IOSR Journal Of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 12, Issue 2 Ser. IV (Mar. – Apr. 2020), PP 66-76
www.Iosrjournals.Org

Eletrical Resistivity Mapping for Intrusive Rocks in Lekwesi, Community, Umuneochi L.G.A Abia State, Nigeria.

Nkporbu, cornelius[1],prof. C.I Eze[2], prof E.D Uko [3]
[1, 2, 3,] *Department Of Physics, Rivers State University, 500001, Port Harcourt Nigeria*
Corresponding Author: Nkporbu, Cornelius

Abstract: *The survey electrical resistivity mapping for intrusive rock in Lekwesi Community in Umuneochi,LGA,Abia state, Nigeria. The sole aimed of the survey was carried out to detect the presence of intrusive rocks in the community and its environs. The study area is underlain by the Benin formation which is within the Niger – Delta Basin. The survey (Vertical Electrical Sounding) was conducted at twelve (12) different locations using the Schlumberger array with a maximum electrode separation of AB/2 = 90m. after adequate and proper connection of the equipments involved in survey followed by the normal spread, the survey conducted and the data accurately acquired. The data was interpreted using the 2D – inverse interpretation resistivity software. The resistivity values of the geo – electric layers vary between 200 m which relatively revealed the Lithology of the area as mainly composed by sands, and alternating sequence of clays and silts from the interpreted data and information obtained from iso-resistivity model and also the resistivities value, it is clear that greater part of the survey area are mostly clays and sandstone. However, from the two survey locations (VES location 11 to VES location 12) which are towards the northerner part of the community very close to Lokpa – Ukwu community clearly shows or indicates the presence of intrusive rocks based on their resistivities values; and the total average over burden thickness is about 10.7m.*

Key Word*: Intrusive Rocks; Overburden Thickness; Resistivity; Schlumberger array, vertical electrical sounding.*

Date of Submission: 16-04-2020 Date of Acceptance: 01-05-2020

I. Introduction

Intrusive rock, which is also known as plutonic rock, igneous rock are generally formed from when magma forced into older rocks at depths within the Earth's crust which then slowly solidifies below the Earth's surface, though it may later be exposed by erosion. Igneous intrusion form a variety of rock types.

Generally, this intrusive rocks crystalize from magma that have been intruded into the earth's crust at depth far below the surface. These intrusions are then usually exposed millions or billions of years later through the process of uplift, mountain – building, and even erosion. Other intrusive rocks are discovered through deep – drilling programs. Country rocks is the surrounding rock that the magma invades. A contact then separates the cooled intrusive rock from the county rocks. Contacts are rarely straight lines, are quite irregular and mark the change in rock types. The edge of the intrusive rock is usually very fine grained because it is here where the most rapid cooling took place. This edge of the intrusion is called chill zone. The grain size in the intrusion increases away from the chill toward the center, where it remained the hottest for the longest time.

The intrusion rock often contains xenoliths – fragments of the country rock that were turn away during the emplacement of the magma and that are generally most abundant.

II. Location And Geology Of The Study Area

The study area is located in LEKWESI community in Umuneochi L.G.A of Abia state, Nigeria. LEKWESI is located at within $5^{0}55^{l}$N through $5^{0}60^{1}$N (latitude) and the longitude $7^{0}25^{1}$E through $7^{0}30^{1}$E.The community lies 5.13km from the Port-Harcourt – Enugu express way to which it is connected by an earth Road.The study area is overlain by the Benin formation which consists of lenticular, unconsolidated and sandy sediments. The community occupies an area of 20.92 hectares of land. The community has a population of 190,928, according to the 2006 Nigeria National Census. The area has a humid tropical climate, having a mean annual rainfall of 2255mm and a mean annual temperature range of 27 – 30 degrees Celcius. The type of rain fall prevalent in this area is Orographic rainfall. The intrusive area is characterized by thick and dense vegetation typical of the tropical rainforest. The fine-grained soil, mostly clay, shale, silts and mixture of these and sands support luxuriant plant growth. The vegetation however is denser in the parts directly overlaid by the Asu-River Group (8).

