GEOELECTRIC MAPPING FOR ACCUMULATION OF TAR SANDS AT IMEGUN VILLAGE, IJEBU-EAST LOCAL GOVERNMENT OF OGUN STATE, SOUTH-WESTERN, NIGERIA

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ABSTRACT

Tar sands are primarily aggregates of tar sands, clay riched in minerals, heavy oil and sometimes water. This research was conducted to map the tar sand deposits at Imegun village in Ijebu-Itele area of Ogun State, Southwestern, Nigeria. Five (5) vertical electrical sounding with Schlumberger configuration and five (5) dipole-dipole configurations were used in this study using ABEM Terrameter SAS 1000. The results were interpreted using WINRESIST and DIPRO software respectively. Four to five geoelectric layers were delineated relative to one another; top soil, sandstone, fine-grained sand, tar sand and sand. The occurrence of tar sand deposits in the study area was observed at resistivity value of 4132Ωm to 10324Ωm with a depth range value of 28.7 to 42.2m. The integration of both techniques show the versatility of the electrical resistivity method in delineating the occurrence of tar sand deposits and the result obtained thereby reveals the presence of tar sands at an average depth of 35.5m.

Key words: Accumulation, Electrical resistivity, Geoelectric layers, Imegun Village and Tar sand.

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INTRODUCTION

Tar sands are primarily aggregates of tar sands, clay rich in minerals, heavy oil and sometimes water. Oil sandswere also called tar sands are premature deposits in which the breakdown of large of large molecules has not progressed to completion. Alternatively, tar sand could be formed when lighter compounds have migrated, leaving the dense material behind, as a result of which tar sand becomes too thick to flow out of the rocks.

Bitumen was first discovered in Nigeria in 1900 in a belt stretching from east of Ijebu-Ode (Ogun State) through Okitipupa (Ondo State), Benin (Edo State) and then in Lagos State (Enu, 1985). Traditionally, the industry's standard tools for oil sands exploration have been seismic reflection surveying and borehole logging.

Enu (1985 and 1990) described the nature and occurrence of the Nigerian tar sand, remarking that it is made up of 84% sand , 17% heavy oil (or bitumen), 4% water and 2% mineral clay. He also studied the porosity of oil sands and observed that the porosity of tar sand ranges from 16% to 35%. The sands also contain some heavy minerals which include opaque, staurolite, tourmaline, zircon, ratite, garnet and alusite; some which could be economically exploited. Nigeria's reserve oil sands are estimated to be 30 to 40 billion barrels of heavy oil in place with future potential recovery of 3654 x 10^6 billion barrels (Adegoke, *et al;* 1991).

Geophysical technique has been used successfully due to its ability to investigate near-surface phenomenon. This method has found application in the investigation of a number of near surface measurement which include hydrogeology,

engineering survey, mapping of subsurface fracture, determination of depth to bedrock and a lot more (Singh, 2006) . The resistivity measurements were made by injecting current through two current electrodes and measuring the resulting voltage difference at two potential electrodes to measure the resistance of the ground which is the ratio of voltage to current (Loke, 2000).

Although, the occurrence of tar sand in Ijebu Itele was first documented by Nigerian Bitumen Corporation but the area has received less attraction from contemporary workers owing to sparse accessibility to data and aversion by residents of the area. The present study considers the use of integrated methods of VES and dipole-dipole to establish the depth at which oil sands occur, determine lithological units of the deposit and identify the possible bitumen saturated zones based on the electrical response of the subsurface.

Physiographical and geological setting of the study area

The study area Itele (fig. 1.0) is located on latitude 6.44^0N – 6.63^0N and longitude 4.04^0E – 4.69^0E. The area falls in the village of Itele, Ijebu-East, Ogun state, Southwestern, Nigeria. The village is accessible through Lagos-Ibadan Express Road and falls in the rainforest region of Nigeria. It is covered by thick vegetation of schrubs and tall wood trees with a mean annual rainfall of 1050mm and average monthly temperature of 23^0C in July to 32^0C in February.

The oil sand belt falls within the eastern end of the Dahomey Basin (MMSD, 2010) which is one of the several sedimentary basins in Nigeria. The basin which is arcuate coastal plains the-on shore part of which underlie the coastal plains of Southwest Nigeria, Benin and Togo. A faulted basement high, the Okitipupa Basement Ridge separated the Dahomey Embayment from the Benue Trough until the late cretaceous subsidence and marine transgression united both basins. From the available subsurface stratigraphic information, it is apparent that some of the basement blocks underlie the Dahomey Embayment are displayed towards the NNE-SSW basin axis as well as towards the offshore.

