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Full Length Research Paper

Electrical and electromagnetic exploration of sulfide ore deposit in Ishiagu, Ebonyi state, Nigeria

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ABSTRACT

Spontaneous Potential (SP) and Electromagnetic (EM) methods have been used to delineate and evaluate the sulfide ore bodies in Ishiagu area, Ebonyi State, Nigeria. The study area lies between latitude $05^{0}56^{1}30^{11}$N to $05^{0}57^{1}45^{11}$N and Longitude $07^{0}30^{1}00^{11}$E to $07^{0}31^{1}00^{11}$E, and covers an area of 5078527.16m^{2}. The ABEM terrameter SAS 300 and ABEM WADI, VLF type 9133001869 were used to measure the S.P and the E.M. respectively. The results were plotted using excel 2007, Karous-Hjelt and fraser software. The points of negative anomaly in S.P were correlated with that of E.M points. The results show that the most promising sites for exploitation are located within the area underlain by the Asu-River group where the estimated overburden thickness from S.P anomaly averages 69m thick.

Keywords: Spontaneous Potential, Electromagnetic, Viability.

INTRODUCTION

The Ishiagu area under review is located within the Lower Benue Trough - Ivo Local Government Area of Ebonyi State,Eastern Nigeria as shown in figure 1. The area is associated with the occurrence of igneous intrusions and volcanics within the sedimentary rocks. These intrusions which occurred during the Santonian, housed the Pb-Zn mineral veins in the area.

Bogue (1952) observed that artisan Lead mining for cosmetic purpose commenced in the area prior 1940 and also noted that the Ishiagu inhabitants produced about 11 tons of hand-picked galena between 1948 and 1949.

This research is centered on detailed exploration of the mineral veins within the study area with a view to locating the exact extent of deposits for proper mine planning and exploitation.

Physiography

The study area has an undulating relief forming part of the expansive Cross River Plain. These hills/elevations are obviously formed due to igneous intrusions and consolidated calcareous sandstone bodies being more resistant than the surrounding shale. The undulating topography suggests a juvenile – intermediate stage of the geomorphic cycle. The 3-D elevation map of the study area is shown in figure 3.

Geology

The study area is underlain by two major formations: the Asu-River Group of the Albian and the Eze-Aku formation of the Turonian. The x-shaped depression oriented N.E-S.W formed in the basement created a condusive wedge system that accommodated the Albian sediments. This includes the Ivo shale and Amagu sandstone as members. The Ivo shale is typically dark grey, finely laminated with alternating silt and clay bands, carbonaceous and distinctly fissile.

The Eze-Aku Formation unconformably overlies the Asu River Group in the study area, and consists of alternating sandstone/siltstone and hard grey to black shale. The contacts between the lithologies may be sharp or gradational; where it is gradational the shale is sandy, silty or calcareous, before passing into siliceous or calcareous sandstone (Ukaegbu and Akpabio 2009). The sandstone unit is fine grained and deep to light brown in colour. The shale is carbonaceous, thinly to thickly bedded and dips 190-350 southeast. The fossil –

