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Use of Resistivity Method for Underground Water Exploration in Granula Sediments (A Case Study of Igara Edo State, Nigeria)

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ABSTRACT : The importance of groundwater cannot be overemphasized. For this reason, the exploration for water, its exploration and purification is therefore vital aspect of Geophysics. The resistivity method of surveying was carried out for the study of underground water in Igara in Edo State, Nigeria. Data were acquired using the ABEM Terrameter 300B using the Schlumberger array method for this purpose. Three locations were taken and for each location the system vertical electrical sounding was used to obtain readings for resistance and the apparent resistivities were also calculated. The results were interpreted using the Geoelectric section of the area, where available along wit the computer models.The result was that there was an initial increase in the curve showing high resitivity and presence of dry soil, but as the curve progressed, there was sharp drop as shown in the computer interaction curve; which showed that there was presence of clay, indicating the presence of water at depth between 45m to 60m. This results obtained correlate with available borehole log.

KEYWORDS: Resistivity, Ighara, underground, Table, water, Geoelectric

I. INTRODUCTION

Electrical resistivity surveys are usually very useful and convenient method when searching for groundwater and in the exploration of mineral. It can also provide information about the subsurface formations when potential measurements are taken at the surface.

The electrical resistivity method as tool for geophysical exploration is based on the fact that the underlying rock materials have resistance and current and as such ohm's law could be applied to them, if the earth is homogenous, the resistively measured is called true resistivity otherwise, the term apparent resistivity is used and this is a weighted average of the resistivities of the various formation.

The usual practice in resistivity survey measurements is to introduce current into the ground by means of two current electrodes and potential drop is measured through a second pair of potential electrodes. The flow of current within the earth is affected by subsurface formation and hence the distribution of electric potential.

Conduction of electricity in the ground occurs through the interstitial water present in the rock and which contains some dissolved salts invariably. As such, low resistively usually indicates the presence of water (clay) in the formation, therefore is perhaps as important as water salinity in establishing the true resistively of a medium (Asokhia 1995).

Elementary Theory

The use of the electrical resistively method as a geophysical tool for exploration is based on the flow of electric current through the ground and rock material. To allow the passage of current through the ground such a rock material should posses some form of electrical resistance, and be able by their nature to store charges. Therefore some basic equations will necessarily relate these quantities.

When we apply a voltage v across the ends of a body of constant cross section area, the current I is proportional to the applied voltage. So that

$$V = IR \quad \text{or} \quad R = \frac{V}{I}$$

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Where R is the proportionality constant called the resistive of the body.

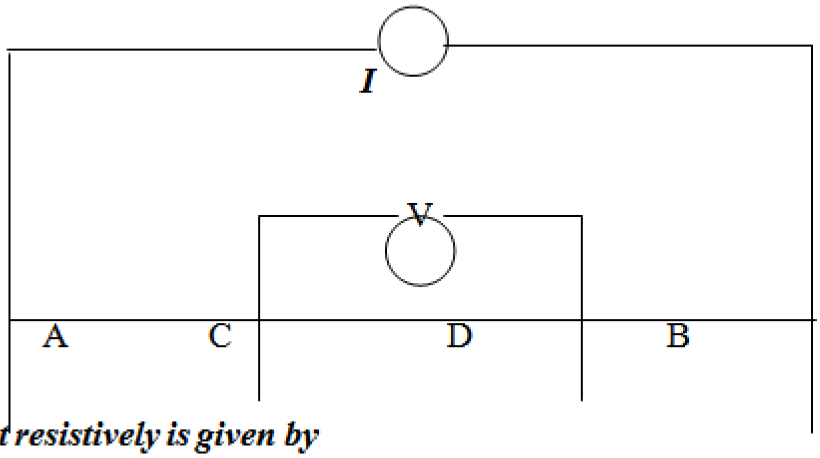
We also know that for a given material, the distance is proportional to its length and inversely proportional to the cross section area A, of the body, so that

$R = \rho L/A$ or $\rho = RA/L$

Where ρ, is the resistivity of the material, and has unit ohm-metre (Ωm).

For vertical electrical sounding (VES) the use of electrical method with depth control in which electrode spacing is increased to obtain information from greater depths at a given surface location (Beck 1981). It is used for detecting changed with depth in the resistivity of the earth, beneath the given location. The principle of VES are based on the fact that the wider the current electrode separation the deeper the current penetration.

