GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES VOL. 13, NO. 2, 2007: 215 - 222
 ISSN 1118-0579

GEOELECTRIC STUDY OF THE CLAY DEPOSIT IN AGBEDE, ESTAKO WEST L. G. A., EDO STATE

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(Received 24 September 2004; Revision Accepted 17 July 2006)

ABSTRACT

A geoelectric survey for clay deposit was carried out in Agbede, Estako West L.G.A., Edo State. A total of Seven Vertical Electrical Soundings were carried out in different parts of the study area using the Schlumberger Configuration with a maximum current electrode spacing ranging from 1360 to 2000m. The data were interpreted using the conventional partial curve matching and computer aided iteration techniques.

The results showed a vertically varying succession of low resistivity (3-30 Ωm) geoelectric layers throughout the study area depicting a thick clay layer of thickness ranging from 55 to 209m. This was correlated with a borehole lithologic log. Clay deposit was intercepted at all the sounding stations.

KEYWORDS: Clay, Geoelectric, Agbede, Resistivity, layers

INTRODUCTION

Clay and shales are abundant in the sedimentary basins of south eastern Nigeria, including parts of Edo and Delta States (Akpokoje et al; 1991). Rock particles found in sedimentary formation range in diameter from a fraction of microns (fine grained particles) to many millimetres (coarse grained particles and conglomerates). Clay refers to the finest grained particles in the sediment with particles less than two micron (2μm), which is a product of diagenesis. Clays have various industrial and domestic uses. They are used in the manufacture of pottery and ceramic wares, filters, and coating. They are also used for the production of papers, bricks and fertiliser.

The study area, Agbede is known for its clay deposit based on the studies of Omavuezi and Boafo (1983) and Project Development Institute (PRODA), 1978 who have investigated the occurrence of clay in parts of Edo State. This paper report the results of geoelectric studies carried out in the study area to obtain the thickness of the clay layer so as to determine whether they are of commercial quantity for use as raw materials as mentioned earlier.

The geoelectric method has been used successfully for subsurface investigation for ground water (Zohdy et al; 1974, Ako and Olorunfemi, 1989; Okweze E.E. 1996; Olorunfemi et. al., 1999). Ananaba et. al. (1993) used this method to study the gravel deposit at Ihiagwa, Owerri. Afolabi et. al (2004) have successfully used the resistivity method to investigate kaolin deposit at Ikere area of Ekiti State. The geoelectric method has been successfully used for Dan site investigation (Olorunfemi et. al., 2000). Electrical resistivities of the layer and the layer thickness and depth were obtained from this method.

GEOLOGY OF THE STUDY AREA

The study area is a suburban community, which lies between Irua and Auchi (Fig. 1). It falls within the Imo shale Formation, which is overlain by Bende Ameki Formation. It is underlain by Tertiary sediments consisting of silt stone, silty clay, clay and shales. The Imo Shale unit was deposited during the Paleocene. It outcrops as an arcuate belt from western Nigeria to the east (Asseez 1989). It consists of a thick clayey shale, fine textured dark grey to bluish grey with occasional admixture of clay ironstone and thin sandstone bands. It attains a thickness of about 500m between Umuahia and Okiqwe along the Imo river (Kogbe 1989). The Ameki Formation constitutes the main bulk of Eocene strata overlying the Imo Formation. In Bende division, Ameki strata consist of rapidly alternating shale, sandy shale and mudstone, clayey sandstone and fine grained argillaceous sandstone with thin limestone bands (Asseez 1989). The geological map of Edo State is shown in Figure 2.

FIELD PROCEDURE

The surface geoelectric method was considered suitable for the investigation because resistivity, thickness and depth information would be obtained which would later be interpreted to determine the extent of the clay deposit.

Seven vertical electrical sounding stations were established and surveyed using the Schlumberger electrode arrangement. The maximum current electrode separation AB ranged from 1360m in some VES stations to 2000m in others, depending on the availability of space for the long spread, while the potential electrodes were varied accordingly.
The Signal Averaging System (SAS 300C) Terrameter with a booster SAS 2000 was used for the acquisition of the data. The booster enabled the current to penetrate deeper.