The stratigraphy of the oil sand belt which falls within the Nigeria sector has also been studied byBillman in 1976 (fig. 2.0) and was reviewed by Adegoke et al; 1981 in the basin of new data. Various researchers have also rendered their support in patching together the stratigraphy of the eastern Dahomey basin; these include Russ (1924), Jones and Hockey (1964), Reyment (1965) and Agagu (1985). The base of the sedimentary succession is the bitumen-bearing sand of enormous economic potentials while most parts of the stratigraphy is dominated by monotomy of sand and shale alternation with varying minor proportion of limestones and clays.

The lithopstratigraphic unit of the eastern Dahomey basin is summarized in Table (1.0) which shows that the study area belongs to Abeokuta group with thickest sedimentary unit in the basin. This together with the fact of its depth of the burial makes it most suitable sedimentary unit for petroleum exploration in the Dahomey basin. This group has been sub-divided into three distinct formations by Omatsola and Adegoke *et al.* (1981) namely; Ise, Afowo and Araromi (from the oldest to the youngest). The subdivision is based on the lithologic homogeneity and similarity of the origin within the basin.

Materials and Methods

In this study, five Vertical Electrical Sounding (VES) and five Dipole-Dipole profiling were carried out. The ohmmeter- Terramater measures the variation in the electrical resistivity of the subsurface by injecting electric current through current electrodes (AB) and picking the potential difference from the potential electrodes (MN). The instrument is designed to measure the resistance. Initial parameters used for survey include a current of 5mA and four cycles for averaging the resistance value.

The survey equipment employed in this study was APEX Terrameter with steel electrodes driven into the ground to give the readings for the Schlumberger and Dipole-Dipole array.The four electrodes were placed on the line and connected with wire (cable) by means of the connectors. There are ports on the reels that enabled connection to be made from one reel of cable to the other end of the terrameter. All the connections were checked to ensure proper contact with the aid of a 12V- battery to power the settings and after which the sequence of measurements were then taken over a traverse of 160m.The readings were displayed digitally and measurements were recorded for each array; by taking their resistance accordingly.Also, Garmin GPS 60 was used to take the coordinates and elevation points at different locations in the study area.

Field Procedure and Instrumentation for Schlumberger Array

The schlumberger array employed during the field exercise is the most widely used in electrical prospecting. All the four electrodes were arranged collinearly and symmetrically placed with respect to the centre. It is required that the distance between the potential electrodes, M and N did not exceed one fifth of the spacing of the current electrodes A and B, for survey accuracy (that is 5MN (d) AB (L). In Schlumberger configuration, the electrodes were moved further and further apart and as a result of these increasing distances, the current penetration progresses deeper (Loke,2000). Thus, the apparent resistivity is thus calculated using: Pa=V/I π (b+a)/a – V/I π b2/a.

Field Procedure and Instrumentation for Dipole-Dipole array

Five Dipole-Dipole profiles were acquired by injecting a total of four (4) steel electrodes with a spacing of 10m between each electrode into the ground. The use of dipole-dipole array in electrical prospecting has become common since the 1950's particularly in Russia where Alpin (1950) developed the necessary theory (Zhody, *et al*; 1980). In terms of logistics on the field, the dipole-dipole array is the most convenient especially for large spacing. The convection for the dipole-dipole array is that current and potential electrode is the same, a, and the spacing between them is an integral multiple of a, na. The apparent resistivity for the survey is calculated by using; Pa = V/I aπn (n+1) (n+2).

Results from both the Schlumberger (VES) and Dipole-Dipole were processed using WINRESIST and DIPRO software respectively. The WINRESIST software gives the final plot for the resistivity, depth and thickness of different layers estimated. Also, the DIPRO software produced the pseudosection for the apparent resistivity against the vertical depth.

RESULTS

Table 2.0shows the summary result for VES points. The quantitative interpretation reveals three to five geo-electric layers which are, topsoil, sandstone, fine-grainedsand, tar sand and sand.