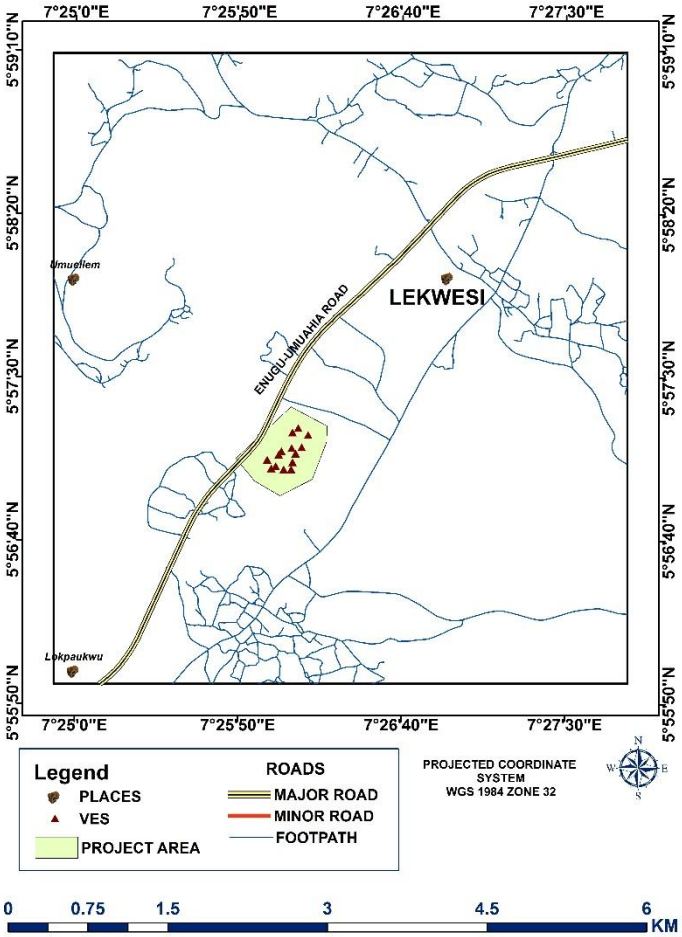


Figure 1: Showing map of study area

III. Material And Methods

The method adopted for the completion of this research work is divided into two parts.

- The desk studies
- The field work

The desk studies encompassed planning and decisions including map production, consultations with some materials relating to my research (including theories) that are relevant to the prospect in view data computation, reduction, data processing, data presentation and data interpretation.

While, the field work is concerned with feasibility and reconnaissance studies which includes scouting of the area of the study, nothing down important locations, hazardous spots that could constitute obstacles during field operations, settlements, roads, rivers relief, power equipment, flow stations, outcrops, Lithogic units, attitude and the real time date acquisition.

MATERIAL FOR THE STUDY

The instruments employed for the research work include

- ABEM Terrameter SAS 3000c
- Etrex GPS
- Compass
- Two 500m current cable reels
- Four stainless electrodes
- Four hammers
- Two measuring tapes

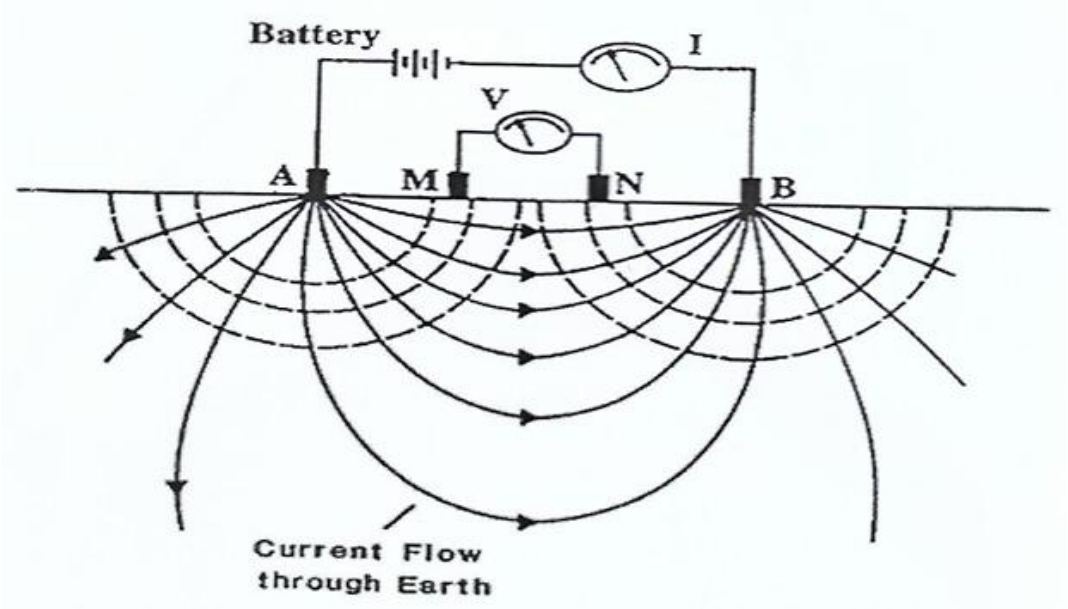


Figure 2: Schumberger array (after Lowrie 1997)

METHOD:The method used is the schlumberger configuration (figure 2). twelve (12) resistivity sounding points and one control point were carried out using the schlumberger configuration. All the sounding points were geo – referenced. The purpose of the VES was to obtain knowledge of the areas of the intrusion and principally the average overburden thickness where the pyroclastic occur.