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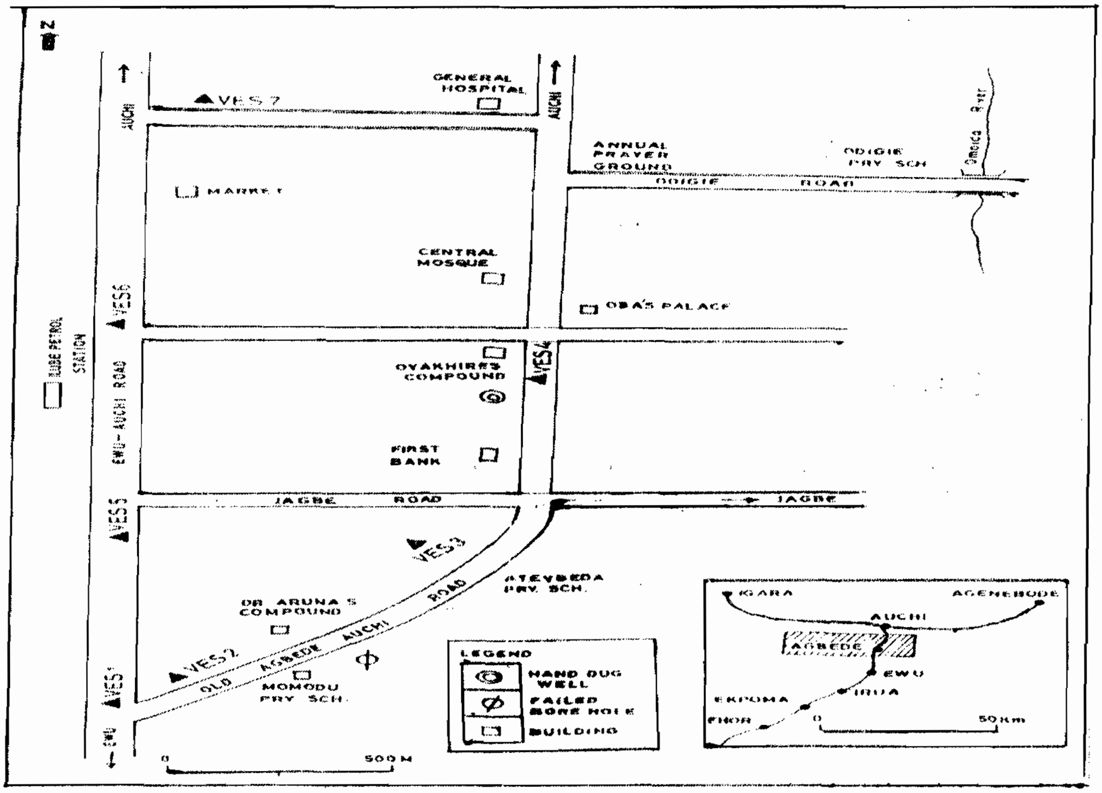


