Geo-electrical Investigation of Groundwater Potential at The Polytechnic,Ibadan,North Campus Southwestern, Nigeria

Adejumo S.A,Oyerinde A.O,Salami A.J

Abstract- Electrical resistivity survey has been carried out at The Polytechnic, Ibadan North Campus to characterize the subsurface geoelectric sequences and evaluate the ground water potential of the area.The area is underlain by Precambrian basement complex of Southwestern Nigeria. A total of thirty five Vertical Electrical Sounding stations were conducted across the areas using Schlumberger electrode array with maximum half current electrode (AB/2) spacing of 75m. The interpretation of the VES result revealed three to five geoelectric layers comprising the top soil, lateritic clay, weathered basement, fractured basement and presumably fresh bedrock. The weathered and fractured basement are the aquifer types delineated for the area with the fractured basement being significant in enhancing the groundwater potential in the area. The weathered basement in about 80% of the area is clayey and has low permeability but offers moderate to high protective capacity to the underlying fractured basement aquifer.The resistivity of the fractured basement range from 96-846ohm-m with a mean value of 403 ohm-m.Based on the value of geoelectic parameters obtained, the groundwater potential of the area is rated medium to high. A sustainable groundwater development project is therefore feasible in the institution.

Index Terms- Aquifers, Electrical resistivity, Fractured basement, Geoelectric , Groundwater potential, Permeability, Vertical Electrical Sounding, Weathered basement.

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1 INTRODUCTION

The population of community of The Polytechnic, Ibadan in Nigeria has geometrically increased owing to the recently introduced daily part time program by the Management of institution. In order to balance the students –staffs ratio as well as providing employment opportunity for graduates, government of the state had also appointed both academic and non academic staffs to the institution. This has demanded for improved basic amenities in particular potable water supply for domestic use. The staffs of the institution depend solely on few shallow hand dug wells as source of water at their various residential quarters which are only productive during raining season but at very low yield during dry season. The few available boreholes at the students hall of residences were also not producing as expected. This recent growth in students and staffs population has imposed great stress on the existing inadequate water supply scheme, thus making these sources of water much more insufficient for its dwellers. The need for good quality water and readily available potable groundwater in this institution to cope with the ever increasing demands for water forms the basis of this research. Groundwater obtained from wells, boreholes and springs may not undergo considerable treatment before becoming potable due to natural filtration process it has undergone through the soil horizons[1]. However, in order to pursue large scale groundwater development it is essential to have a good estimate of groundwater potential [2]. The occurrence of groundwater in the basement complex terrain of Nigeria is highly unpredictable and hence to achieve success in groundwater development programs requires a combination of hydrologic, geophysical and geologic survey[3].Geophysical survey involving electrical resistivity, Seismic, gravity and electromagnetic methods constitutes the most reliable means, outside direct mechanical drilling, through which basement structures such as fractures zones, basement depressions and ancient river channels that are of hydrogeological significance can be mapped [4],[5].The ability of electrical resistivity in providing necessary information on the subsurface geology, in groundwater prospecting over other methods has been demonstrated by various authors [6],[7],[8].The present work had been based on geophysical survey technique using the electrical resistivity method to locate zones of high groundwater potential as a mean of recommending the most appropriate way of providing adequate and potable water for the residents of the institution.

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2 SITE DESCRIPTION, GEOLOGY AND HYDROGEOLOGY

The Polytechnic, Ibadan, North campus lies between latitude 7^{0}26^{I}30^{II} and 7^{0}27^{I} 10^{II} and longitude 3^{0}52^{I} 40^{II} and 3^{0}53110^{II} (fig 1). The topography is gentle, with surface elevation ranging from 194m to 217m above sea level. The area is underlain by the Precambrian basement complex rocks of Southwestern Nigeria[9].These rocks are inherently characterized by low porosity and permeability. The highest groundwater yield in basement terrain is found in areas where thick overburden overlies fracture zones; these zones are often characterized by relatively low resistivity value [10]. The basement aquifers are often limited in extent both laterally and vertically[11]. The localized (discontinuous) nature of the basement aquifer system makes detail knowledge of the subsurface geology, its extent of weathering and structural disposition through geological and geophysical investigation inevitable.

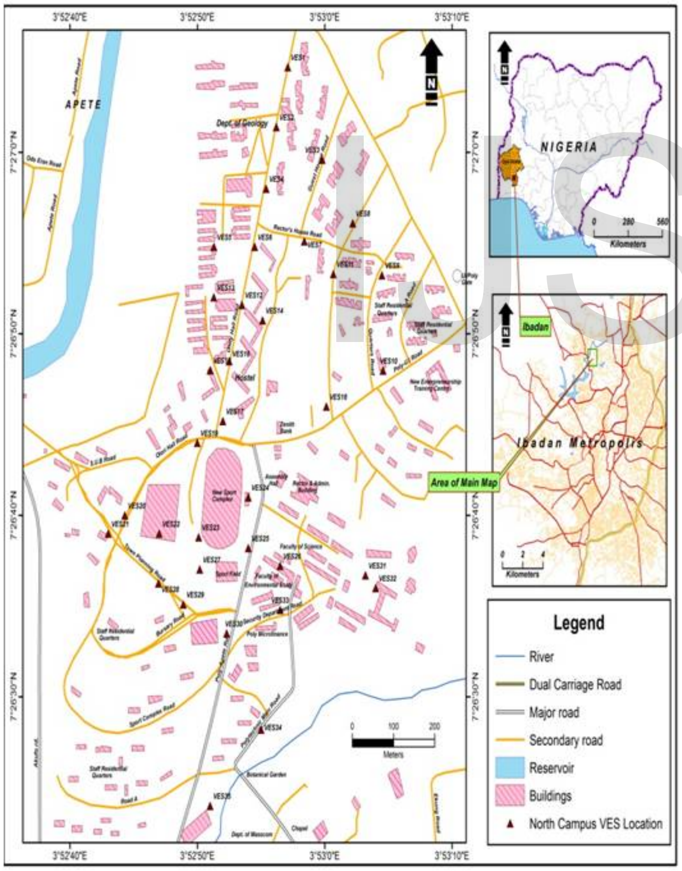


Fig 1 Location map of The Polytechnic, Ibadan showing the VES locations

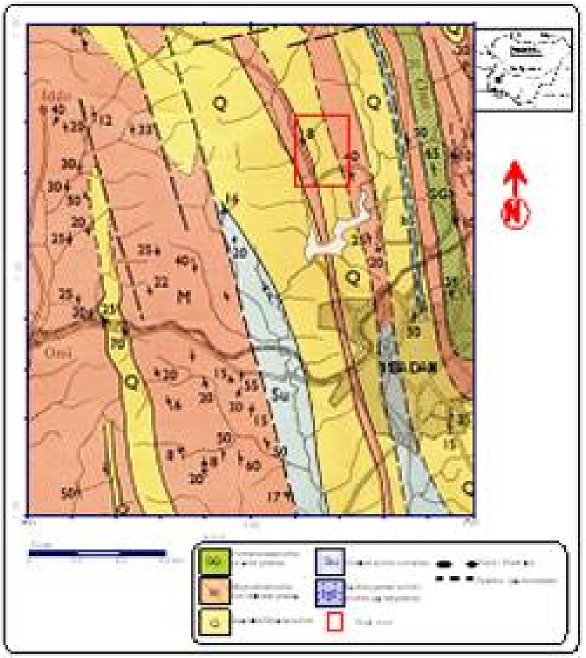


Fig.2 Geological map of Ibadan showing the study area.