Figure 3.0 represents the geo-electric section relating VES 2 andVES3. Four geoelectric layerswere delineated. The first geo-electric layer represents the topsoil with resistivity and thickness values that vary between 1165 - 1463 Ωm and 0.8 – 1.0 m respectively. The second geo-electric layer was delineated within the depth that vary between 6.3 – 6.7 m with resistivity and thickness values that vary between 2044 - 2504 Ωm and 5.4 – 5.8 m beneath the surface. This layer is composed of sand. The third geo-electric has resistivity and thickness values that vary between 4415 - 6077 Ωm and 24.9 – 31.9 m within the depth range of 31.7 – 38.2 m respectively. This layer constitutes tar sand. The fourth geo-electric layer is composed of sand and has resistivity values that vary between 1028 – 1479 Ωm with no thickness because current electrodes terminate at this region.

2-D Resistivity Profiling along Traverse Four

Fig. 4.0 represents the inverted resistivity section generated from the 2-D data with a maximum spread length of 160 m. The interpretation of the pseudo-section was done based on the resistivity data collected.The first geoelectric layer represent the topsoil with resistivity values that ranges from 1540 to 4200 Ωm within the depth range of about 2 – 5 m. This layer constitutes sandstone and tar sand layer and it was directly observed on the surface during the geophysical survey. Beneath the topsoil down to depth range of about 5 - 50 m iscomposed of tar sand with resistivity values that vary between 3527 to 5000 Ωm. The tar sand within this layer was also delineated from the VES results.

2-D Resistivity Profiling along Traverse Five

Fig. 5.0 represents the inverted resistivity section generated from the 2-D data with a maximum spread length of 160 m. The interpretation of the pseudo-section was done based on the resistivity data collected.The first geoelectric layer represent the topsoil with resistivity values that ranges from 2705 to 3302 Ωm within the depth range of 2 to 3 m. Beneath the topsoil down to depth range of about 3 to 40 m is composed of sandstone, fine grained sand and tar sand. However, the tar sand was delineated as the third geoelectric layer with resistivity values that vary between 3127 to 5723 Ωm within the depth range of about 29.4 to 42.2 m.

Correlation between VES and 2-D Results along Traverse Two

The VES 3 and 4 were correlated with the 2D resistivity result along profile Two (fig. 6.0). From the integration of both techniques, the topsoil which represents the first geoelectric layer has resistivity values that range from 1071 to 1165 Ωm and 1.0 to 1.3m. Beneath the topsoil down to depth of 50 m in 2D constitute sand and tar sand. However, the sandstone and tar sand was delineated as the second and third geoelectric layer with resistivity values that vary between 2044-2864 and 4415-5216 respectively. The fourth geo-electric layer has resistivity values that vary between 994 – 1028 Ωm with no thickness because current electrodes terminate at this region.This layer constitutes sand.

Table 1.0: Stratigraphic Relationship of Formation in the Dahomey Basin(Source: Jones and Hockey, 1964 and Omatsola and Adegoke, 1981)

PERIOD	GEOLOGIC AGE	JONES AND HOCKEY (1964)	ADEGOKE *ET AL.,* (1981)
Quaternary	Recent Oligocene To Plio-Pleistocene	Alluvium Coastal Plain sands	Alluvium Coastal Plain sands
Tertiary	Eocene	Ilaro Formation	Ilaro formation
	Palaeocene	Ewekoro Formation	Oshosun formation
	Lower Eocene		Akinbo formation
Cretaceous	Cretaceous	Abeokuta formation	Araromi formation, Afowo formation, Ise formation
Precambrian	Precambrian	Basement complex	Basement complex

Table2.0: VES Points of the Location

'ES	Layers	Resistivity (? -m)	Thickness (m)	Depth (m)	Lithology	Curve Type
	1	1205	0.9	0.9	Topsoil	KHK
	2	2270	1.3	2.2	Sand stone	
	3	1259	4.6	6.8	Fine grained sand	
	4	4132	21.9	28.7	Tar Sand	
	5	1387	--	--	Sand	
	1	1463	0.9	0.9	Topsoil	
	2	2504	5.4	6.3	Sand stone	AK
	3	6077	31.9	38.2	Tar Sand	
	4	1479	--	--	Sand	
	1	1165	1.0	1.0	Topsoil	
	2	2044	5.8	6.7	Sand stone	AK
	3	4415	24.9	31.7	Tar sand	
	4	1028	--	--	Sand	
	1	1071	1.3	1.3	Top Soil	
	2	2864	5.8	7.0	Sand stone	AK
	3	5216	22.4	29.4	Tar Sand	
	4	994	--	--	Sand	
	1	2521	0.7	0.7	Topsoil	
	2	3970	2.7	3.4	Sand stone	KHK
	3	758	3.6	6.9	Fine grained sand	
	4	10324	35.3	42.2	Tar Sand	