The vertical electrical sounding (VES) were carried out in the area using the schlumberger electrode configuration and a maximum current electrode spacing AB/2 = 90m. the AbemTerrameter SAS 3000c was used to acquire the data. It has a liquid crystal digital rea out and an automatic signal averaging microprocessor. Four stainless non – polarizable electrodewere used, two current electrodes and two potential electrodes. A fully charged 12V DC battery was used to supply current. The current electrode spacing was increased symmetrically about the station point. Keeping the potential electrode constant until it becomes necessary to increase the potential electrode and the recorded signal diminished. The AB/2 range from 1.5m to 100m to sound depths from about 1m to 60m. the potential electrode spacing (p1 p2) ranged from 0.5m to 50m. the geometric factor G, was calculated for each spread. The apparent resistivity values computed were plotted against half of the current electrode spacing (AB/2) on a log. Log graph scale. The results later served as input for a computer assisted interpretation using the 2D – inverse interpretation resistivity software.

IV. Result and discussion

Interpretation of result for VES location 1

AT VES LOCATION 1 - It is noted that, this shows a four-layer subsurface structure with the resistivity values ranging 172 Ωm for layer 1,105ΩmΩm, for layer 2, 9.8 for layer 3, 7312 Ωm at layer 4, The thickness of the topsoil is about 2.49m, and the thickness for layers 2 and 3 are 4.45m and 13.8m respectively. While the depth of penetrationare 2.49m, 7.14m and 20.9m. Therefore, comparing the resistivity value with the range of resistivity for common rock type, it shows clearly that intrusive rocks cannot be located at this location. The value shows that the location is mostly of shale and sand stone. And has QH curve type.

Figure 3: showing curve generated for VES location 1

Interpretation for VES location 2.

AT VES LOCATION 2 – The apparent resistivity curve for location 2,shows a four-layers subsurface structure with resistivities values,35.8Ωm, 1454Ωm, 148Ωm, 50.6Ωm.

While the thicknessare 0.51m, 0.649m, 5.9m. And the depth of penetration are 0.51m, 1.16m and 7.06m respectively. While the curve type is the KQ. So,Based on this values, it shows that the location will consist of mostly shale and salty water.

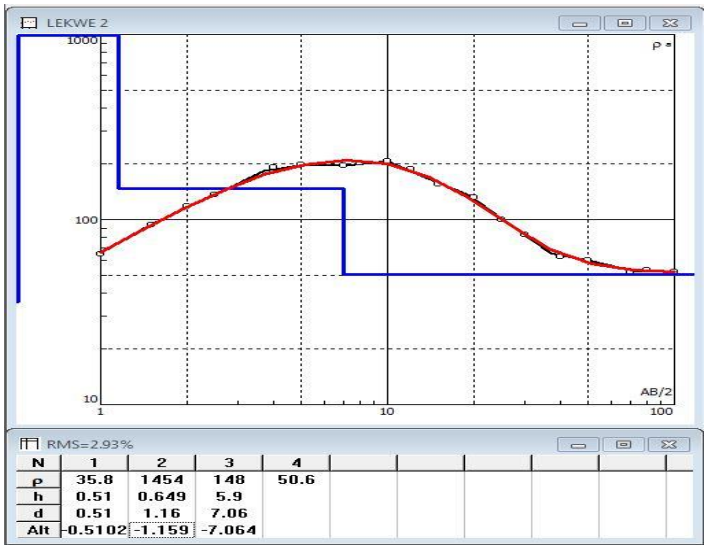


Figure 4: showing curve generated for VES location 2

Interpretation of result for VES location 3

AT VES LOCATION 3 - It consist of four layers subsurface structure with values for the resistivity's as 66 Ωm, 115 Ωm, 84 Ωm and 600 Ωm respectively for layers 1 to 4 while the thickness are 0.751m, 2.33m, and 20.4m for the three layers. And the depth of penetration are 0.715m, 3.08m and 23.5 for the various layers. From the resistivity's values, it shows that there is completely absent of intrusive rocks rather what is predominantly present in this location is clay and sandstone. The curve type is QH.

Figure 5:showing generated for VES location 3.