3 MATERIAL AND METHOD

The geophysical prospecting method adopted for this study is the Electrical resistivity method. Thirty five Vertical Electrical Soundings (VES) were conducted across the study area using Schlumberger electrode configuration, with half electrode spacing (AB/2) varying from 1-75m. The Omega resistivity meter was used for the data acquisition. The readings of the resistance as obtained from the resistivity meter at each observatory point were multiplied by the corresponding geometric factor (K) in order to obtain the apparent resistivity (ρa) at each point. The apparent resistivities obtained is then plotted against corresponding AB/2 on log-log graph paper. The field curve were manually interpreted[12] using Master curves[13] and auxiliary point charts [14], [15] The resistivities and thickness of the VESes obtained from initial (manual) interpretation were later used as an initial model for computer-assisted interpretation [16] which is input by the interpreter into a computer program. The program, through an iterative process varies the thickness and electrical resistivity of each layer until it finds a final geoelectric model that satisfactorily best fits the data.

4 RESULTS AND DISCUSSION

4.1 Resistivity Sounding Curves

Typical sounding curves obtained are shown in fig 3, these include the H, KH, HKH, A and K type with three, four to five geoelectric layer combination. The H curve type predominates constituting 45.7% of the total while KH, K, HKH and A types constitutes 37.1 ,8.6, 5.7 and 2.9% of the total respectively. Qualitative hydrogeologic deduction is often possible to make from curve types[17].The H and KH curves which are often associated with groundwater possibilities [18] are the major types in the area.The results summary of the VES interpretation is shown in Table 1.

TABLE 1.RESULT SUMMARY OF VES INTERPRETATION IN THE STUDY AREA

VES NO	LAYER	RESISTIVITY (Ω-m)	THICKNESS (m)	PROBABLE LITHOLOGY	CURVE TYPE
1	1	140	1.4	Top soil	H
	2	96	9.4	Weathered basement	
	3	423	-	Fractured basement	
2	1	264	3.0	Top soil	H
	2	74	38.0	Weathered basement	
	3	327		Fractured basement	
3	1	110	0.8	Top soil	KH
	2	179	5.7	Lateritic clay	
	3	142	14.3	Weathered basement	
	4	211		Fractured basement	
4	1	39	0.7	Top soil	KH
	2	301	4.7	Lateritic clay	
	3	52	18.2	Weathered basement	
	4	677		Fractured basement	
5	1	225	0.6	Top soil	KH
	2	418	0.9	Lateritic clay	
	3	15	7.6	Weathered basement	
	4	123		Fractured basement	
6	1	132	0.8	Top soil	KH
	2	159	2.5	Lateritic clay	
	3	39	21.1	Weathered basement	
	4	1347		Fresh basement	
7	1	72	1.1	Top soil	K
	2	291	7.7	Weathered basement	
	3	165	-	Fractured basement	
8	1	131	3.3	Top soil	H
	2	64	21.1	Weathered basement	
	3	234	-	Fractured basement	
9	1	89	1.6	Top soil	KH
	2	212	6.9	Lateritic clay	
	3	101	18.9	Weathered basement	
	4	846	-	Fractured basement	
10	1	71	1.5	Top soil	KH
	2	207	7.2	Lateritic clay	
	3	123	17.4	Weathered basement	
	4	217		Fractured basement	
11	1	71	0.5	Top soil	
	2	164	0.8	Lateritic clay	KH
	3	14	9.5	Weathered basement	
	4	383		Fractured basement	
12	1	108	1.6	Top soil	H
	2	15	19.3	Weathered basement	
	3	517	-	Fractured basement	
13	1	138	0.7	Top soil	HKH
	2	83	2.2	Clayey formation	
	3	186	6.1	Lateritic clay	
	4	82	75	Weathered basement	
	5	114		Fractured basement	
14	1	66	1.6	Top soil	K
	2	203	4.9	Lateritic clay	
	3	69		Weathered basement	
15	1	85	1.3	Top soil	K
	2	30	12.3	Weathered basement	
	3	363	-	Fractured basement	
16	1	64	1.5	Top soil	H
	2	17	13.1	Weathered basement	
	3	607	-	Fractured basement	
17	1	104	2.1	Top soil	H
	2	28	15.9	Weathered basement	
	3	1316		Fresh bedrock	
18	1	127	3.2	Top soil	H
	2	23	44	Weathered basement	
	3	57		Fractured basement	
19	1	70	2.1	Top soil	H
	2	31	12.8	Weathered basement	
	3	699	-	Fractured basement	
20	1	61	3.4	Top soil	A
	2	156	11.3	Weathered basement	
	3	242		Fractured basement	

21	1	60	1.6	Top soil	KH
	2	171	13.4	Lateritic layer	
	3	112	25.4	Weathered basement	
	4	255		Fractured basement	
22	1	145	0.8	Top soil	KH
	2	227	4.8	Lateritic layer	
	3	46	26.3	Weathered basement.	
	4	594	-	Fractured basement	
23	1	237	1.9	Top soil	H
	2	46	12.8	Weathered basement	
	3	469	-	Fractured basement	
24	1	134	1.2	Top soil	H
	2	41	23.1	Weathered basement	
	3	589	-	Fractured basement	
25	1	195	2.1	Top soil	H
	2	36	7.7	Weathered basement	
	3	894		Fractured basement	
26	1	99	2.7	Top soil	KH
	2	252	3.2	Lateritic clay	
	3	43	21.4	Weathered basement	
	4	421		Fractured basement	
27	1	79	1.8	Top soil	KH
	2	205	8.6	Lateritic clay	
	3	96	25.3	Weathered basement	
	4	467	-	Fractured basement	
28	1	79	1.2	Top soil	KH
	2	218	3.6	Lateritic layer	
	3	51	14.3	Weathered basement	
	4	760		Fractured basement	
29	1	141	0.8	Top soil	KH
	2	385	2.4	Lateritic layer	
	3	48	22.1	Weathered basement	
	4	613		Fractured basement	
30	1	215	1.3	Top soil	H
	2	32	8.5	Weathered basement	
	3	382		Fractured basement	
31	1	110	1.5	Top soil	HKH
	2	73	3.3	Clayey formation	
	3	115	5.5	Lateritic clay	
	4	39	26.6	Weathered basement	
	5	106		Fractured basement	
32	1	94	4.1	Top soil	H
	2	24	12.8	Weathered basement	
	3	96		Fractured basement	
33	1	112	3.2	Top soil	H
	2	21	9.2	Weathered basement	
	3	745		Fractured basement	
34	1	87	1.4	Top soil	H
	2	27	5.5	Weathered basement	
	3	214		Fractured basement	
35	1	215	1.8	Top soil	H
	2	71	11.7	Weathered basement	
	3	549		Fractured basement	