Fig. 1: Location map of study area showing VES points

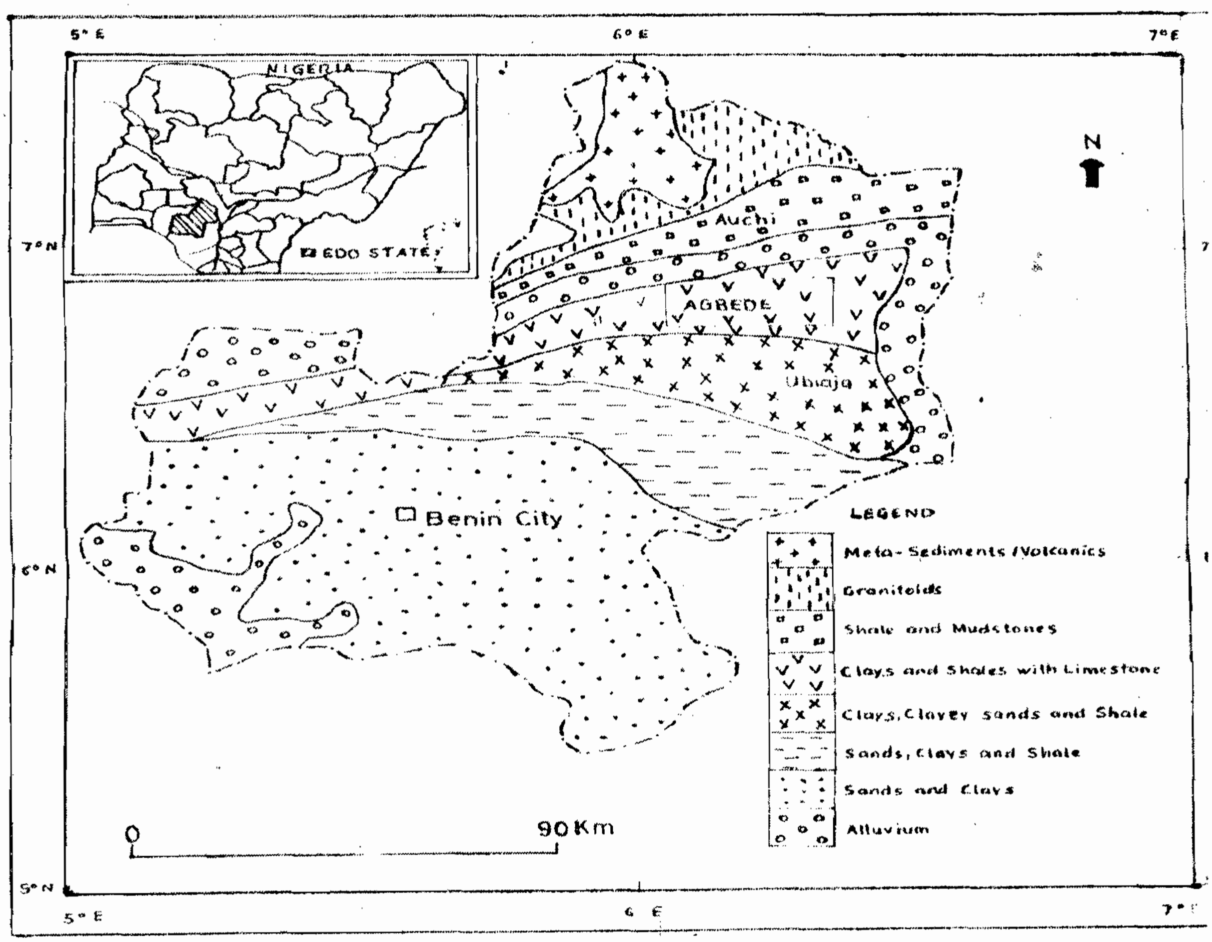


Fig. 2: Geological Map of Edo State showing Study Area

The apparent resistivity values obtained from the geoelectric survey were plotted against half current electrode separation on a log-log graph. Figure 3 shows the typical sounding curves of the VES stations.

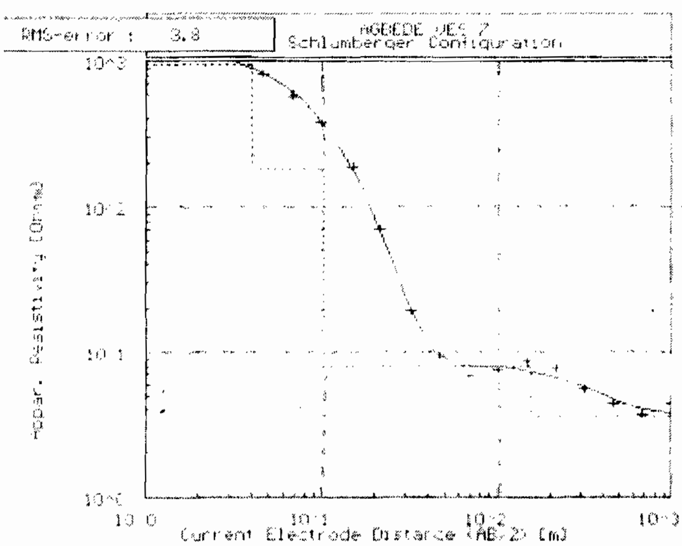
The VES curves were interpreted quantitatively by partial curve matching using two layer model curves and the corresponding auxiliary curves. This method involves matching small segments of the field curve with appropriate theoretical curves in order to determine the thickness and apparent resistivity of a particular layer. The results of curve matching provided starting models that were then used for computer iteration using the resist computer software (Vander Velpen, 1988). The VES results from the interpretation are presented as geoelectric sections (Fig. 4).