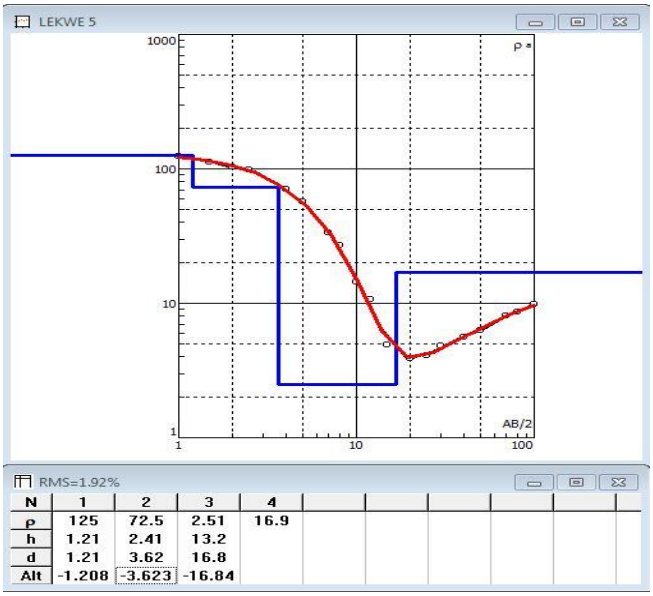
Interpretation of result for VES location 4

AT VES LOCATION 4 - Again it consist of four layers subsurface structure with a vary resistivities values such as 72.3 Ωm for layer 1 and 2.05 Ωm for layer 2, 14.7Ωm for layer 3 and 94.8 Ωm for layer 4. The thickness as well as the depth at this location is equally very low. The thickness for the layers respectively are 1.29m, 2.06m and 14.8m. While the depth are 1.29m, 3.35m. and 18.1m. And the curve type is QH. Also intrusive rocks cannot be located at this very place rather there is abundant of clay and shale

Figure 6: showing curve generated form VES location 4

Interpretation of result for VES location 5

AT VES LOCATION 5 - The location has four layers' subsurface structure with relatively very low resistivity values for the various layers, 125 Ωm, 72.5 Ωm, 2.5 Ωm, and 16.9 Ωm for the various layers respectively. With thickness 1.21m, 2.41m, 13.2m and the depth of penetration are 1.21m,3.62m and 16.8m for the first, second and third layers. While the curve type for this location is the HK type. The locations predominantly consist of clay and shale with water also.

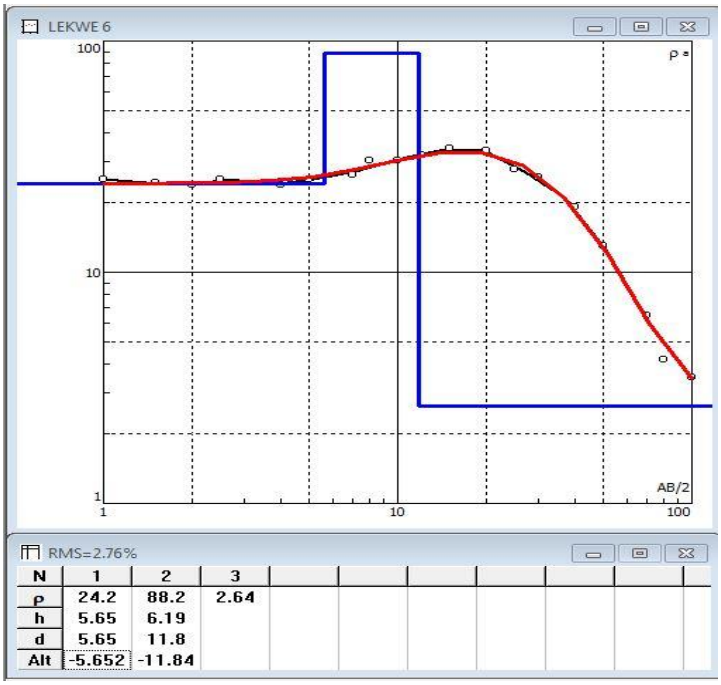


N	1	2	3	4
ρ	125	72.5	2.51	16.9
h	1.21	2.41	13.2	
d	1.21	3.62	16.8	
Alt	-1.208	-3.623	-16.84	

Figure 7: showing the curve generated form VES location 5

Interpretation of result for VES location 6

AT VES LOCATION 6 - The apparent resistivity curve for this location shows a three layers subsurface structure with 24.2 Ωm as its resistivity value for layer 1 and 88.2 Ωm and 2.64 Ωm as the resistivity values for layer 2 and layer 3. The thickness is 5.65m and 6.19m while the depth is 5.65m and 11.6m. the shape of the curve here is the K type. There is predominantly the presence of brackish water shale at the location.