4.2 Geoelectric Section

The geoelectric parameters (resistivity and thickness) obtained from the inversion of the Vertical Electrical Sounding data are presented as geoelectric section and maps. Fig 4a is a geoelectric section drawn through VES locations 1, 2, 4, 6, 12 and 16 in the North East to Southwest direction of the study area. The interpretative cross-section AA^1 shows three geoelectric layer in VES 1, 2, 12 and 16 and four layers in VES 4 and 6. The top soil which is relatively thin is characterized by resistivity values between 39 ohm-m and 140 ohm-m with a thickness that varies from 0.7 m to 1.6 m and composed predominantly of clayey sand toward Northeastern end at locations of VES 1 and 2. At VES 4 and VES 16 the top soil is presumed resistivity to be clayey while at VES 6 and 12 is probably sandy clay from the observed resistivity. Beneath the top soil at the Northeastern and Southwestern flanks at locations around VES 1, 2, 12 and 16 is the weathered basement with resistivity value between 15 ohm-m and 96 ohm-m having thickness ranging from 9.4m to 38.0m. This layer forms an aquiferous unit around these flanks while at the Central portion of the profile at locations around VES 4 and VES 6, the section identified a lateritic clay unit characterized by resistivity value of between 159 and 301

Ohm-m with thickness ranging from 2.5m and 4.7m. This layer confines the underlying weathered basement with resistivity values of 52 Ohm-m and 39 Ohm-m at locations around VES 4 and 6 respectively. The basement unit with resistivity values ranging from 327 Ohm-m – 676 Ohm is presumed as fractured bedrock along the section and identified as major aquifer unit based on the resistivity values, except at location around VES 6 with resistivity value of 1347 Ohm-m which indicate fresh bedrock, Fig. 4a.

Fig. 4b shows geoelectric section for profile BB^1 across North-South direction of the study area which is made up of data from VES 5, 15, 19, 23 and 27. The section shows three to four geoelectric layers. The top soil has resistivity value ranging from 0.6m – 3.2m characteristic of clayey sand/sandy clay. Beneath this layer at the Northern end is a thin layer of soil with relatively high resistivity value of 418 ohm observed under VES 5 which does not extend to VES 15 but reappeared at VES 27 at the Southern flank having a resistivity and thickness values of 205 Ohm and 8.6m respectively characteristic of lateritic sand. The next layer which is recognized as the aquifer unit with resistivity range of 15 Ohm-m – 96 Ohm-m with thickness of 7.6m – 25.3m is presumed weathered basement. The last layer with resistivity value that vary from 123 Ohm-m – 699 Ohm-m with infinite thickness is suggestive of fractured basement.

Fig. 4c shows a geoelectric section orienting W-E cutting across VES points 20, 22, 23, 25, 26 & 31. The interpretation of six VES data along this section reveals three to five geoelectric layers, but with three distinct lithologic layers. The top soil has resistivity values ranging from 61 Ohm-m to 237 Ohm-m and thickness varying from 0.8m to 3.4m and is composed predominantly of clayey sand and sandy clay; the weathered basement, with resistivity of 39 Ohm-m to 156 Ohm-m and thickness ranging from 8.6 to 26.6m.In crystalline basement terrain, the thickness and resistivity value of unconsolidated materials overlying the basement is important factor in evaluation of groundwater potential[19] The last layer with resistivity range of 106 – 579 ohm-m is presumed to be fractured basement and recognized as major aquiferous unit across the section.

Fig. 4d shows geoelectric section drawn through VES locations 1, 3, 8 and 9 in the Northwest to Southeast direction of the study area. The cross section shows three to four geoelectric layers. The top soil on this section has resistivity values ranging from 89 ohm-m to 140 ohm-m characteristic of clayey sand to sandy clay soil. The thickness of this layer range from 0.7m– 3.3m. Under this top soil is a layer of soil with resistivity values ranging 179 Ohm-m to 212 Ohm-m appearing at VES points 3 and 9 respectively. This layer is lateritic in nature and suggestive of a confirming stratum. The next layer which is probably conducive and depicts the layer identified as the aquifer unit characterized by resistivity values in the range of 64 ohm-m – 142 ohm-m with thickness value of 9.4m – 17.4m is the presumed weathered basement.