RESULTS AND DISCUSSION

The observed typical depth sounding curves in the study areas are five layer KQH, QQH, HKQ, and QQQ– type curves respectively (Fig 3).
The geological interpretation of the geoelectric models resulting from the quantitative interpretation of the VES curves was based on an abortive borehole lithology obtained in the vicinity of the survey area (Table 1).

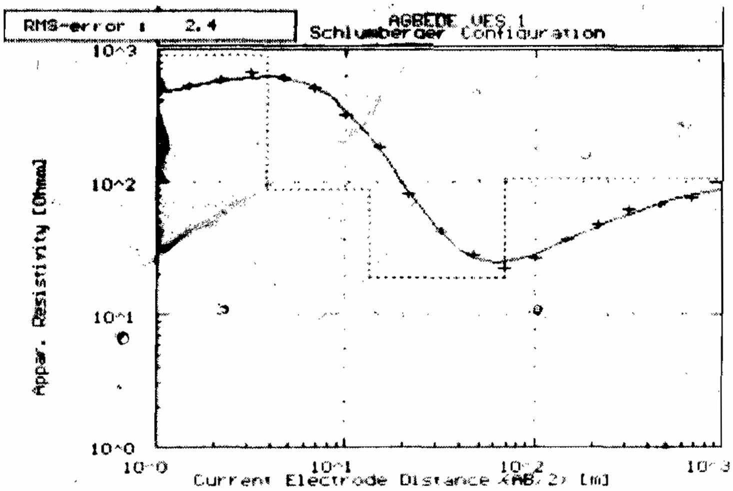
Table 1. Lithological log of abortive borehole in Agbede Primary School

0 – 8m		Lateritic top soil
8 – 45m		Clay (Grayish)
445 – 75m		Clay (Hard Grayish)
75.3 – 100m		Silt
100 – 185m		Clay (Grayish Plastic)
185-225m		Clay
255 302m		Shale (Dark Greyish)
302 346m		Clay
The total depth is 346m.		

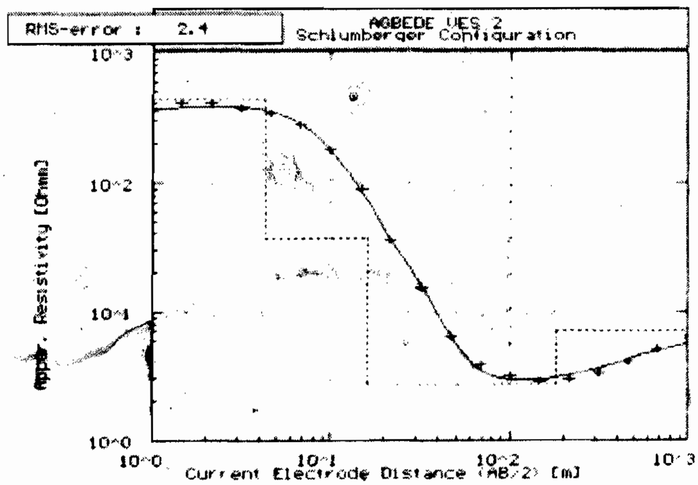


No	Res	Thick	Depth
1	1273.6	1.0	1.0
2	943.2	3.0	4.0
3	185.4	6.1	10.1
4	4.9	143.2	153.3
6	3.6	-.-	-.-

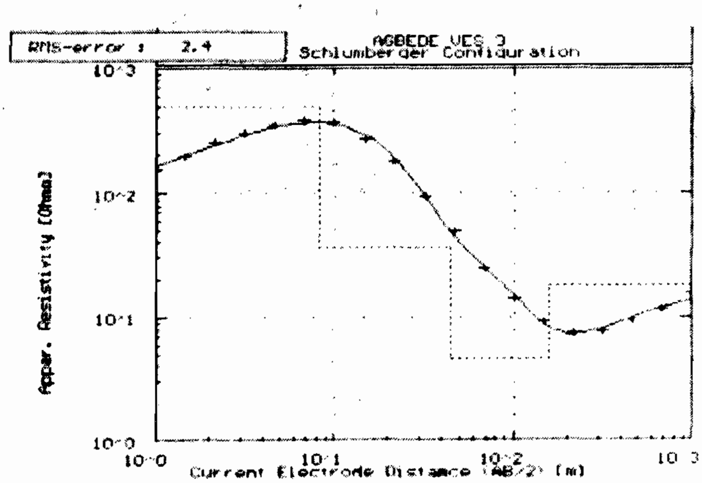
Fig. 3a: Typical sounding curves of VES stations