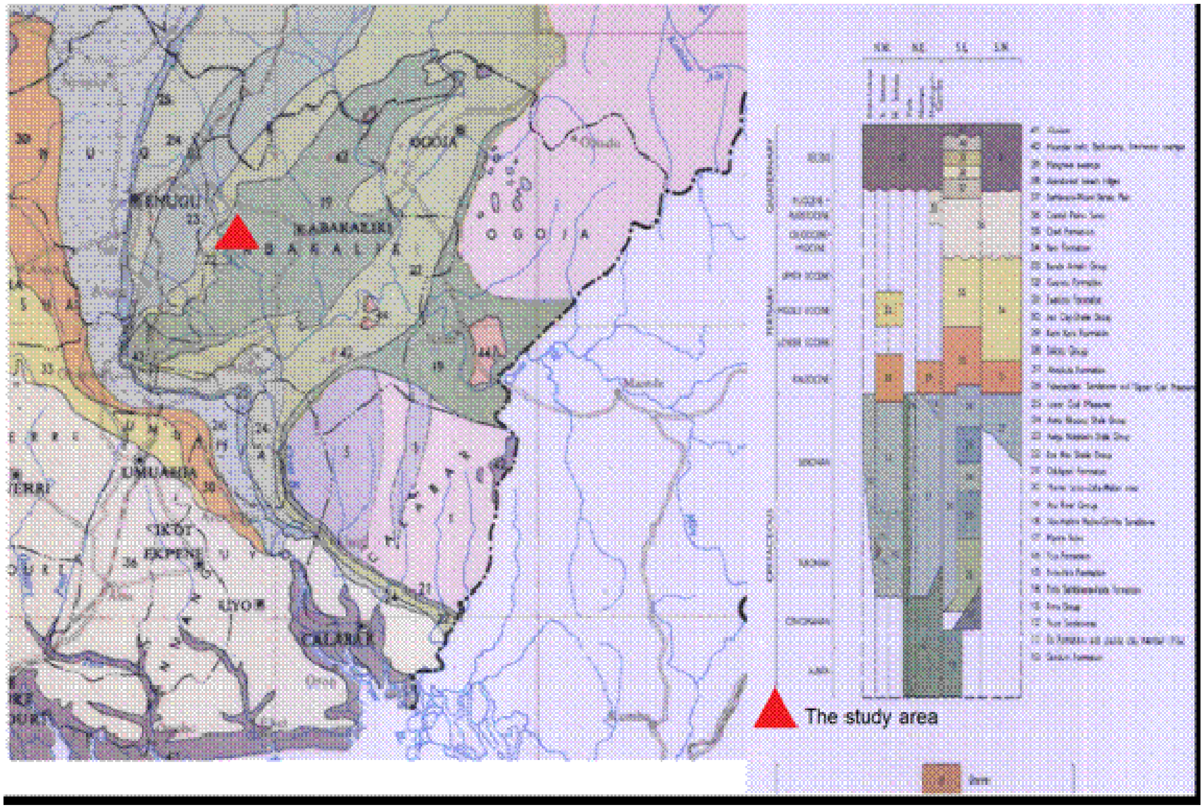

Figure 1. Geologic Map of Eastern Nigeria showing the position of the study area (Modified after Geologic Map of Nigeria 1964)