N	1	2	3
ρ	24.2	88.2	2.64
h	5.65	6.19	
d	5.65	11.8	
Alt	-5.652	-11.84	

Figure 8: showing the curve generated form VES location 6

Interpretation of result for VES location 7

AT VES LOCATION 7 - This location consist of four layers, layer 1, has 42.9 Ωm resistivity value with thickness of 0.5m and depth of penetration is also 0.5m at the topsoil and the resistivity value for layer 2 to 4 are 0.5 74 Ωm, 7.33 Ωm and 1668 Ωm. And the thickness for layer 1 and 2 are 0.836m and 8.22m with depth of penetration as 9.56m and 1.34m respectively. There is predominantly clay and shale at this location.

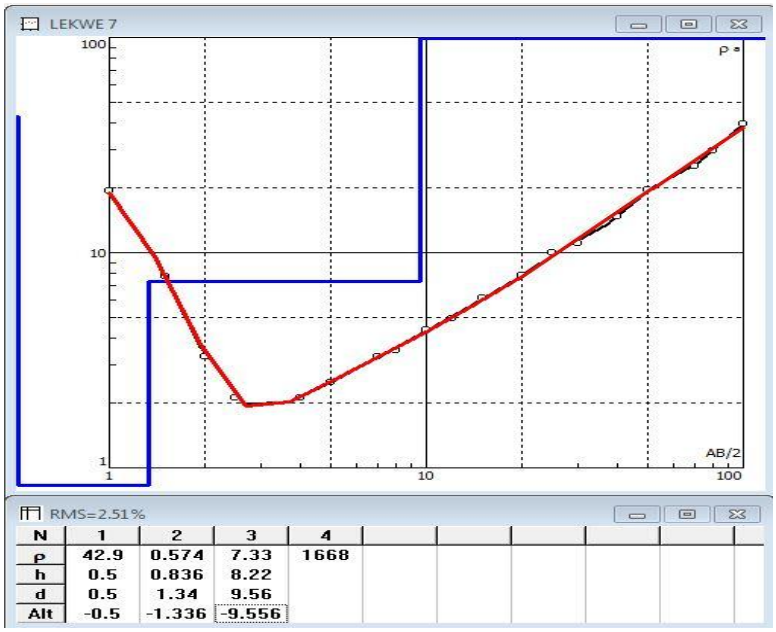


Figure 9: showing the curve generated form VES location 7

Interpretation of result for VES location 8

AT VES LOCATION 8 - The location has four layers subsurface structure with the following resistivities values for each of the layer, layer 1.92.1 Ωm, layer 2. 36.2 Ωm, layer 3. 6.48 Ωm, and layer 4. is 105 Ωm. The corresponding thickness and depth of penetration are 1.34m, 8.2m and 15.9m and 1.34m, 9.5m, 25.5m. the curve type for this location is the QH type. Predominantly there will be the presence of salty water and clay with little amount of sandstone at this location.

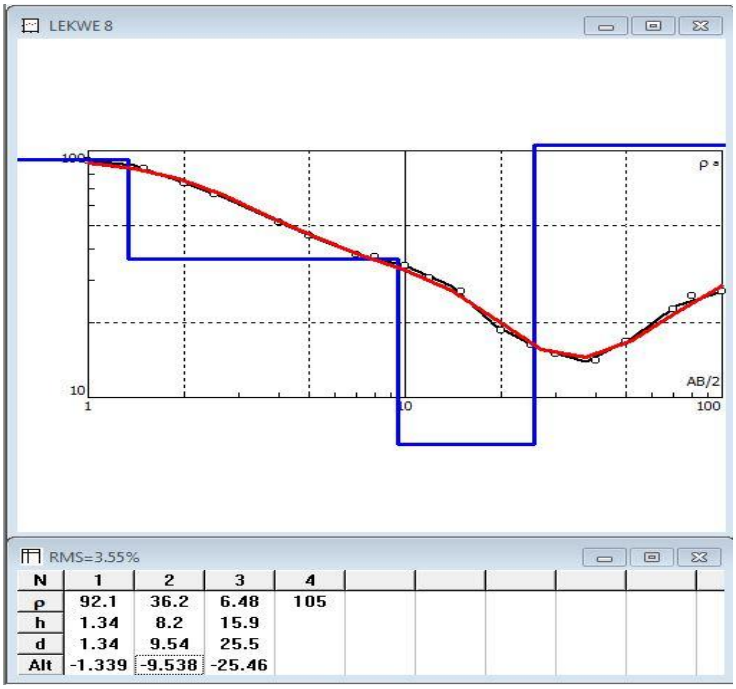


Figure 10: showing the curve generated from VES location 8

Interpretation of result for VES location 9

AT VES LOCATION 9 - the location has three layers subsurface structure with the following resistivities for the various layers for layer 1, the resistivity value is 101 Ωm, layer 2. 2.51 Ωm as the resistivity value for layer 3. The thickness are 1.98m and 12.5m for the layer 2 and 3 respectively while the depth of penetration are 1.98m and 14.5m respectively also. With the low resistivities value, clays and salty water will be predominantly presence at this location. The shape of the curve type is HK.