No	Res	Thick	Depth
1	426.7	0.9	0.9
2	883.6	2.9	3.8
3	88.8	9.4	13.2
4	19.1	55.8	69.0
5	106.2	-.-	-.-

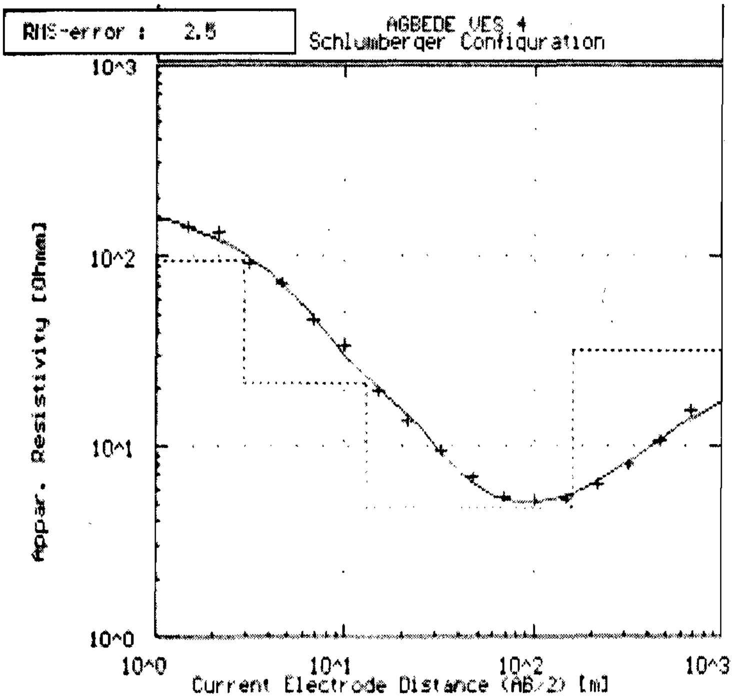


No	Res	Thick	Depth
1	359.3	0.8	0.8
2	434.4	3.5	4.3
3	37.3	11.7	16.0
4	2.7	167.4	183.4
5	7.1	-.-	-.-

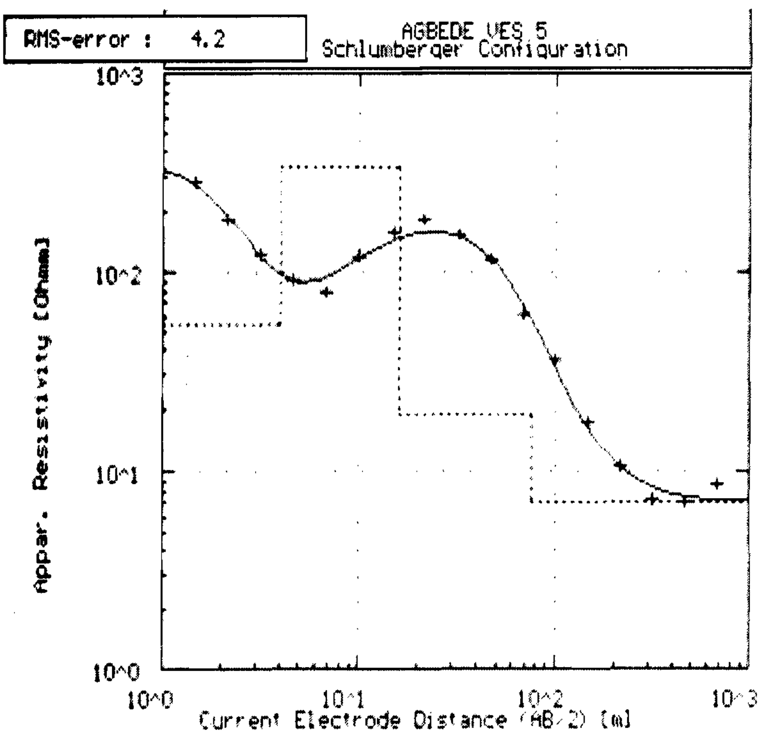


No	Res	Thick	Depth
1	136.8	0.7	0.7
2	405.6	7.4	8.1
3	35.8	36.9	45.0
4	4.5	113.4	158.4
5	17.8	-.-	-.-