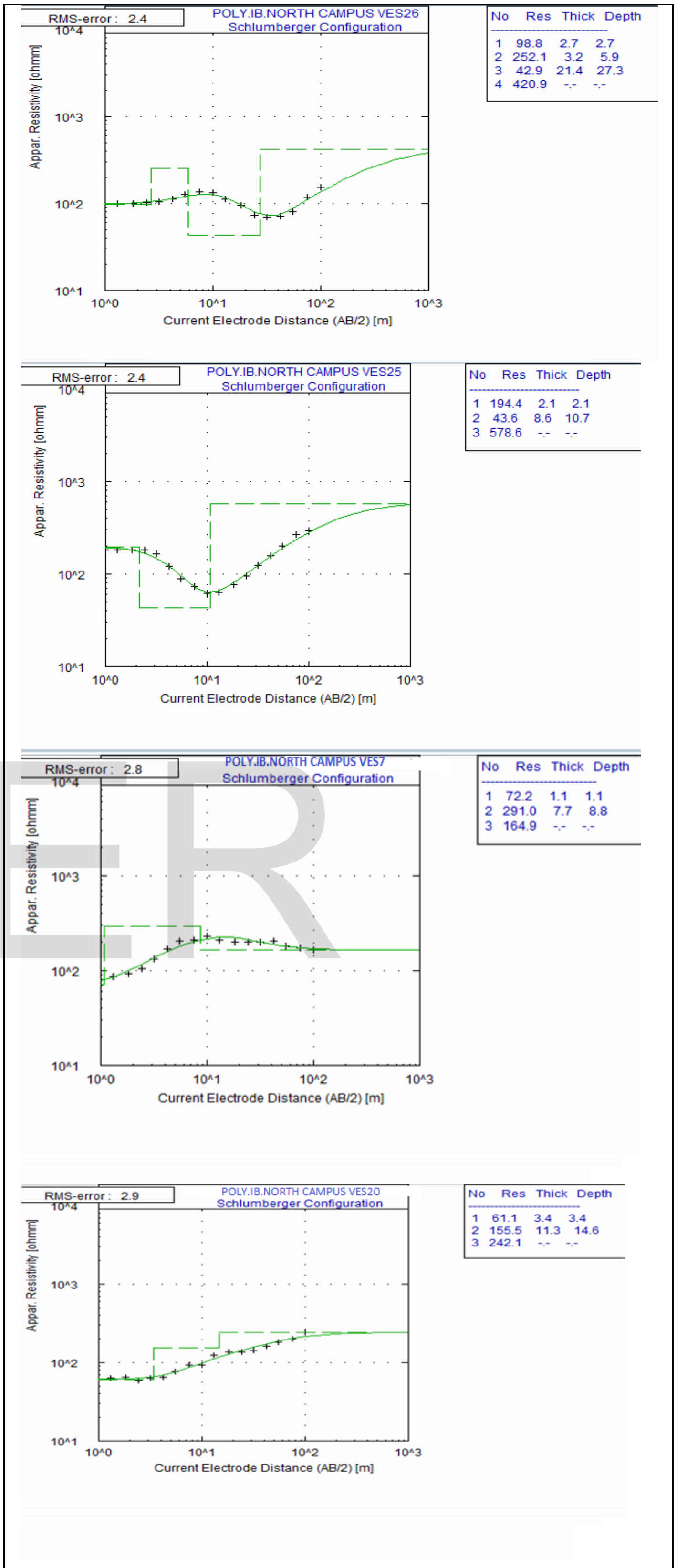


Fig 3 Typical VES curves of the study area

The underlying bedrock with resistivity values ranging from

211 Ohm-m – 846 Ohm-m with infinite thickness is suggestive of fractured basement and is recognized as another aquiferous unit across the profile.

Fig. 4e shows the geoelectric section cutting across VES 15, 17, 24 and 33 in the North- West and South -West direction of the study area. The section delineates three geoelectric layers. The first layer has resistivity value that range from 87 Ohm-m – 134 Ohm-m representing clayey sand / sandy clay top soil. The second layer is continuous beneath all locations along the profile. It is recognized as the aquifer layer with resistivity values ranging from 21 – 41 Ohm-m having an average thickness of 15m and presumed to be weathered layer but predominantly composed of clay. The last layer with resistivity value of between 316 Ohm-m and 745 Ohm-m with infinite thickness is suggestive of fractured basement and depicts the major aquiferous unit around the location across the profile.

Fig. 4f is a geoelectric section orienting North- West to South-East direction of the study area and cutting across VES 21, 28, 29 and 30. Along this section, the interpretation of these four VES reveals three-four geoelectric layers. The Top soil has resistivity values varying from 60 Ohm-m to 210 Ohm-m and thickness value of between 0.8m and 1.6m characteristic of clay / clayey sand. The second layer has a resistivity value that varies from 171 Ohm-m to 385 Ohm-m and thickness ranging from 2.4m – 13.4m.This layer which has relatively high resistivity is identified as lateritic clay confining the underlying layer and terminated beneath VES 29. The next layer characterized by relatively low resistivity in the range of 112 Ohm and 320 Ohm-m with thickness ranging from 8.5m to 25.4m reflect the layer identified as the aquifer unit and presumed to be weathered basement. The underlying bedrock is characterized by resistivity values ranging from 255 ohm-m – 760 ohm-m with an infinite thickness is suggestive of fractured basement and form an aquiferous unit across the profile.

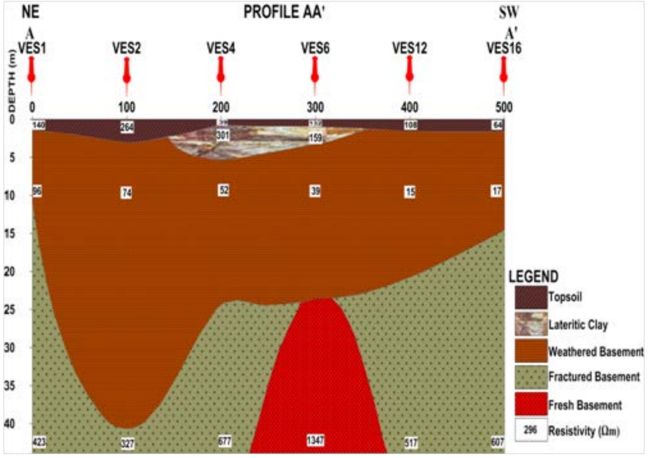


Fig 4a Geoelectric section across VES 1, 2,4,6,12 and 16.

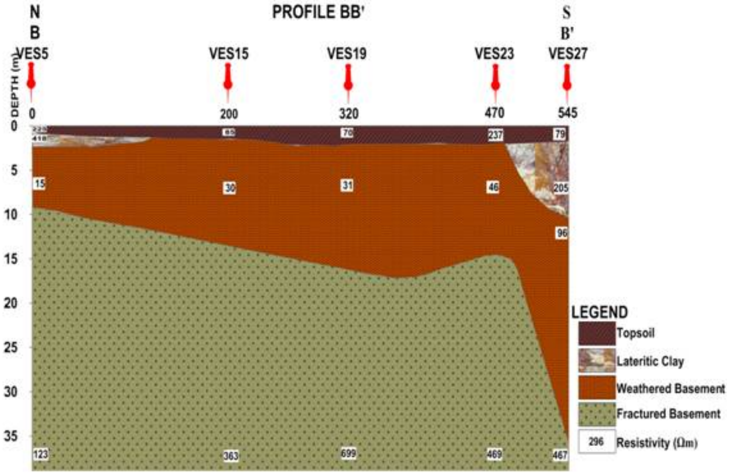


Fig 4b Geoelectric section across VES 5, 15, 19, 23 and 27.

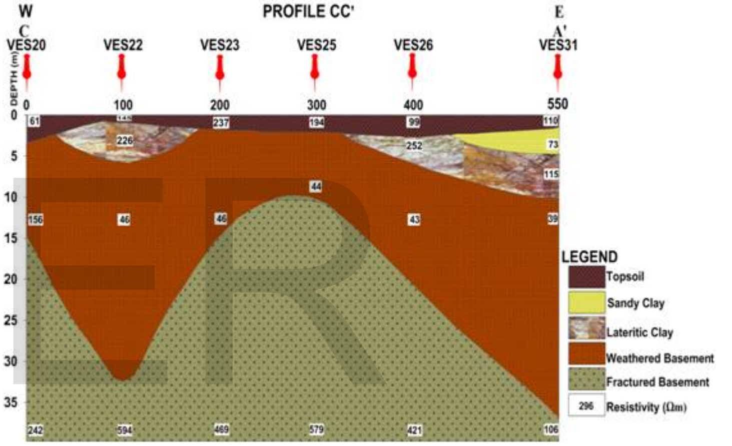


Fig4c Geoelectric section across VES 20, 22, 23, 25,26 and 31.