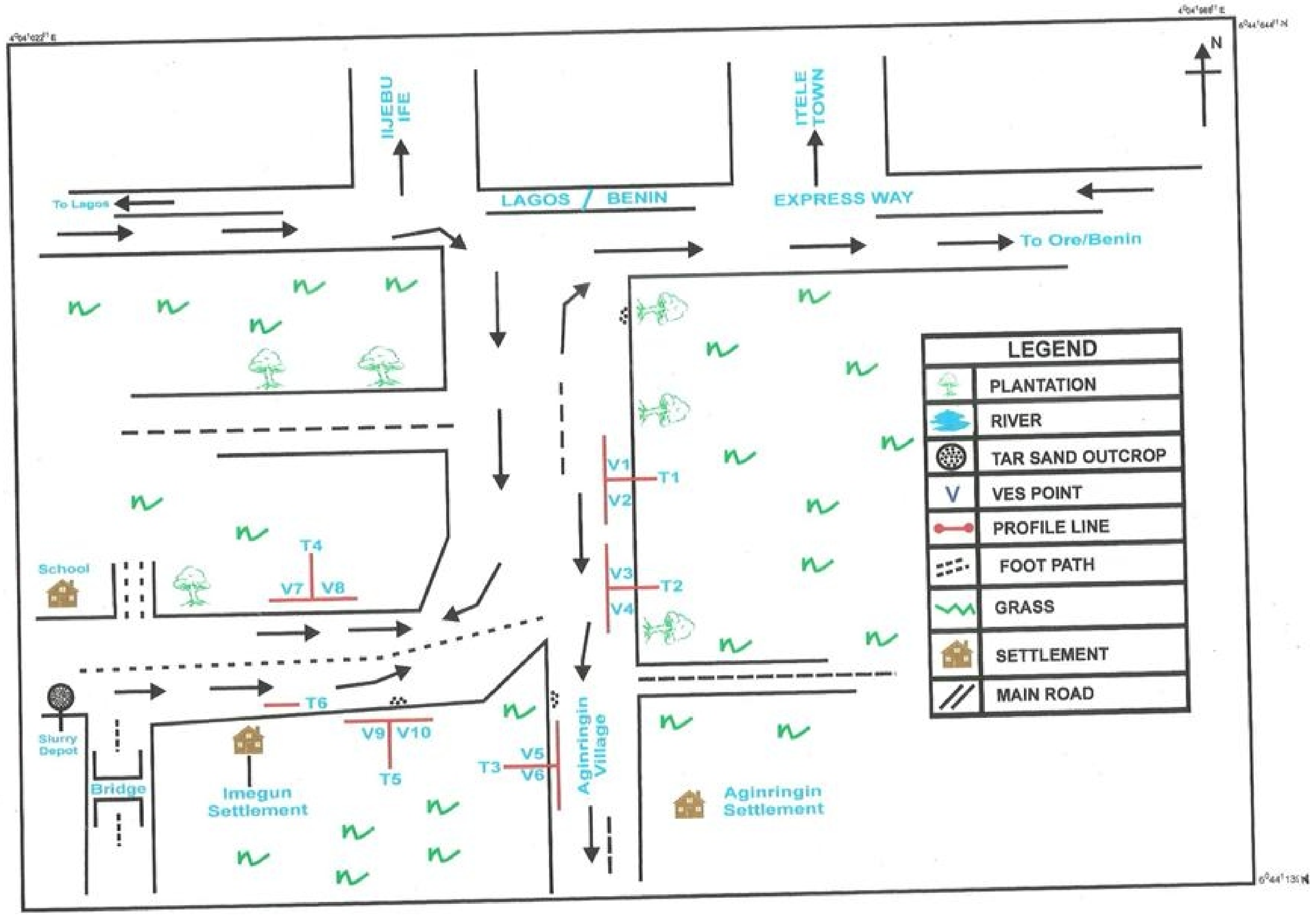

Fig. 1.0: Location map of the study area showing the sounding points

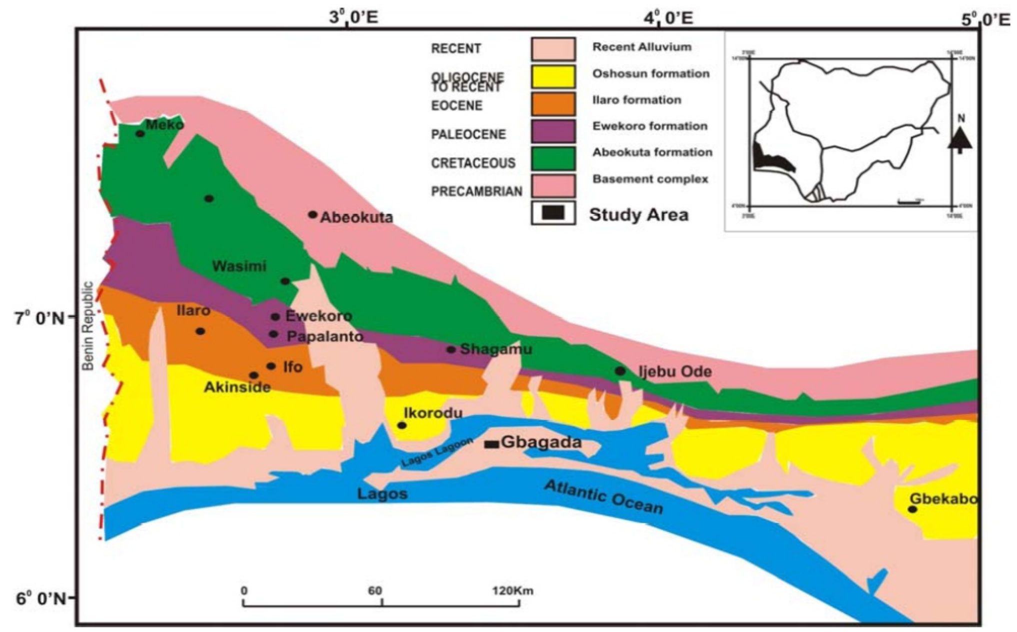

Fig. 2.0: Geologic Map of Eastern Dahomey Basin (Modified after Billman, 1976).