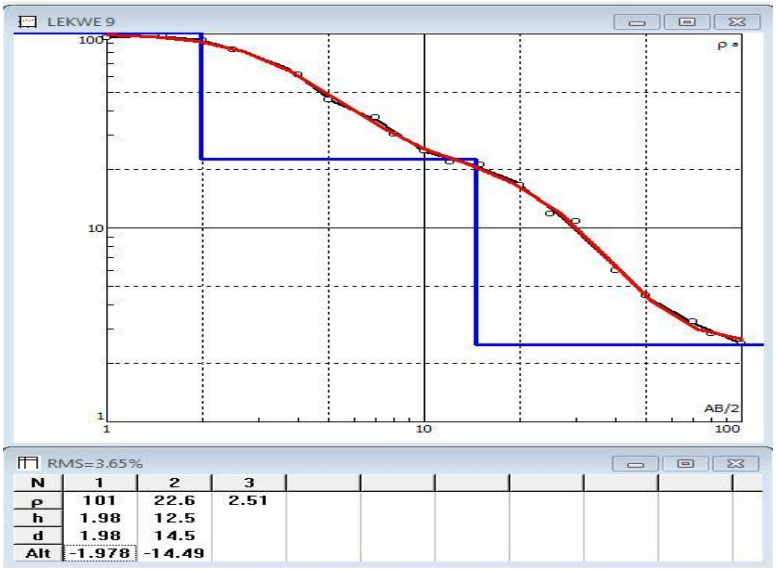


Figure 11: showing the curve generated form VES location 9

Interpretation of result for VES location 10

AT VES LOCATION 10 - The location has four layers subsurface structure and the resistivities values for the various layers are 333 Ωm, 146 Ωm, 3388 Ωm and 525 Ωm respectively. While the thickness and depth of penetration are 0.931m, 7.81m, 8.94m and 0.931m, 8.74m, 17.7m accordingly. The curve type at this location is the HA curve type. Here there will be the presence of shale and sandstone.

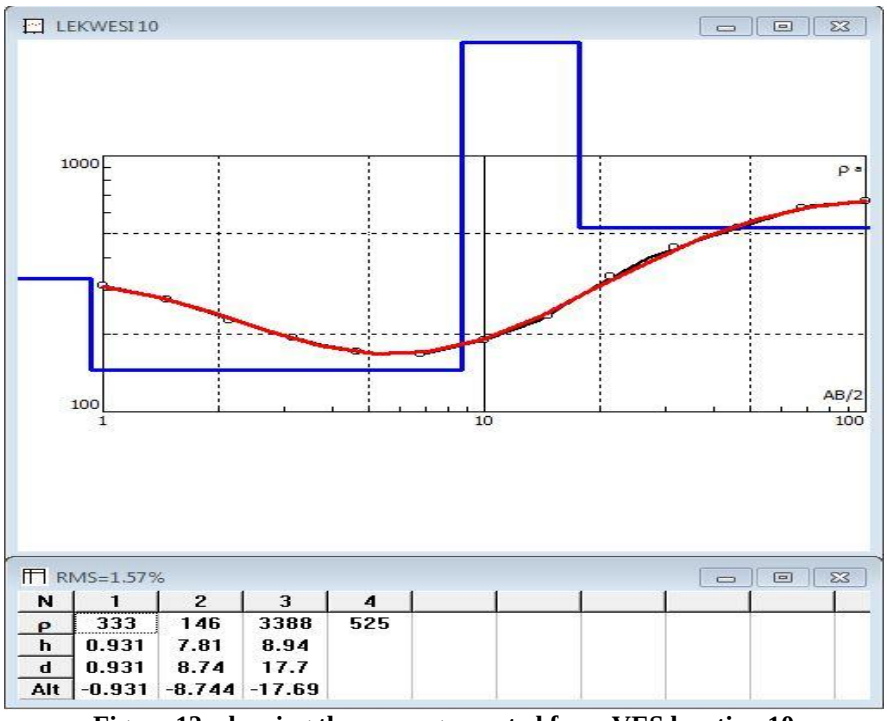


Figure 12: showing the curve generated form VES location 10

Interpretation of result for VES location 11

AT VES LOCATION 11 - The location consists of three layers subsurface structure with a low resistivities value that shows the presence of clay and shale. The resistivities value are 88 Ωm, 372 Ωm and 107 Ωm for the first, second and third layers respectively. The thickness and depth has the following values; 1.34m and 66.7m for thickness and 1.34m and 68m for the depth. The curve type here is the AK curve type.