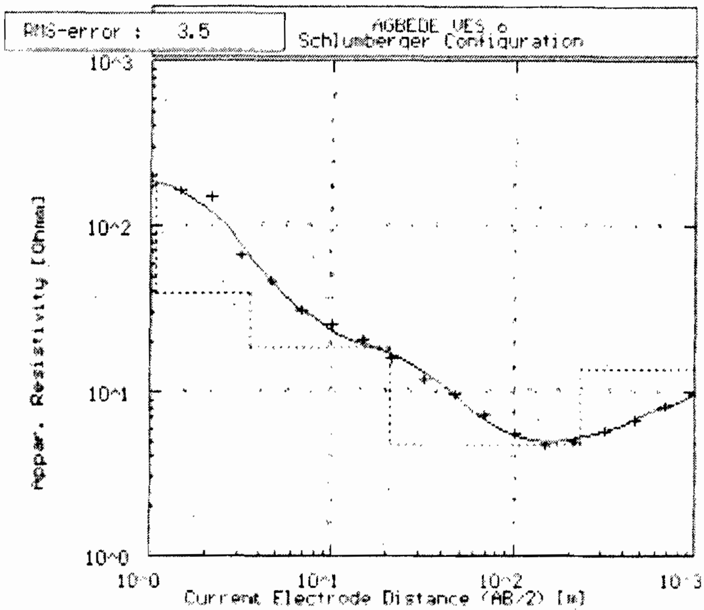
Fig. 3b Typical sounding curves of VES stations



No	Res	Thick	Depth
1	169.9	0.9	0.9
2	94.7	2.1	2.9
3	21.6	10.0	12.9
4	4.7	146.2	159.1
5	31.7	-.-	-.-



No	Res	Thick	Depth
1	379.7	1.0	1.0
2	54.5	3.0	4.0
3	342.7	12.1	16.1
4	19.0	59.3	75.4
5	7.1	-.-	-.-



No	Res	Thick	Depth
1	209.3	1.1	1.1
2	39.[illegible]	2.5	3.5
3	18.2	17.2	20.7
4	4.6	209.4	230.1
5	13.9	-.-	-.-

Fig. 3c Typical sounding curves of VES stations

The first geoelectric layer beneath the VES stations has resistivity which varies from 136 to 1274Ωm reflecting the variable composition and moisture content of the topsoil with thickness ranging from 0.7 to 1.1m.

The second geoelectric layer has resistivity values ranging from 39 to 943Ωm corresponding to Clayey - lateritic soil. The thickness of this layer ranges from 2.1 to 7.4m. The third layer has resistivity values ranging from 18 to 342Ωm corresponding to clayey to Silt layer with thickness ranging from 6 to 36m.

High conductive clay horizon was intercepted in the fourth. The resistivity of this layer ranged from 2.7 to 19 Ωm corresponding to a low resistive clay layer. The thickness of this layer ranges from 59 to 209m.

The fifth layer shows an increase in resistivity values from 7 to 106Ωm and the lithology of this layer may probably be a shale layerj beyond which the lithology is uncertain.

These results correlate favourably with the lithologic log from the abortive borehole drilled around VES station 7.

The maximum thickness of the clay layer from the geoelectric section is about 230m in agreement with deductions of Kogbe (1989). Summary of the resistivity sounding result is shown in Table 2.

Table 2. Summary of results.