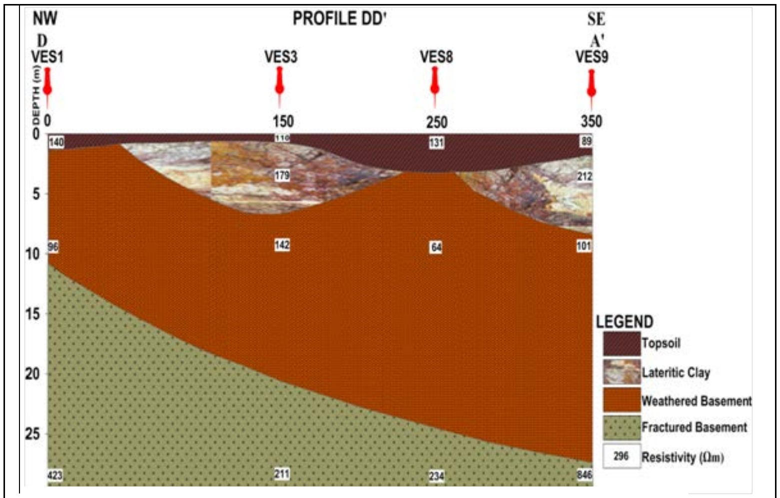


Fig. 4d Geoelectric section across VES 1, 3, 8and 9.

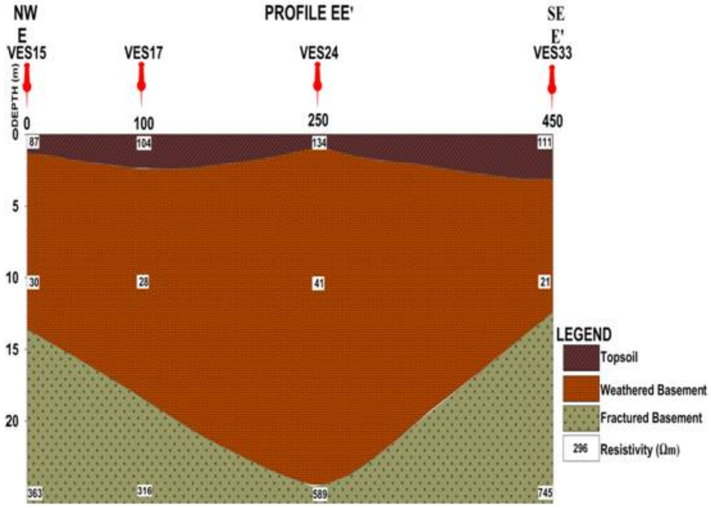


Fig. 4e Geoelectric section across VES 15,17,24 and 33.

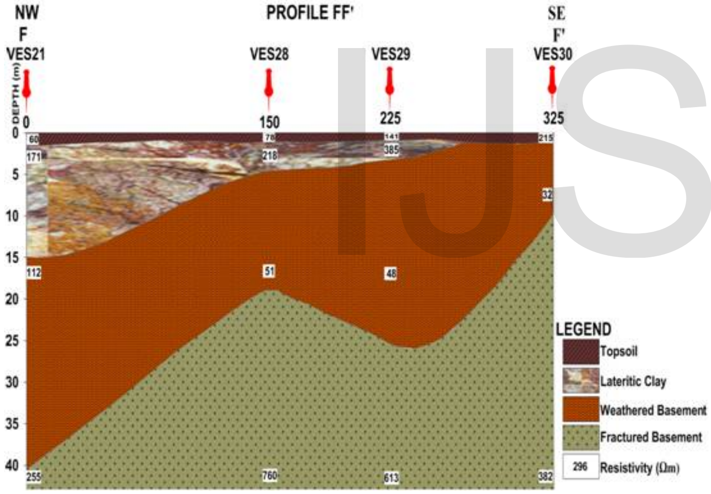


Fig 4f Geoelectric section across VES 21,28, 29, and 30.

4.3 Isoresistivity and Isopach Maps of the Topsoil

Fig. 5a is the Isoresistivity map of the top soil in the study area. It shows the resistivity values ranging from 40 – 270 Ohm-m and reveals the heterogeneous nature of the composition of the top soil varying from clay to sandy clay / clayey sand. The Northwestern and Southwestern part of the area is predominantly composed of clayey sand top soil while the remaining part composed mainly of sandy clay based on the resistivity value.

The Isopach map of the top soil (Fig 5b) shows the distribution of the thickness of the top soil in the study area. The thickness as it could be observed from the map is greater than 1.5m at the Western, Eastern, Northern and Southeastern parts and less at other part of the area.

4.4 Iso resistivity and Isopach maps of the weathered basement

The Iso resistivity map of the weathered basement in the study area is as shown in Fig 6a. This layer is considered as the upper aquiferous unit in the area. It is characterized by resistivity value that range from 15 – 156 ohm-m with the frequently occurring resistivity value of between 15 and 60 ohm-m typical of clay which may be constantly saturated but poorly permeable to the interstial formation water for abstraction [20].As revealed by the map only 20% of the study area has resistivity value typical of clayey sand constituting the weathered basement notably in the Western and Northeastern part which could be recognized as fairly pervious formation while the remaining parts is clayey and less permeable.

Fig. 6b shows the Isopach map of the weathered basement and represents the variation in the thickness of the layer in the study area. It varies from 5-75m, with most frequently occurring thickness in the range of 10-15m covering the North Eastern, Central and Southwestern part of the map. The lowest thickness is observed at the Southeastern part while the Northwestern and eastern part is characterized by relatively high weathered basement thickness in the study area. This zones of the relatively thick weathered basement presumes to be fairly good groundwater potential zone.

4.5 Isoresistivity map of the fractured basement

Fig. 7 shows the Isoresistivity map of the fractured basement, the major aquiferous unit in the area. It reflects the resistivity values ranging from 50-850 ohm-m. Based on the resistivity values, the map revealed that the bedrock fracturing at the Southeastern, Northwestern and Eastern part is more pronounced than those of North-eastern, South-western and Central portions of the study area. This suggest more productive basement aquiferous unit at locations around highly fractured bedrock in the area.

4.6 Isopach map of the overburden

Fig. 8 shows the Isopach map of the overburden in the study area with thickness varying from 5-85m. The overburden at a location is assumed to include all material above the presumably fresh basement. It is thickest at the Northwestern, Eastern and Southwestern part ranging from 30-85m while towards the southern and central portion of the map, it's fairly thick with a range of 5-30m.