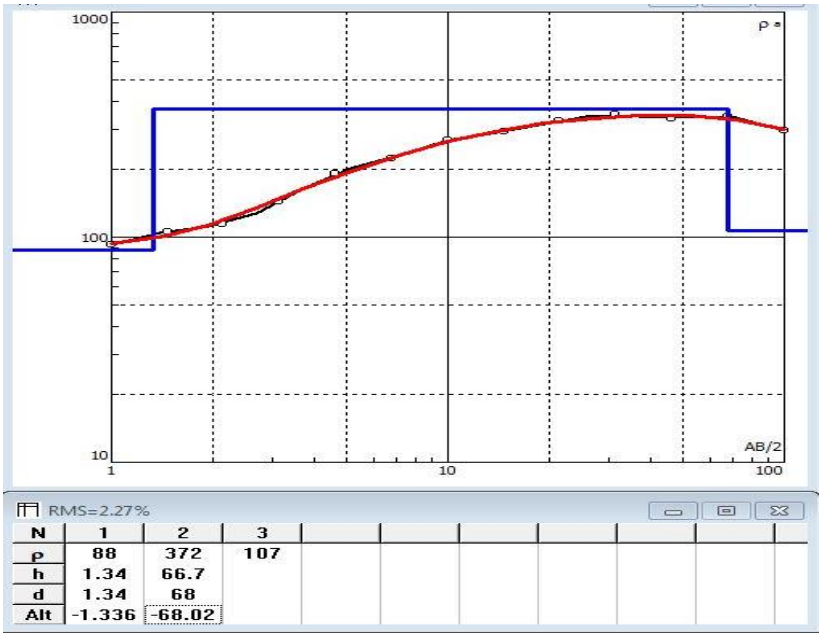


Figure 13: showing the curve generated form VES location 11

Interpretation of result for VES location 12

AT VES LOCATION 12 – The apparent resistivity curve for this location indicates three-layers subsurface structure. And the location is towards the north side of community (lekwesi) the study area, very close to Lokpa-ukwu community. The high values of resistivitiesin this location indicated the presence of intrusive rocks at this location. The resistivities values are 1010 Ωm and 395 368 Ωm respectively, comparing this with the range of resistiveties for common rock type shows clearly that there is the presence of intrusive rocks at this location. The thickness and depth of penetration are 10.7m, 11.3m and 10.7m, 22.1m respectively. It is advisable to move towards this direction for a profitable mining. So it can be clearly established that, towards the northerner side of the community, closed to Lokpa-ukwu community, there will be intrusive rocks because of the resistivities values at this location.

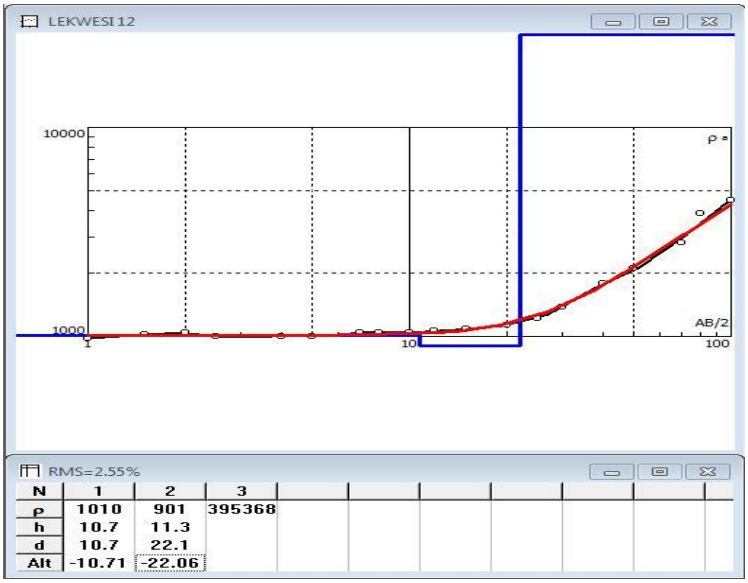
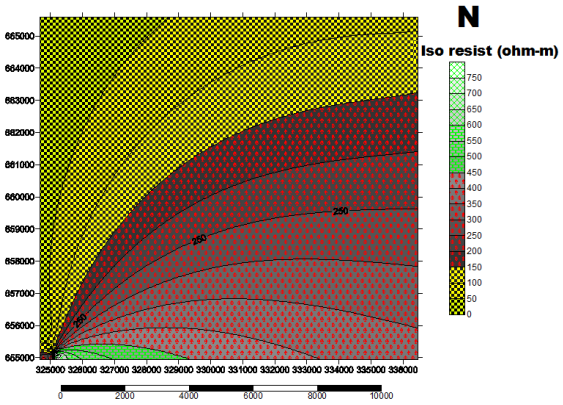
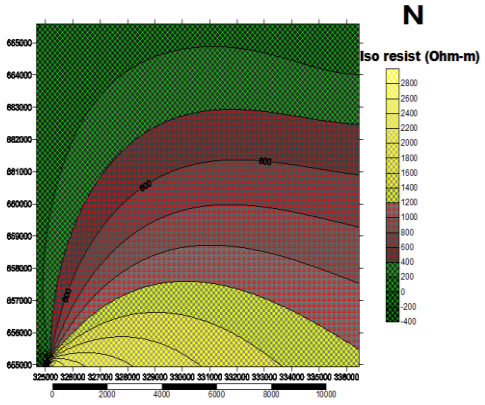