The diagram below shows Schlumberger electrode Array



The apparent resistively is given by

The apparent resistively is given by

$\rho_a = (\wedge CD\ V/T)\ (L/CD)^2 - 0.25)$

When CD = distance between potential electrodes,

L = AB/2 = half the distance current electrodes

AB is the distance between current electrodes. In this work, field measurement was taken at AB/2 = 1.00, 1.47, 2.15, 3.16, 4.64, 6.81, 10.00, 14.70, 21.50, 31.60, 46.40, 68.10, 100.00 and 147.00. A common initial value of CD is 0.15m and this is expanded gradually to satisfy the condition CD ≤ AB/5 DATA ACQUISITION AND INTERPRETATION

The fieldwork, employing the Schlumberger vertical electrical sounding was carried out in the months of August & September in Igara, Edo State, Nigeria.

The ABEM Terrameter was utilized in data gathering. Three VES was taken at different location. The maximum current electrode spread was 147m. the field values of the resistivities measured was used to compute the apparent resistivity.

The data as usually presented as a series of graph expressing the variation of apparent resistivity with increasing electrode separation. This curves qualitatively represent the variation of resisitivity with depth and as such, the curves may be quantitatively interpreted by inspection. Quantitative interpretation is usually done either by curve fitting or with the assistance of the computer (Osemeikhian and Asokhia 1994). In this work the computer assistance was used. Computer interactive analysis employing digital liners filters was employed in the analysis of data. The programme used in this work is that in Flolines, Ugbowo, Benin-city like others programmes, it gives a set of layers parameters employing a 9-point and 20-point digital filters (Korfoed 1979). The observed values and the computed (theoretical) values gotten from the computer are shown in figures 1,2 & 3 (Attached).

II. RESULTS

The results obtained from the computer interactive analysis are shown in the attached figure.1,2 and 3

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. The result displayed the geoelectric layer, thickness and the commulative thickness in metre of the studied area.

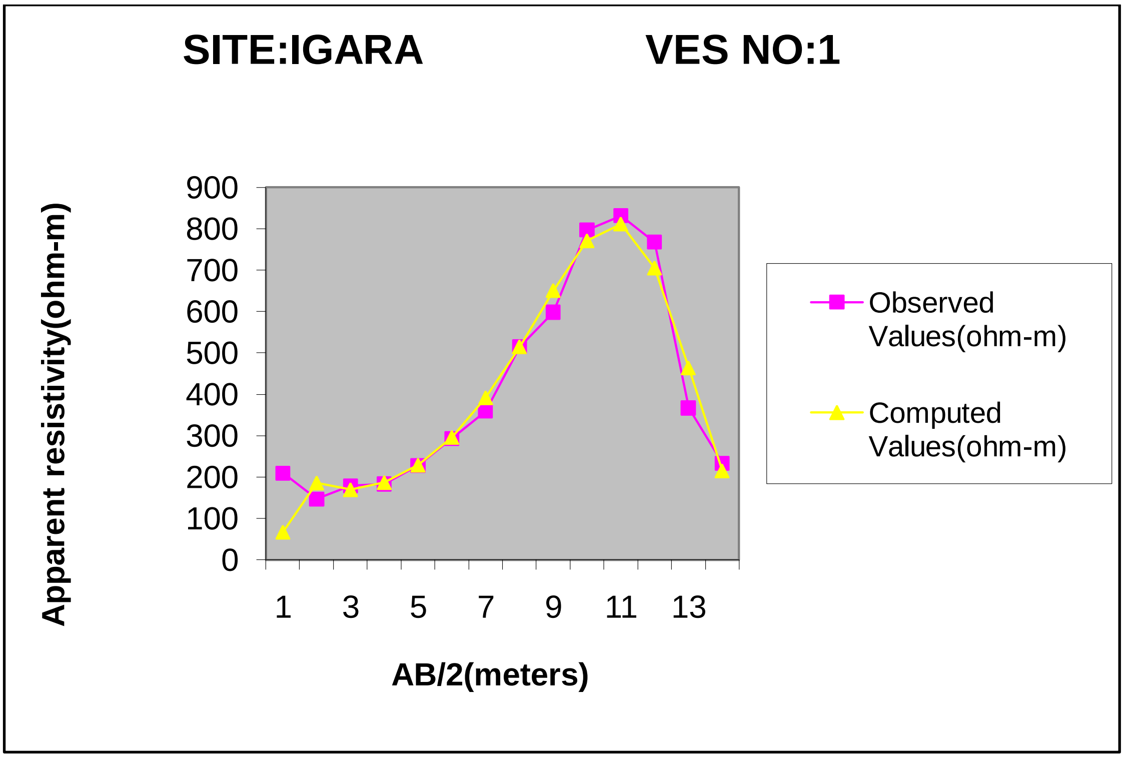

FIG 1

BSERVED (Field) AND COMPUTED (Theoretical)DATA

AB/2	Observed	Computed
Values(m)	**Values(ohm-m)**	**Values(ohm-m)**
1.00	209.09	66.78
1.47	147.00	185.61
2.15	178.89	169.35
3.16	183.41	186.54
4.64	227.69	228.67
6.81	293.19	295.73
10.00	359.11	391.35
14.70	514.66	514.59
21.50	597.81	650.38
31.60	796.62	770.45
46.40	831.00	811.05
68.10	766.95	704.67
100.00	366.65	463.56
147.00	233.00	214.83