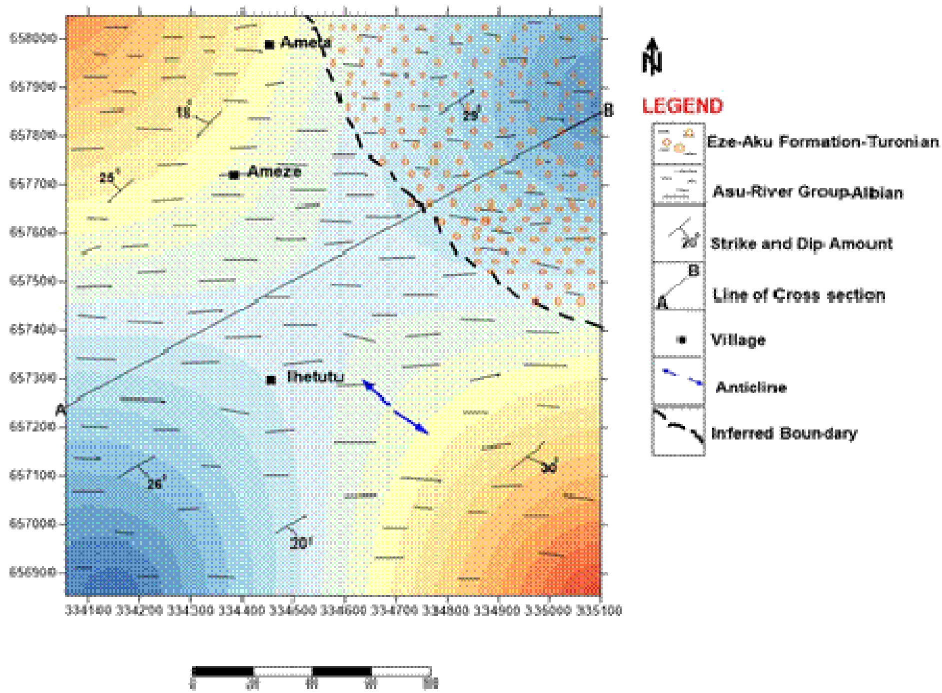

Figure 2. Geologic Map of the study area

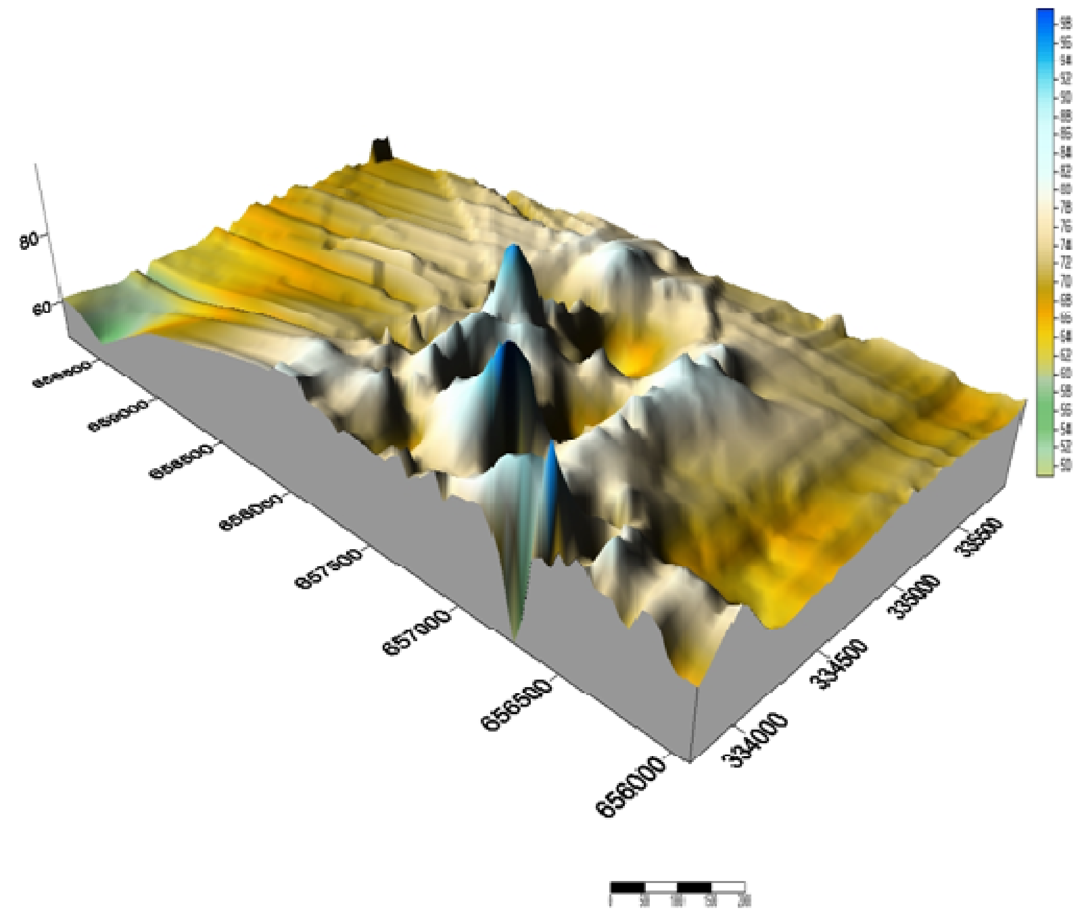

Figure 3. Elevation map of the area

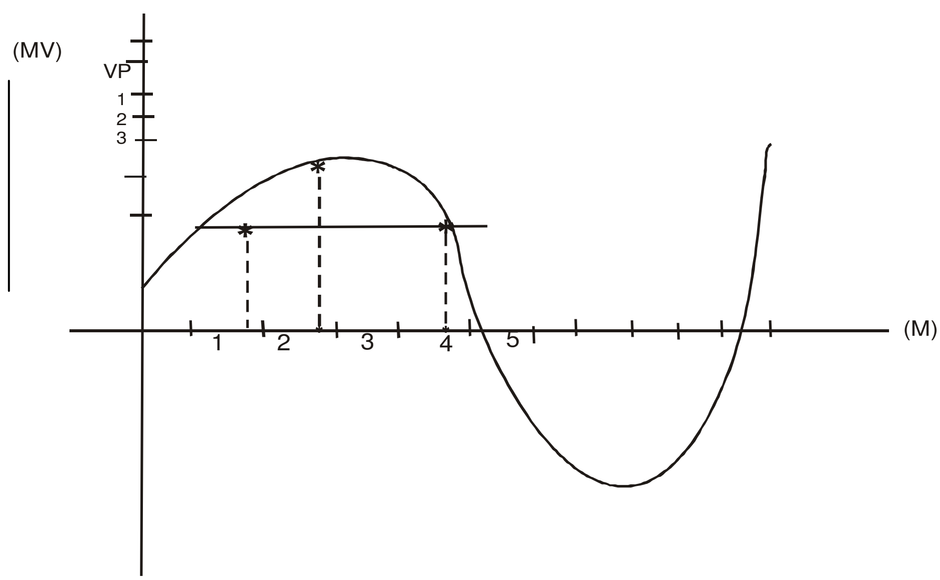