VES Stations	No. Of Layers	Total Depth Penetrated	Approximate Clay Thickness
1	5	69	55
2	5	183	167
3	5	158	113
4	5	159	146
5	5	75	59
6	5	230	209
7	5	153	143

CONCLUSION

This paper describes the geoelectric survey of Agbede clay deposit. The survey involved a total of seven deep vertical electrical soundings (electrode separation AB/2 varied from 680 – 1000m) using the Schlumberger method. The VES results presented as geoelectric sections identified five subsurface layers of which layer four is a thick clay layer as shown on the geoelectric section (fig. 4).The result reveals that the study area has an extensive clay/shale unit with an average thickness of about 126m. The maximum depth obtained from the interpretation of the geoelectric data was about 230m. This area offers a large deposit of clay layer that may be of economic significance and could be exploited for commercial purposes

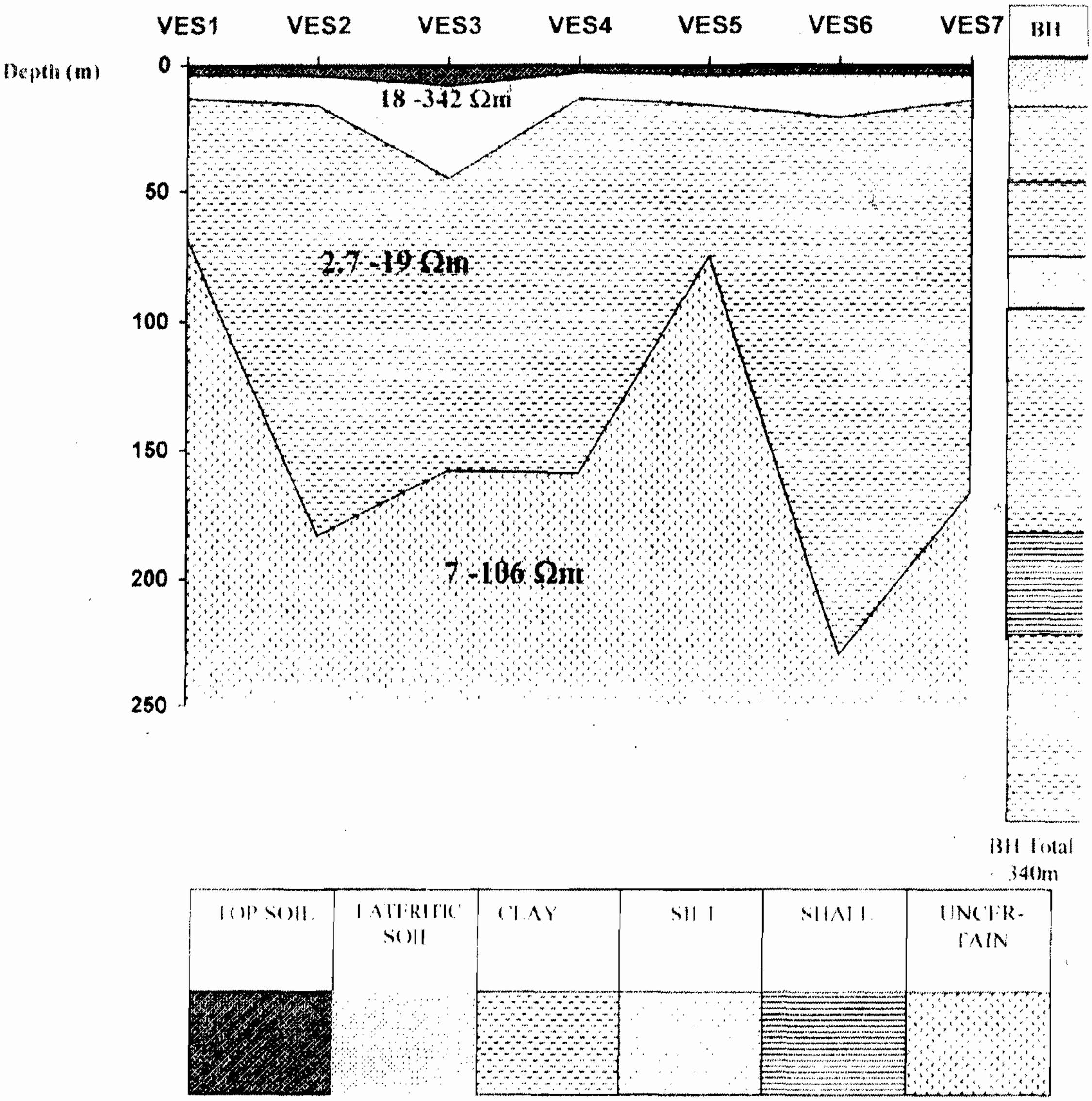


Fig 4. Geoelectric section of Agbede

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