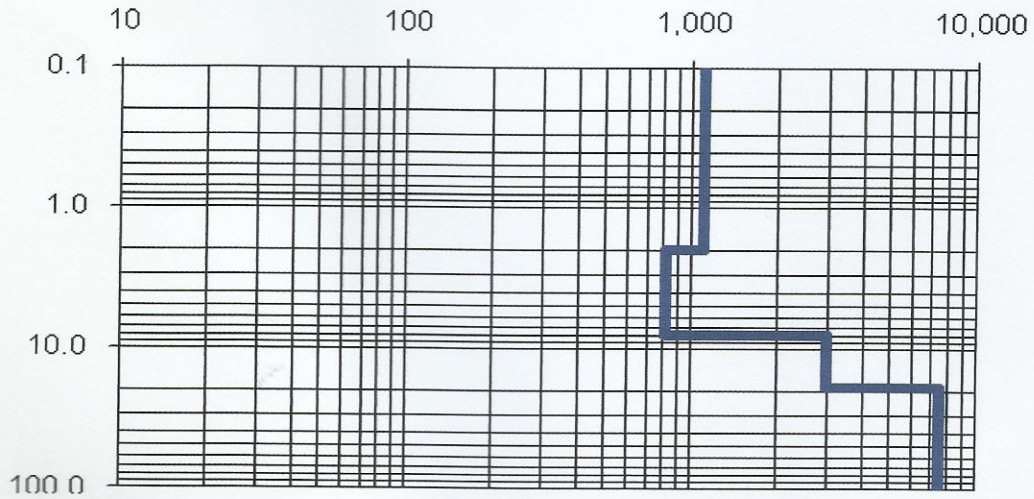


FIG 2F: SCHLUMBERGER VES & MODEL AT THE POINT D40/S6

Container Pad,AML - D40/S6

Client : AML	Community : Container Pad,AML
Project : Private	Sounding Number : D40/S6
District : Tonkolili	Coordinates East : 02'016.18"
Date : 04-12-2010	Coordinates North : 09'944.02"
Field Operator : Obeng	GPS Datum :
Interpreted by : Obeng	Azimuth : 70

Schlumberger Array VES Field Data

AB/2 (m)	MN(m) 1.0 (MN-1)	MN(m) 10 (MN-2)	MN(m) 30 (MN-3)	ΔV I (MN-1)	ΔV I (MN-2)	ΔV I (MN-3)	ρ (ohm-m) (MN-1)	ρ (ohm-m) (MN-2)	ρ (ohm-m) (MN-3)
1.0	2.4			########			3748.7		
2.0	11.8			681.4700			8028.4		
3.0	27.5			306.3300			8420.7		
4.0	49.5			198.2000			9807.0		
5.0	77.8			124.1200			9650.9		
6.0	112			94.0570			10563.7		
8.0	200			53.2380			10662.3		
10.0	313			33.1070			10374.9		
15.0	706	63		12.0240	426.8300		8489.8	26818.5	
20.0	1,256	118		6.0211	253.1700		7561.6	29825.9	
25.0	1,963	188		5.4265	55.4740		10650.6	10456.6	
30.0	2,827	275		3.8253	32.6250		10812.8	8968.3	
35.0	3,848	377		1.0874	18.3120		4184.0	6903.5	
40.0		495			10.1160			5005.4	
50.0		778			4.1644			3238.0	
60.0		1,123			1.0341			1161.4	
70.0		1,532			0.8147			1247.7	
80.0									
100.0									
125.0									
150.0									
175.0									
200.0									

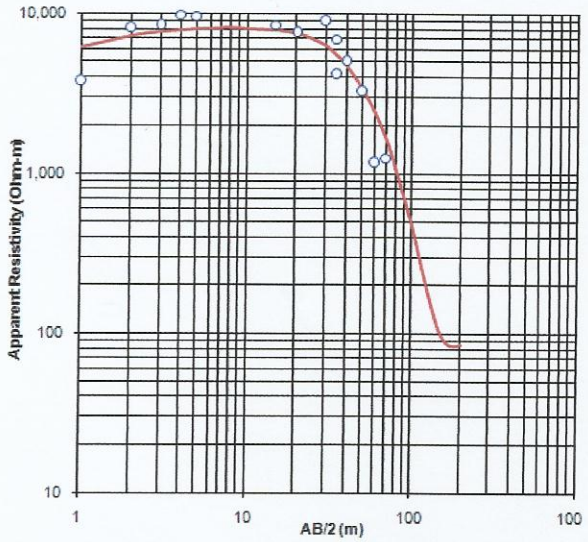
Client : AML
Project : Private
District : Tonkolili
Date : 04-12-2010
Field Operator : Obeng
Interpreted by : Obeng