4.7 Longitudinal unit conductance map

Fig. 9 shows the longitudinal conductance map produced for aquifer protective capacity of the area. The longitudinal unit conductance of the weathered basement unit obtained in the study area was used to infer the rating of the aquifer protective capacity. The longitudinal conductance varies between 0.05 and 1.92 mhos in the study area (Table 2). The area with longitudinal conductance value above 0.7 mhos is considered as good protective capacity. The area with longitudinal conductance value ranging between 0.2 and 0.69 mhos is classified as zone of moderately protective capacity. The portion where the longitudinal conductance value range from 0.1 and 0.19 mhos was classified as zone of weak protective capacity and where it is less than 0.1 mhos was classified as poor aquifer protective capacity [21]. On the basis of above classification, the aquifer protective capacity within the study area range between weak to good, with 28.6% weak, 60% moderate and 11.4% good. This indicates that the overburden in most places in the study area offers moderate protection to the underlying aquifer.

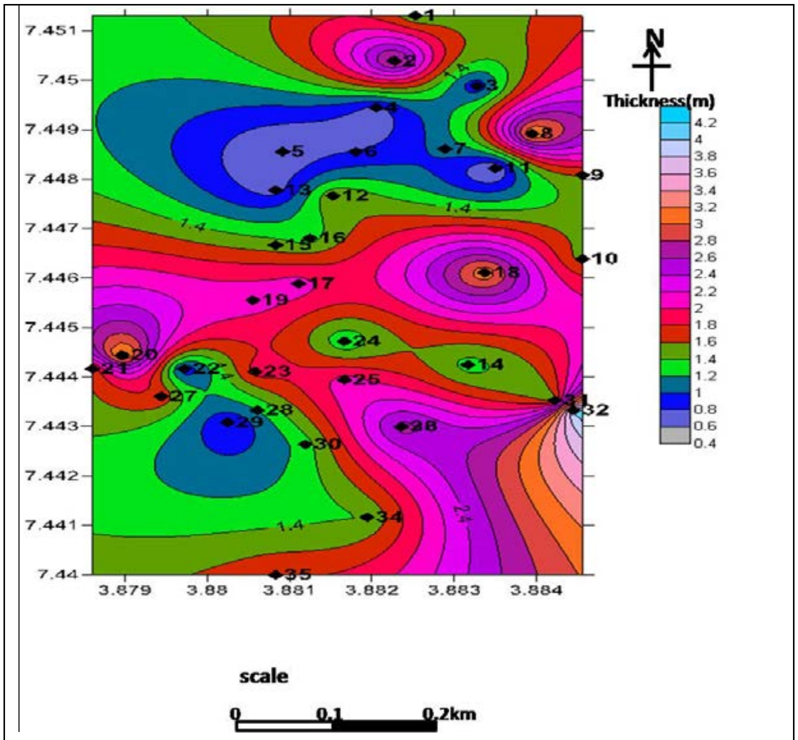


Fig 5b. Isopach map of the topsoil

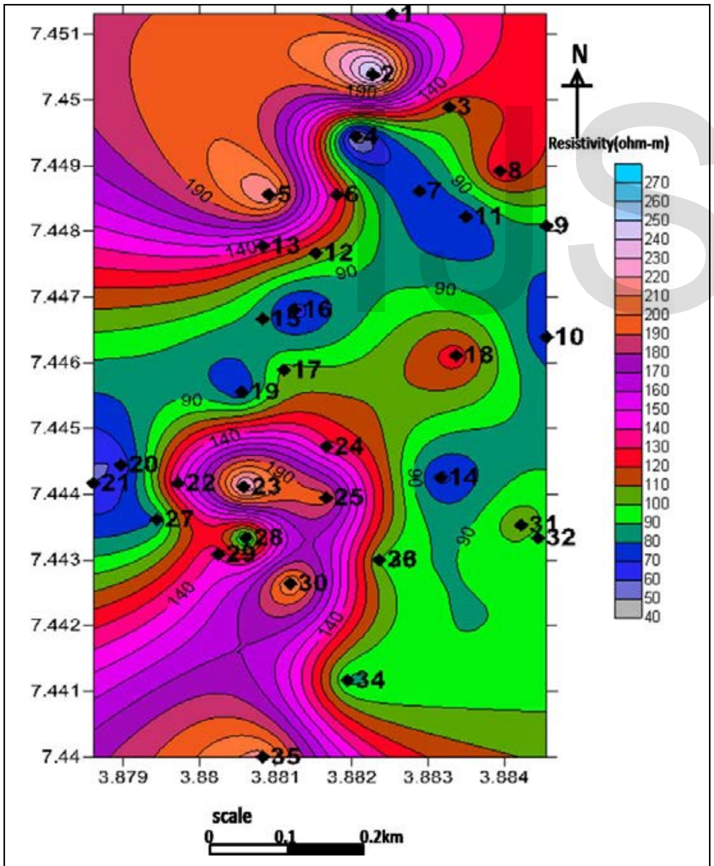


Fig 5a. Isoresistivity map of the topsoil

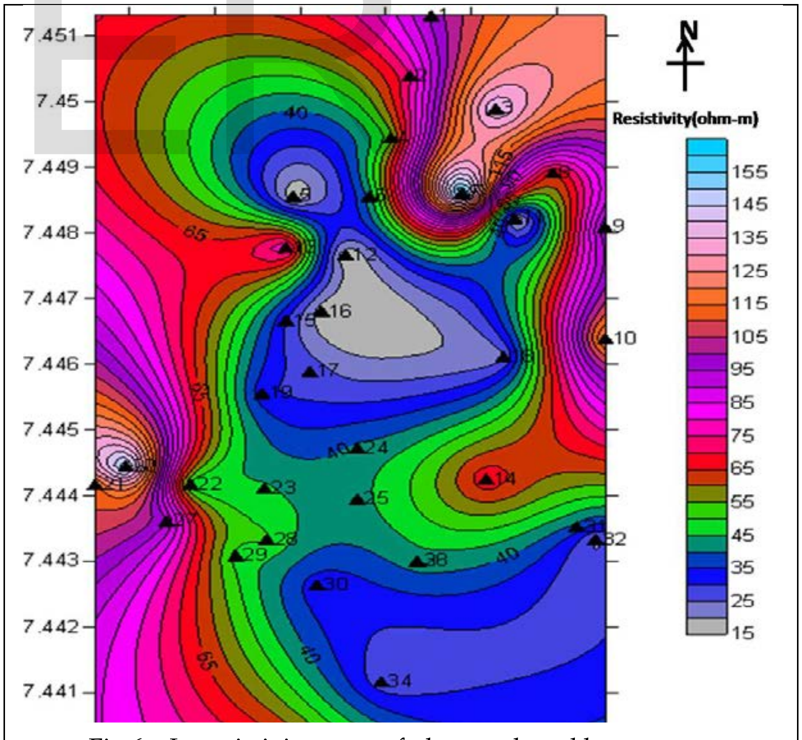


Fig 6a. Isoresistivity map of the weathered basement

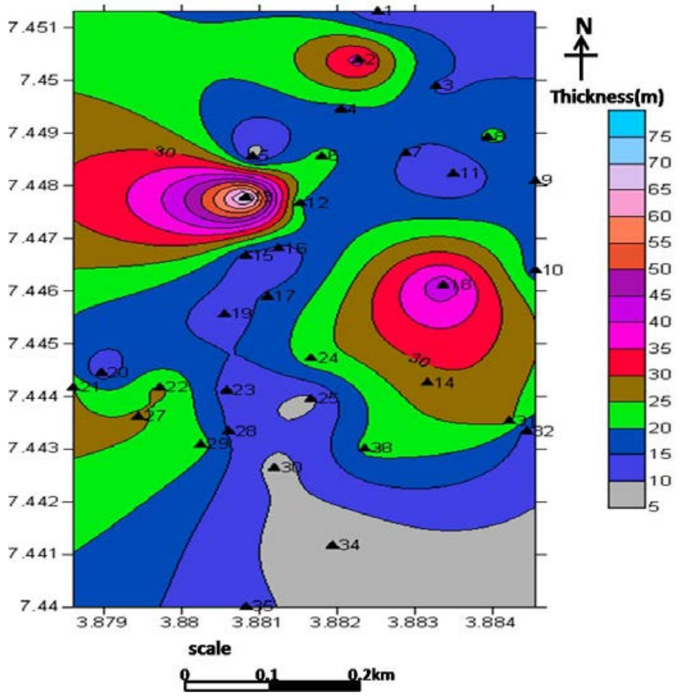


Fig 6b. Isopach map of the weathered basement

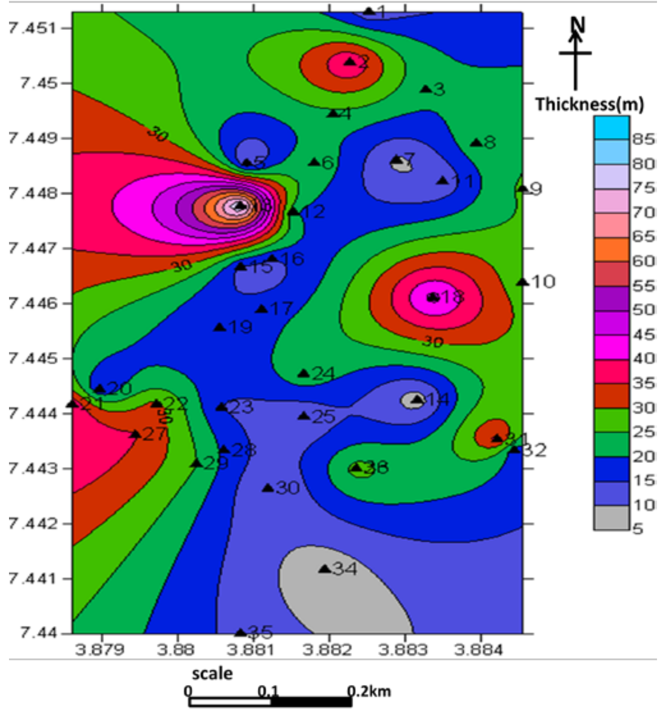


Fig 8. Isopach map of the overburden

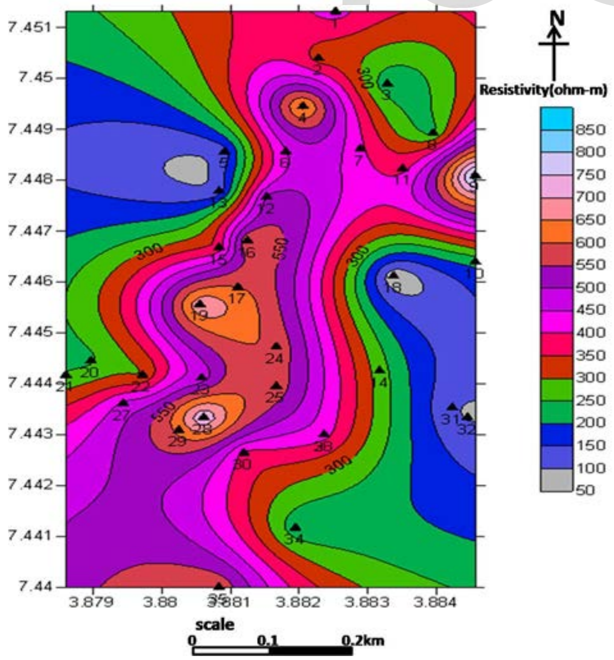


Fig 7. Isoresistivity map of the fractured basement

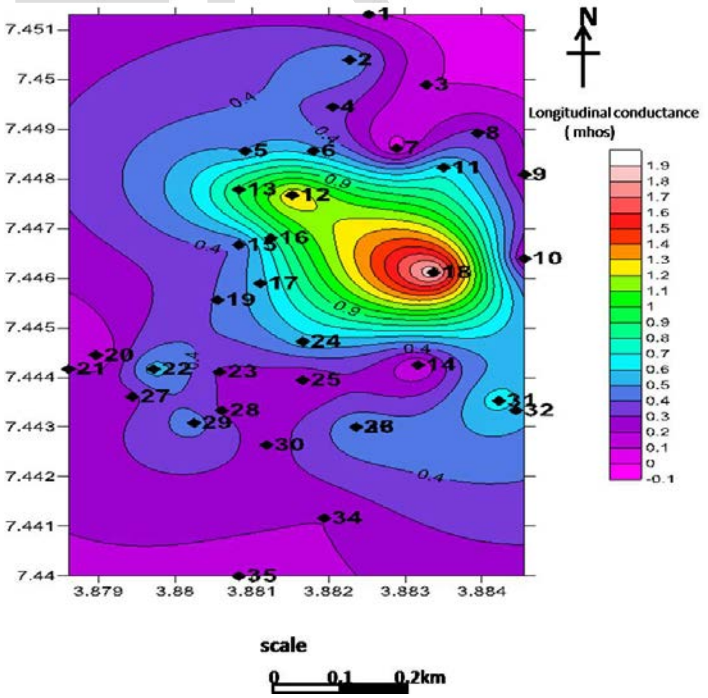
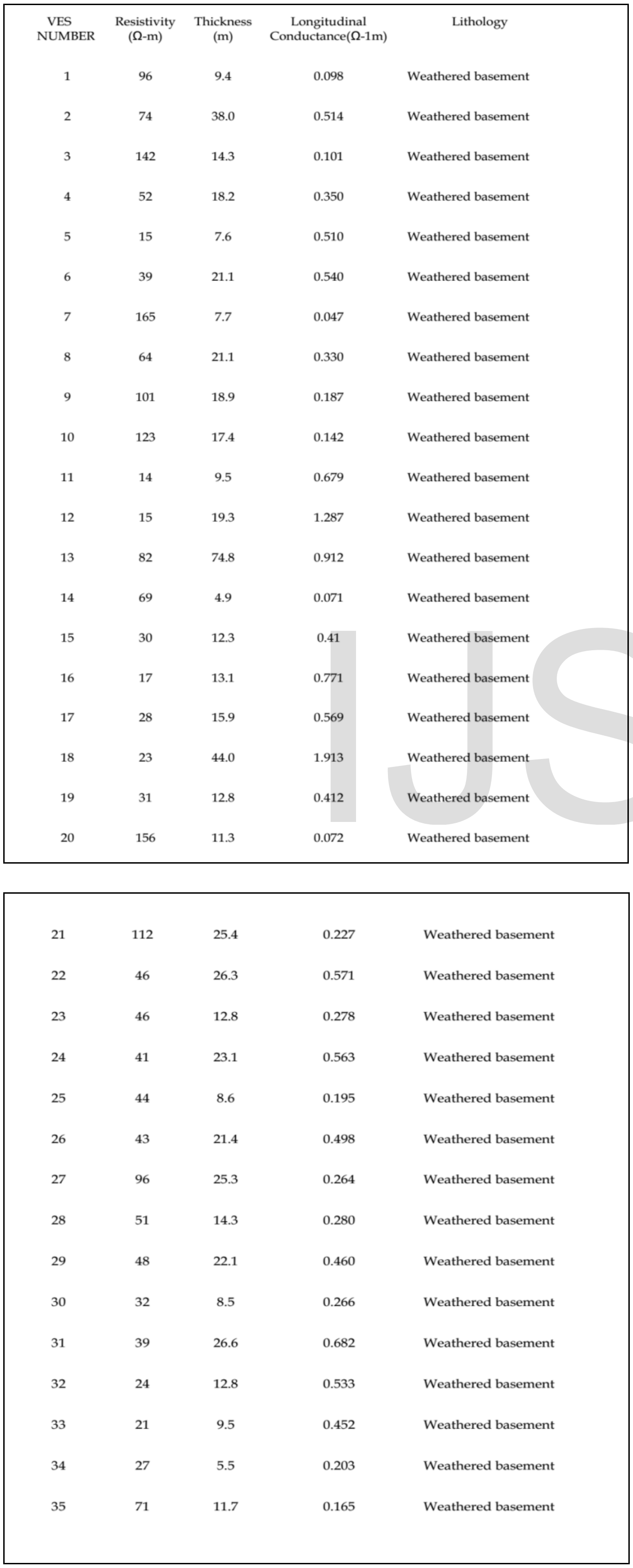


Fig 9. Longitudinal conductance map of the area

TABLE 2.

SHOWING LONGITUDINAL CONDUCTANCE VALUES OF WEATHERED BASEMENT IN THE STUDY AREA



VES NUMBER	Resistivity (Ω-m)	Thickness (m)	Longitudinal Conductance(Ω-1m)	Lithology