Figure 4. Geophysical Investigation Grid Lines of Block A and B

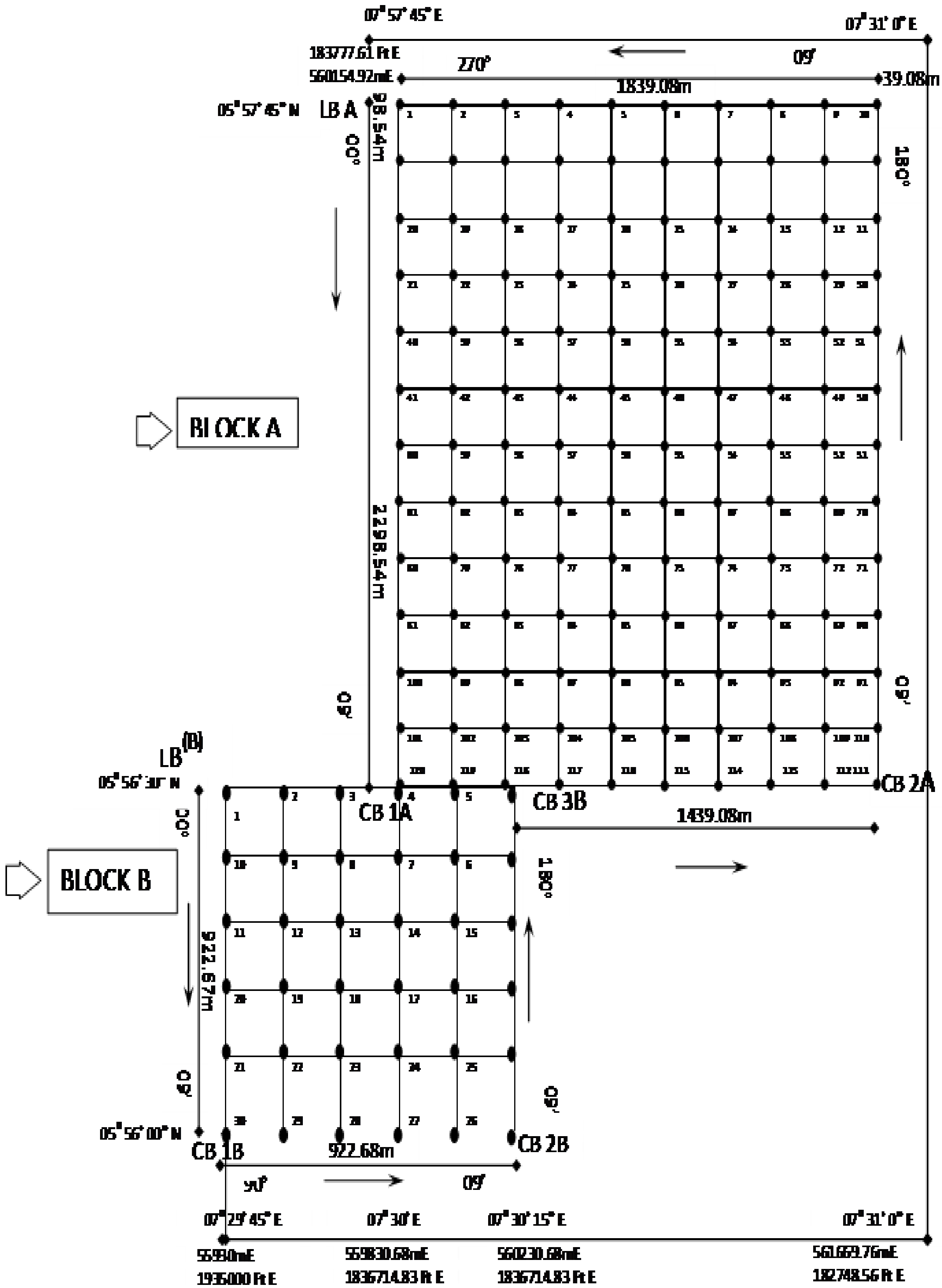

Figure 5. Geophysical Survey Grid Lines of Block A and B (Sketch not to scale)