MODEL PARAMETERS

Geoelectric Layer	Resistivity (ohm-m)	Thickness (m)	Cumulative Thickness(m)
1	240.00	0.53	0.53
2	121.00	1.33	1.86
3	412.00	3.64	5.5.00
4	2060.00	11.48	16.98
5	1363.00	11.53	28.51
6	50.90	16.95	45.46
7	31.20	infinity	infinity

RMS **Error(%)** **3.51**

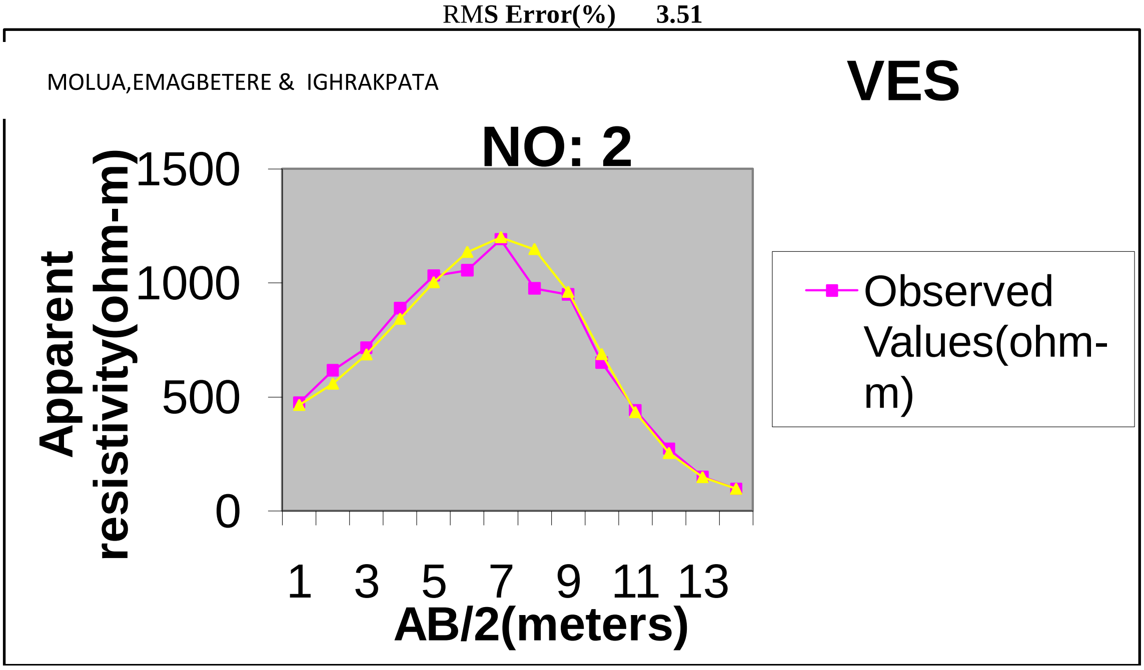

FIG 2

OBSERVED (Field) AND COMPUTED (Theoretical)DATA

AB/2 Values(m)	**Observed Values(ohm-m)**	**Computed Values(ohm-m)**
1.00	474.83	465.37
1.47	615.73	558.30
2.15	714.84	686.67
3.16	888.89	842.88
4.64	1031.57	1003.09

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6.81	1054.94	1135.85
10.00	1190.81	1200.29
14.70	975.76	1148.27
21.50	948.97	960.86
31.60	650.00	688.07
46.40	441.43	433.80
68.10	272.00	254.49
100.00	149.00	148.84
147.00	97.00	97.75

MODEL PARAMETERS

Geoelectric Layer	**Resistivity** (ohm-m)	**Thickness** (m)	**Cumulative** Thickness(m)
1	365.00	0.58	0.58
2	826.00	0.64	1.22
3	1634.71	3.94	5.19
4	1272.00	6.42	11.61
5	344.97	24.77	36.38
6	128.00	11.53	47.91
7	72.30	infinity	infinity