1	96	9.4	0.098	Weathered basement
2	74	38.0	0.514	Weathered basement
3	142	14.3	0.101	Weathered basement
4	52	18.2	0.350	Weathered basement
5	15	7.6	0.510	Weathered basement
6	39	21.1	0.540	Weathered basement
7	165	7.7	0.047	Weathered basement
8	64	21.1	0.330	Weathered basement
9	101	18.9	0.187	Weathered basement
10	123	17.4	0.142	Weathered basement
11	14	9.5	0.679	Weathered basement
12	15	19.3	1.287	Weathered basement
13	82	74.8	0.912	Weathered basement
14	69	4.9	0.071	Weathered basement
15	30	12.3	0.41	Weathered basement
16	17	13.1	0.771	Weathered basement
17	28	15.9	0.569	Weathered basement
18	23	44.0	1.913	Weathered basement
19	31	12.8	0.412	Weathered basement
20	156	11.3	0.072	Weathered basement
21	112	25.4	0.227	Weathered basement
22	46	26.3	0.571	Weathered basement
23	46	12.8	0.278	Weathered basement
24	41	23.1	0.563	Weathered basement
25	44	8.6	0.195	Weathered basement
26	43	21.4	0.498	Weathered basement
27	96	25.3	0.264	Weathered basement
28	51	14.3	0.280	Weathered basement
29	48	22.1	0.460	Weathered basement
30	32	8.5	0.266	Weathered basement
31	39	26.6	0.682	Weathered basement
32	24	12.8	0.533	Weathered basement
33	21	9.5	0.452	Weathered basement
34	27	5.5	0.203	Weathered basement
35	71	11.7	0.165	Weathered basement

4.8 Groundwater Potential Evaluation

The groundwater potential evaluation of the area is based on the various categories of maps; Aquifer resistivity, aquifer thickness and longitudinal unit conductance of the area as deduced from the geoelectric parameters (resistivity and thickness) obtained from the interpretation of VES result. In the evaluation of groundwater potential of a basement complex terrain, the above observed nature and thickness of the weathered layer are important parameters [22] ,[23].In the study area weathered and fractured basement aquiferous units were delineated. The weathered basement in about 80% of the area is clayey due to its observed