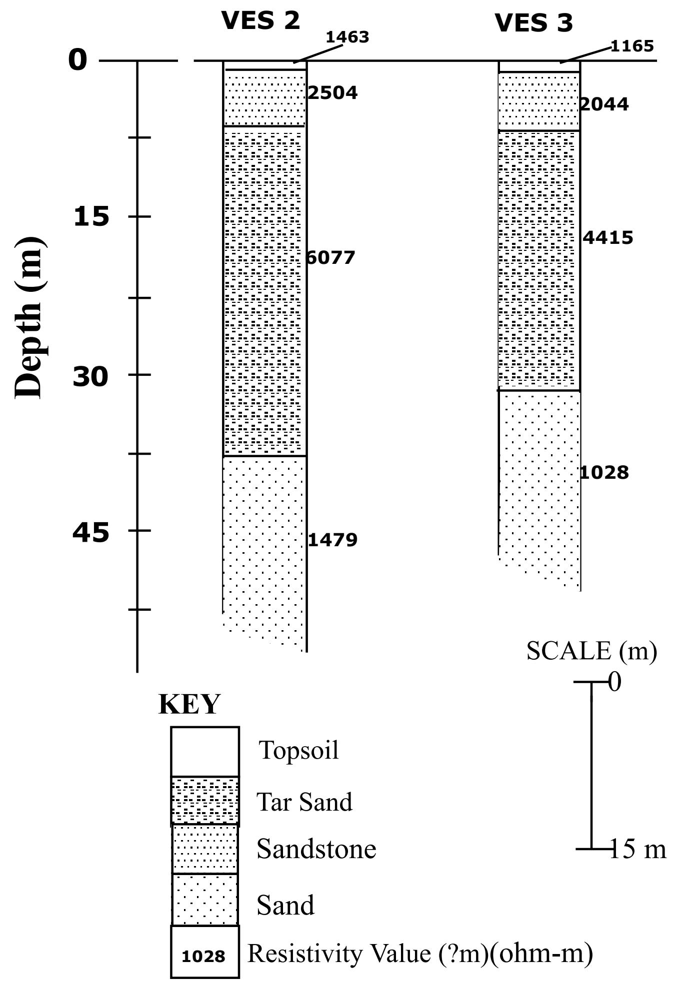

Fig. 3.0: Geoelectric Section Relating VES 2 andVES3

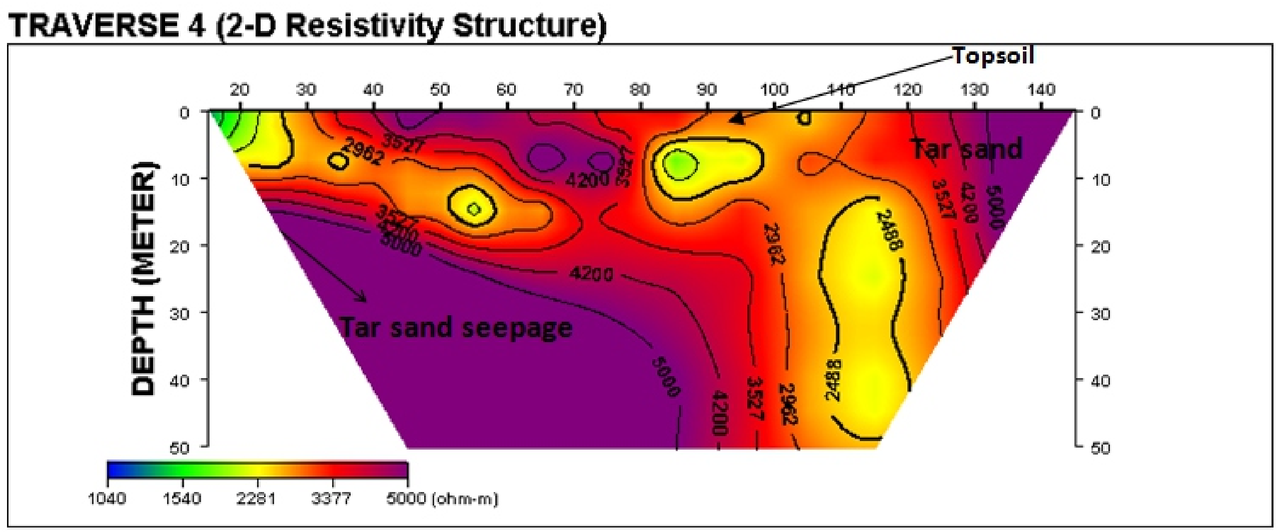

Fig. 4.0: 2-D Resistivity Section along Traverse Four

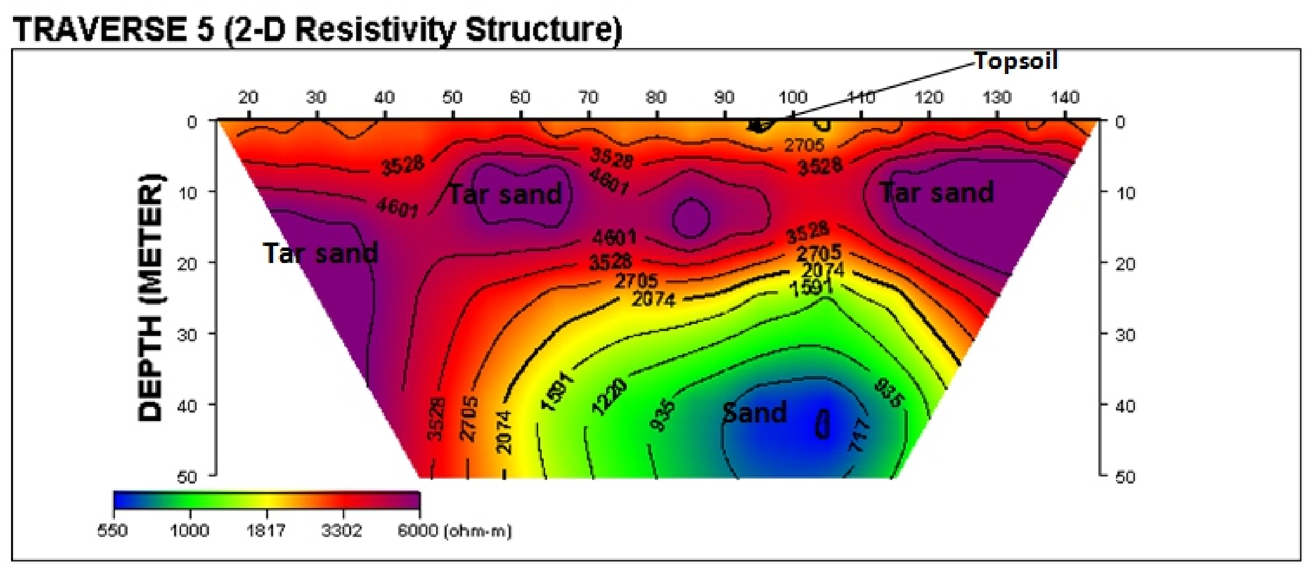

Fig 5.0: 2-D Resistivity Section along Traverse Five

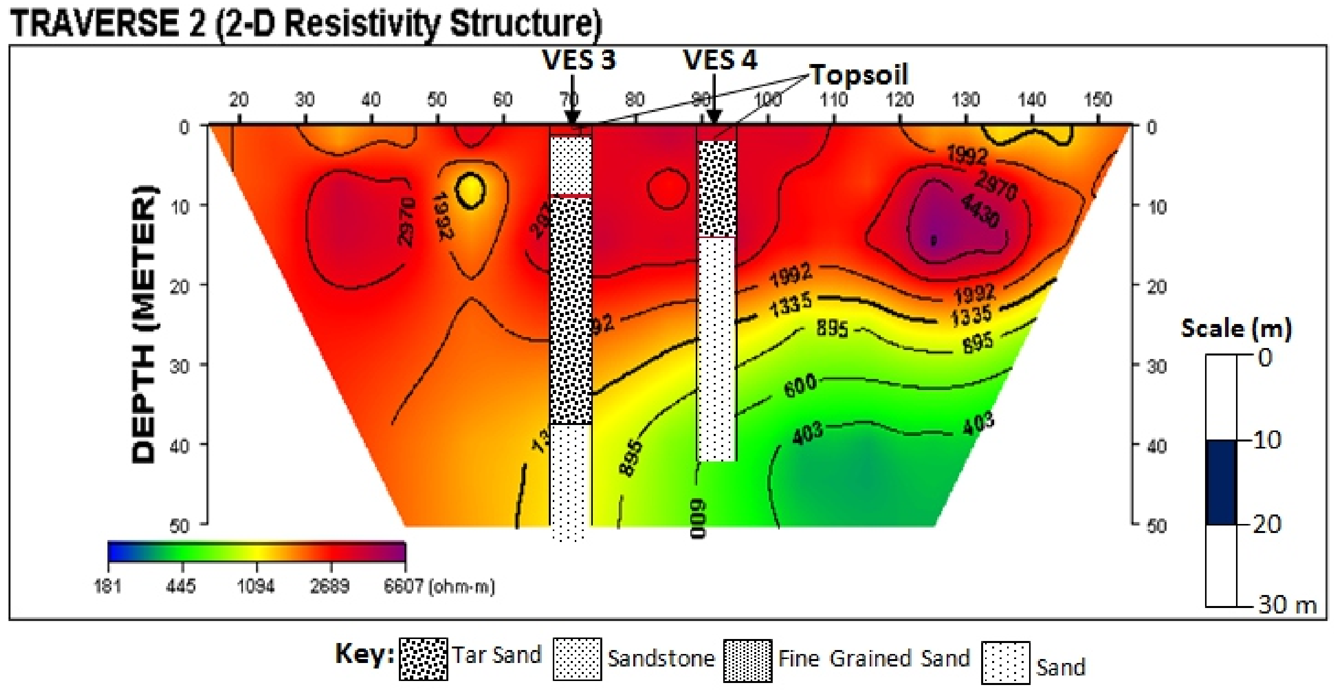

Fig. 6.0: Correlation of both the 2-D and the VES Results along Profile 2

CONCLUSION

Geophysical method involving Vertical Electrical Sounding (VES) and 2-D Dipole-Dipole Resistivity techniques have been carried out at Imegun village in Ijebu-Itele area of Ogun State, South-western Nigeria with the aim of assessing tar sand deposits (Bitumen) within the area.The Vertical Electrical Sounding (VES) is presented as 1D resistivity profile indicating the depth extent of each lithological unit while the 2D is presented as 2-D resistivity imaging. Three to five geo-electric layers were delineated which comprises of the topsoil, sand stone, fine-grained sand, tar sand and sand.