BLOCK A

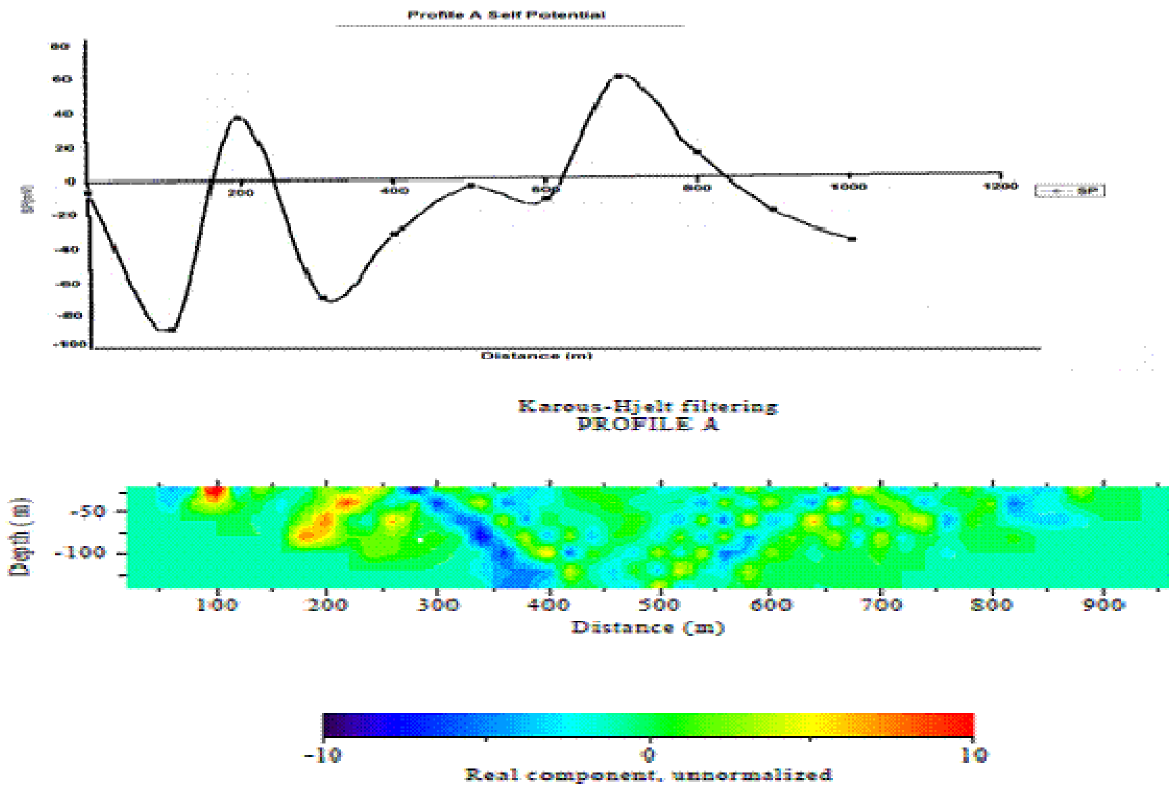

Figure 6. Profile A ; (a) S.P graph (b) E.M graph and filtering

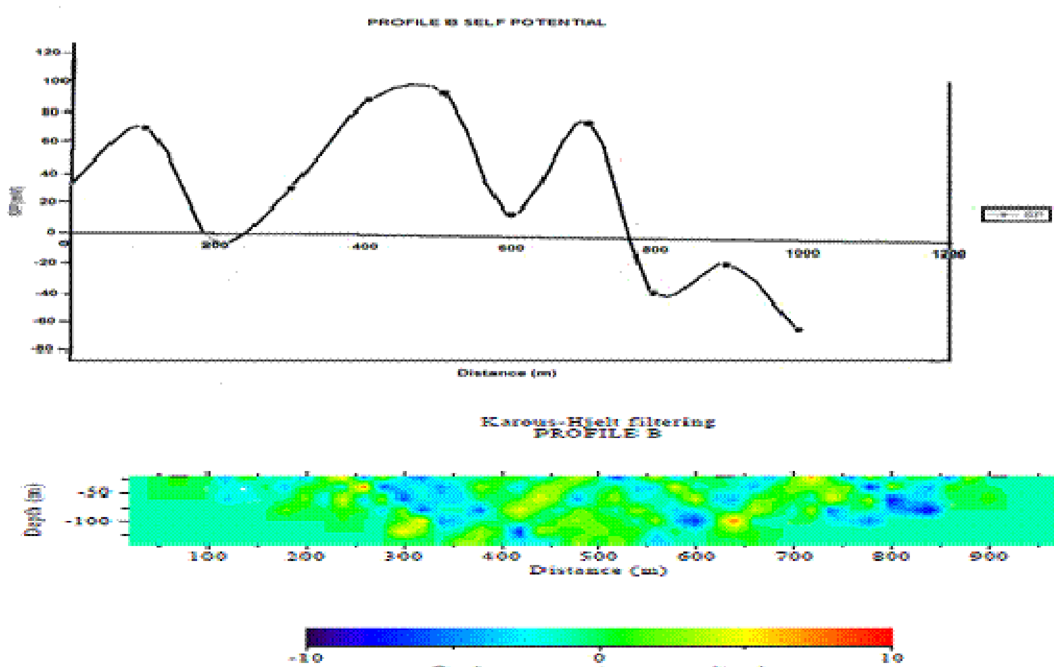