Figure 14: showing the curve generated from VES location 12

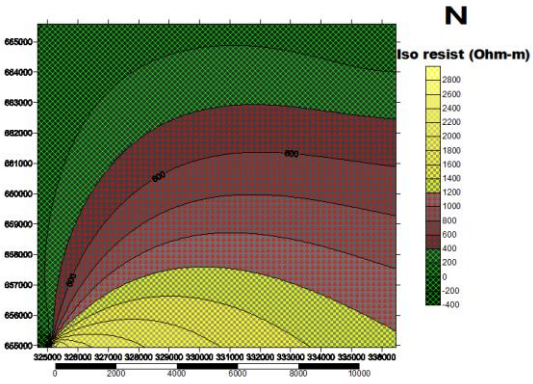
Resistivity contour maps display the lateral variation in the surface geology of the area. The area with low resistivity value indicate the occurrence of relatively good conductors and the lowest resistivity value obtained was 1.8 Ωm at VES location 3 while those with high value indicate very poor conductors and the highest resistivity value obtained were 395368 Ωm that generally indicates the presence of intrusion which is towards the north side of the community.



ISO – RESISTIVITIES (5M)



ISO – RESISTIVITIES (30M)



ISO – RESISTIVITIES (50M)

V. Conclusion

From the resistivities values gotten from the various VES location point at the study area and the inferred lithology obtained shows a dominant sand unit profiles, various part of the study area also consists of sand stone and clay. The northerner direction of the community or the study area where there is the presence of intrusive rocks is relative very far from the community (Lekwesi). And the two VES locations that shows where this rocks are presence are VES locations 11 and 12. And the depth to the intrusion is between 10.7m to 22.1m. few quarries companies are operating within the area.

Aknowledgement

Let me sincerely thank Mr.VurasiBaate for offering useful suggestions and ideas that enabled the completion of this research work and the good people of Lekwesi for granting me the opportunity to carried out the survey in their village, God bless you. And also to my wife for her supporting role.

References

[1]. Reyment, R.A, Aspect of Geology of Nigeria Ibadan University press, 56 – 63, (1965)
[2]. Koefoed O, Geosounding principles, resistivity sounding measurement (nertherland, Elsvier scientific publishing company, 1979).
[3]. Obiora and Umeji, petrography of some altered intrusive rocks from the lower Benue Rift; Journal of mining and Geology Vol. 41, 2005, No 1, pg 1- 8
[4]. Abam TSK and Ngah S.A Evaluation of sub – soil geo – electric properties in A proposed power sub – station site AtEbubu, rivers state, Nigeria – Tks Aba mint. Journal of engineering research and application 4 (9), 2014, 45 – 52
[5]. Udo, R.K, the Geographical regions of Nigeria, Heinemann educational books, London and university of califonia press, 1970, 232 pages 2.
[6]. Slictter L.B, principle of geophysics, 1933.
[7]. Telford, W.M, geldart, L.P, sherriff, R.E and keys, D.A, applied geophysics, Cambridge university press, 1976, 120 – 125.
[8]. Keller, R; Dipole method for deep resistivity (1997).
[9]. Kogbe, C.A, paleogeographic History of Nigeria from Albian times, (1980).
[10]. Ghosh, D.P and Koefoed, O, the application to liner filter theory of the direct interpretation of geoelectric resistivity sounding measurement geophysics journal 1986, 80, 100 – 136.

Nkporbu, cornelius. "Eletrical Resistivity Mapping for Intrusive Rocks in Lekwesi, Community, Umuneochi L.G.A Abia State, Nigeria." *IOSR Journal of Applied Physics (IOSR-JAP)*, 12(2), 2020, pp. 66-76.