Integration of VES and 2D methods show that the resistivity of the first geo-electric layer ranges from 1028 to 2521 Ωm and thickness of 0.7 - 1.3mrespectively having an average depth of 1.0m.

The second geoelectric layer constitutes sandstone having resistivity value that ranges from 2044 – 3970Ωm with thickness values that range from 1.3–5.8 m within the depth range of 2.2 to 7.0 m. The third geoelectric layer has resistivity values that range from 758 – 6077Ωm with thickness value that ranges from 3.6 to 31.9m. This layer is composed of fine-grained sand/ Tar sand. The fourth geo-electric layer was found in VES 2, VES 3 and VES 4 which constitutes sandwith resistivity values that ranges from 994 - 1479 Ωm. Only VES 1 and VES 5 has the fifth geoelectric layer constitutes sand with resistivity values that range from 801 - 1387 Ωm.According to Odunaike *et al.* (2010) and Akinmosin *et al.* (2011) in search for tar sands in Southwestern region, the results obtained in the study area fall within the range and thereby establishing the presence and also in abundance at an average depth of 35.5m.

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ANALGESIC AND ANTI-INFLAMMATORY POTENTIAL OF THE ETHANOL EXTRACT OF LEAVES OF *Laportea aestuans* (L.) CHEW IN ALBINO WISTAR RATS

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ABSTRACT

In traditional medicine, *Laportea aestuans* (*LA*)is used in treatment of several ailments including pain and inflammatory conditions. This study evaluates the analgesic and anti-inflammatory potential of the ethanol extract of the leaves of *LA* using hot–plate induced analgesia and carrageenan–induced acute inflammatory model in Albino Wistar rats (120g-160g). The analgesic activity was assessed by oral administration of the extract doses; 50, 100 and 150 mg/kg bwt to separate groups of rats, 100 mg/kg bwt of ibuprofen (positive control) and 10 mL/kg bwt of distilled water (negative control).0.1mL of 1% carrageenan suspended in distilled water was injected intra-peritonially into the sub-plantar region of the right-hind paw of the rats to induce inflammation. Similar doses were given to test its anti-inflammatory activity but 10 mg/kg of diclofenac sodium was given as the positive control. The results obtained showed significant ($p<0.05$) dose -dependent difference among the groups. 150 mg/kg of the extract gave promising analgesic and anti-inflammatory effect which could be relatively compared with the control. LA reduced the activity of the enzymes supporting inflammation; a stable oedema formation was experienced at the second hour which could signify maximum level of carrageenan activity while a decline in oedema formation set in at the third hour up to the twenty-fourth hour. Phytochemical screening showed diverse secondary metabolites which could account for its wide therapeutic spectrum.
These results justify the rational use of the plant in local management of pain and inflammation.

Keywords: *Laportea aestuans (LA),* Analgesic, anti-inflammatory activities, Carrageenan, Ibuprofen,Diclofenacsodium

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INTRODUCTION

Inflammation is a protective response of mammalian tissues against diverse stimuli, giving rise to a series of complex events which are facilitated by a number of inflammatory mediators like the prostaglandins, prostacyclin and leukoterines which persuade, uphold and exaggerate many associated disorders (Ricciotti and Fitzgerald, 2011). It is key to pathophysiological processes of cancer, stroke, arthrithis, neurodegenerative and cardiovascular disease (Coussens and Werb,2002; Gil, 2002). It is characterised by pain, swelling, redness oedema and heat (Mantovani. 2010). Pain affects the proper functioning of the body such that when a part of the body is injured, all other parts are affected (Breivik et al., 2008). It is a complex biological and localized response of the vascular tissues to unwanted agents or toxins released in the body (Laupattarakasem et al., 2003; Schmid-Schönbein, 2006; Ferrero et al., 2007) giving a feverish condition as one of its symptoms (Tomlinson et al., 1994).

Uncontrolled inflammation is very detrimental to tissues, as such, there are increasing drive to explore natural agents even from marine environment to search for novel anti-inflammatory agents. One such is the recent identification of nitrosporeusine A and B, which are marine natural products that