RMS **Error(%)** **3.51**

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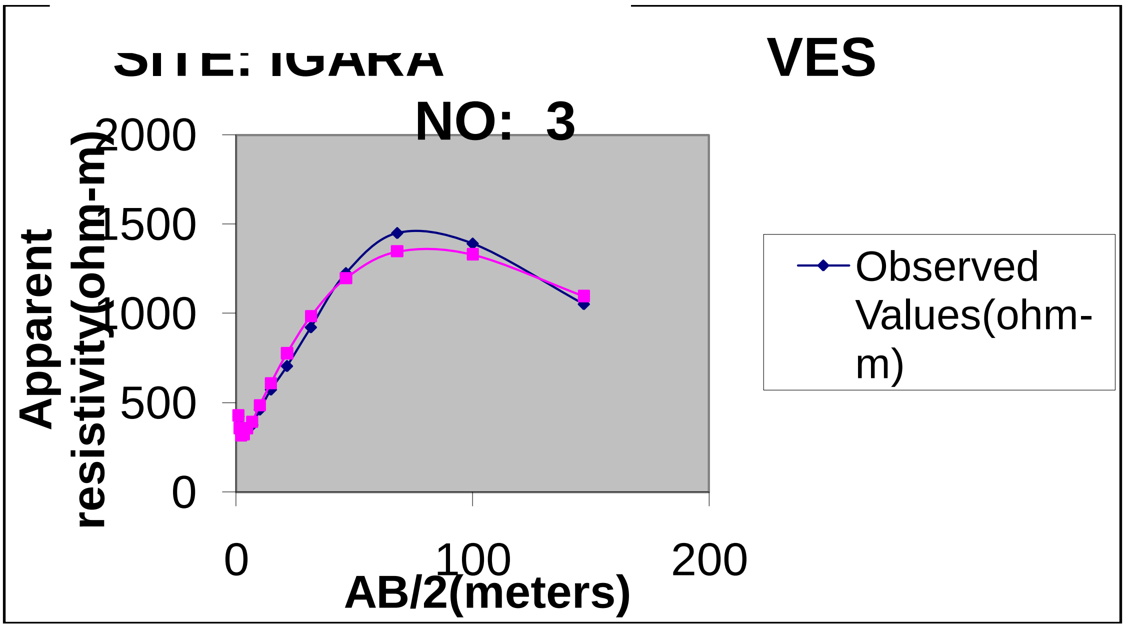

FIG 3

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OBSERVED (Field) AND COMPUTED (Theoretical)DATA

AB/2 Values(m)	Observed Values(ohm-m)	Computed Values(ohm-m)
1.00	422.30	430.23
1.47	375.26	360.10
2.15	323.22	318.67
3.16	322.38	324.62
4.64	360.13	358.56
6.81	375.00	394.30
10.00	460.00	487.23
14.70	572.00	609.42
21.50	704.00	777.16
31.60	921.00	984.41
46.40	1224.50	1197.44
68.10	1449.00	1346.84
100.00	1390.00	1329.97
147.00	1051.00	1096.76

MODEL PARAMETERS

Geoelectric Layer	Resistivity (ohm-m)	Thickness (m)	Cumulative Thickness(m)
1	583.58	0.56	0.56
2	189.91	0.70	1.26
3	396.34	4.39	5.65
4	978.00	7.06	12.71
5	2829.54	34.47	47.18
6	623.00	13.32	60.50
7	315.00	infinity	infinity

RMS **Error (%) 3.51**

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III. CONCLUSION

The result is that there was an initial increase in the curve showing high resistivity and shows presence of dry soil, but as the curve progressed, there was sharp drop as shown in computer interaction curves., therefore the curve showed that there was presence of clay which indicate the presence of water at resistivities 50.90

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and 31.20, 128.00 and 192.30 and finally 315.00 for the three resistivity sounding that was analyzed. In summary, from the analysis, it was shown that water could be found to a depth between 45.m to 60m in Igara area of Edo State. This result correlates with the result of the existing boreholes in the area.

REFERENCES

[1]. Asokhia M. B. (1995) Engineering Geology Samtos Service Ltd Lagos Nigeria.
[2]. Beck A .E. (1981) Physical principles of exploration method Mc Nigeria Association of petroleum of Eploratiornist.
[3]. Dobrin M. B. and Savit (1988) introduction to Geophysical presenting, fourth edition McGraw-Hill International edition.
[4]. Emenike E. A. (2001) Geophysical exploration for Groundwater in sedimentary environment: A Case study from Nanka over Nanka formation in Anambra Basic South Eastern Nigeria. Published in the Global of pace and Applied Sci. Vol. II 7 No 1.
[5]. Frohlich R. K. (1973) Detection of Fash water aquifers in Glacial deposits of North and Western Missionri by Geo electric methods wat Rev. Bull Vol 9 No 4.
[6]. Korfoed O. (1979) Direct Method of Interpreting Resisitivty observations Geophys Prosp. Vol. 13 N0 4.
[7]. Osemeikhan J.E.A. and Asokhia M. B. (1994) Applied Geophysics Santos Services Ltd.