Community : Container Pad,AML
Sounding Number : D40/S6
Coordinates East : 02'016.18"
Coordinates North : 09'944.02"
GPS Datum :
Azimuth : 70

Container Pad,AML - D40/S6

GeoVES 1.3
MS Excel based modelling of Vertical Electrical Soundings in the Schlumberger Array using Gosh linear filters

Data		Model		
AB/2 (m)	Measured Apparent Resistivity (Ohm-m)	Modelled Apparent Resistivity (Ohm-m)	Model Error	Included in Model (1=yes)
1.0	3748.7	6,100	5,530,372	1
2.0	6026.4	7,283	555,470	1
3.0	8420.7	7,714	499,164	1
4.0	9807.0	7,922	3,552,149	1
5.0	9650.9	8,035	2,612,079	1
6.0	10563.7	8,095	6,096,274	1
8.0	10682.3	8,127	6,426,724	1
10.0	10374.9	8,096	5,194,244	1
15.0	8489.8	7,873	380,905	1
20.0	7561.6	7,479	6,822	1
25.0	10650.6	6,920	13,914,830	1
30.0	10612.8	6,240	20,912,110	1
35.0	4184.0	5,501	1,734,011	1
15.0	26818.5	7,873	358,946,129	1
20.0	29825.9	7,479	499,382,916	1
25.0	10456.6	6,920	12,504,820	1
30.0	8968.3	6,240	7,444,520	1
35.0	6903.5	5,501	1,967,543	1
40.0	5005.4	4,761	59,836	1
50.0	3238.0	3,424	34,485	1
60.0	1161.4	2,373	1,468,907	1
70.0	1247.7	1,608	130,133	1



Model Parameters						
Model Layer	Resistivity (Ohm-m)	Resistivity Range	Thickness (m)	Thickness Range	Depth (m)	Depth Range
1	3000		0.2		0.2	
2	8300		22		22.2	
3	2100		7		29.2	
4	80					
5						
6						
7						
8						

Geoelectrical Model

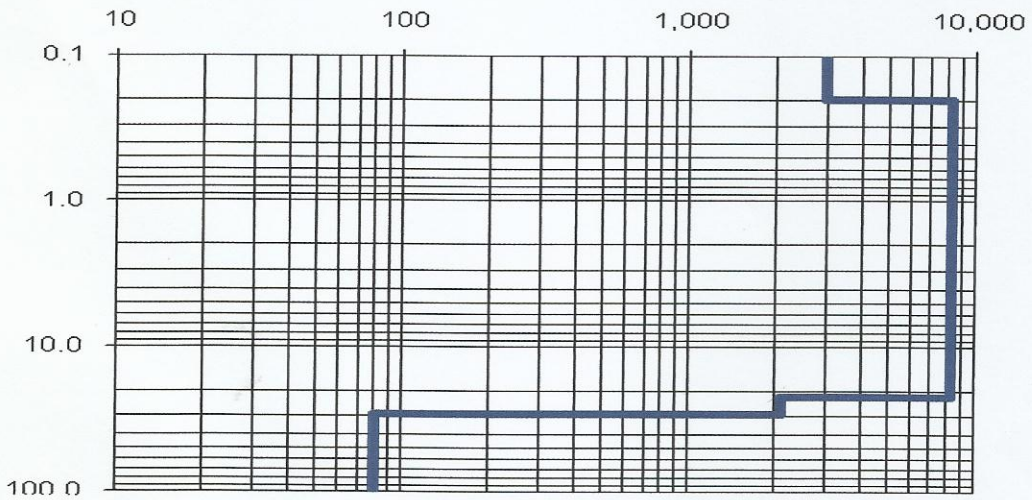


FIG 2G: SCHLUMBERGER VES & MODEL AT THE POINT D90/S7

AML,Container Pad - D90/S7

Client : AML	Community : AML,Container Pad
Project : Private	Sounding Number : D90/S7
District : Tonkolili	Coordinates East : 02'016.44"
Date : 04-12-2010	Coordinates North : 09'944.44"
Field Operator : Obeng	GPS Datum :
Interpreted by : Obeng	Azimuth : 70