relatively low resistivity Fig.8 thereby contributing less to the groundwater potential of the area for its low groundwater discharge capability but offers moderate protection to the underlying aquifer. However, the fractured basement with relatively low resistivity in about 75% area of the map as shown in fig 7 constitute the major aquifer unit due to its high permeability which rendered it having high groundwater discharge capacity. The groundwater potential rating of the area in general is medium to high. In view of groundwater abstraction, area with fractured basement resistivity in the range of 100-450 ohm notably in the Northwestern, Northeastern, Southeastern, Northern and Western parts are accorded more preference to well development.

5.0 CONCLUSION

The electrical resistivity sounding survey using Schlumberger array carried out in the study area delineated three to five subsurface sequences comprising the top soil, lateritic layer, weathered basement, fractured basement and presumably fresh bedrock. The weathered and fractured basement constitutes the aquifer units.The weathered basement although relatively thick but clayey in most places making it less promising due to its low groundwater discharge capacity. The fractured basement is highly permeable and has high groundwater discharge capacity owing to its low resistivity observed in most areas. Hence the groundwater potential rating of the area is considered moderate to high. In this study, the result have provided reliable information for an elaborate groundwater abstraction and has identified the probable causes of boreholes failure in parts of the area which was due to clayey nature of the weathered basement. The study indeed has shown that in order to have a sustainable groundwater development project, an adequate geophysical investigation is necessary to assess the groundwater potential of the area.

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