Schlumberger Array VES Field Data

AB/2 (m)	MN(m) 1.0 (MN-1)	MN(m) 10 (MN-2)	MN(m) 30 (MN-3)	ΔV I (MN-1)	ΔV I (MN-2)	ΔV I (MN-3)	ρ (ohm-m) (MN-1)	ρ (ohm-m) (MN-2)	ρ (ohm-m) (MN-3)
1.0	2.4			########			2677.3		
2.0	11.8			466.7800			5499.1		
3.0	27.5			266.1200			7315.4		
4.0	49.5			151.5000			7496.2		
5.0	77.8			91.1930			7090.7		
6.0	112			59.2890			6658.9		
8.0	200			31.6080			6330.3		
10.0	313			21.2820			6669.2		
15.0	706	63		9.4466	114.2800		6670.0	7180.4	
20.0	1,256	118		5.5988	60.5960		7031.3	7138.8	
25.0	1,963	188		3.5264	41.2870		6921.3	7782.4	
30.0	2,827	275		2.2168	26.4370		6266.1	7267.2	
35.0	3,848	377		1.7210	17.8710		6621.8	6737.2	
40.0		495			9.4622			4681.9	
50.0		778			6.0402			4696.5	
60.0		1,123			3.0121			3382.9	
70.0		1,532			1.6671			2553.2	
80.0									
100.0									
125.0									
150.0									
175.0									
200.0									

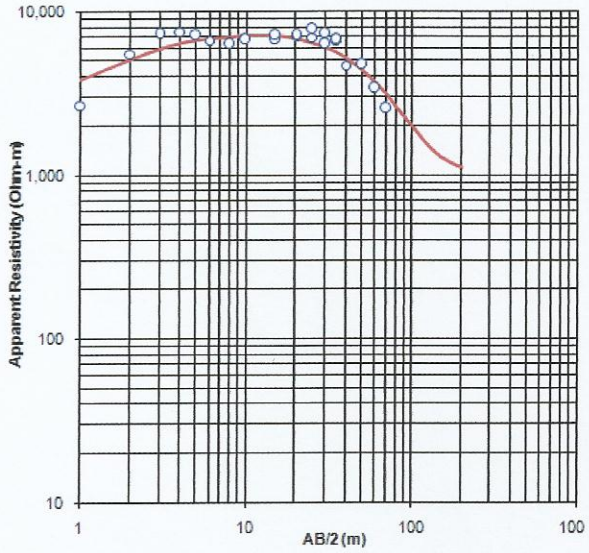
Client : AML
Project : Private
District : Tonkolili
Date : 04-12-2010
Field Operator : Obeng
Interpreted by : Obeng

Community : AML,Container Pad
Sounding Number : D90/S7
Coordinates East : 02'016.44"
Coordinates North : 09'944.44"
GPS Datum :
Azimuth : 70

AML,Container Pad - D90/S7

GeoVES 1.3
MS Excel based modelling of Vertical Electrical Soundings in the Schlumberger Array using Gosh linear filters

Data		Model		
AB/2 (m)	Measured Apparent Resistivity (Ohm-m)	Modelled Apparent Resistivity (Ohm-m)	Model Error	Included in Model (1=yes)
1.0	2677.3	3,829	1,326,234	1
2.0	5499.1	5,146	125,030	1
3.0	7315.4	5,892	2,026,606	1
4.0	7496.2	6,336	1,348,704	1
5.0	7090.7	6,618	223,669	1
6.0	6658.9	6,804	20,981	1
8.0	6330.3	7,010	462,599	1
10.0	6659.2	7,092	178,947	1
15.0	6670.0	7,031	130,326	1
20.0	7031.3	6,777	64,459	1
25.0	6921.3	6,430	241,620	1
30.0	6266.1	6,034	53,816	1
35.0	6621.8	5,617	1,009,757	1
15.0	7180.4	7,031	22,329	1
20.0	7138.8	6,777	130,626	1
25.0	7762.4	6,430	1,829,701	1
30.0	7267.2	6,034	1,520,582	1
35.0	6737.2	5,617	1,254,943	1
40.0	4881.9	5,196	264,556	1
50.0	4696.5	4,393	92,191	1
60.0	3382.9	3,667	92,526	1
70.0	2553.2	3,100	299,093	1



Model Parameters						
Model Layer	Resistivity (Ohm-m)	Resistivity Range	Thickness (m)	Thickness Range	Depth (m)	Depth Range
1	2600		0.5		0.5	
2	7500		14		14.5	
3	5000		20		34.5	
4	1000					
5						
6						
7						
8						

Geoelectrical Model