Figure 7. Profile B; (a) S.P graph (b) E.M filtering

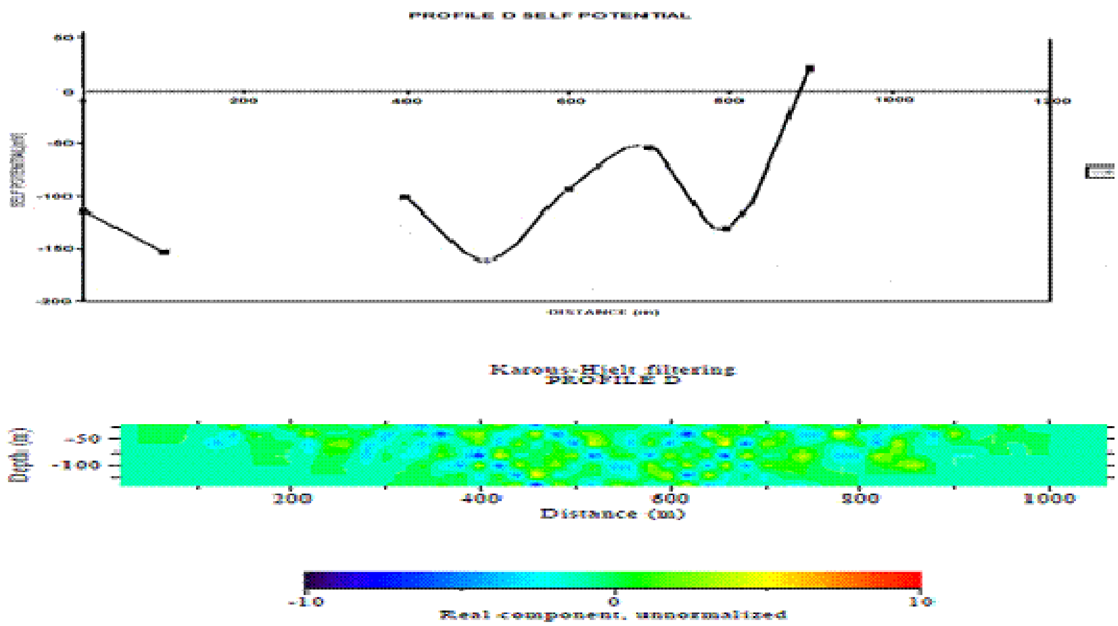

Figure 8. Profile D; (a) S.P graph (b) E.M filtering

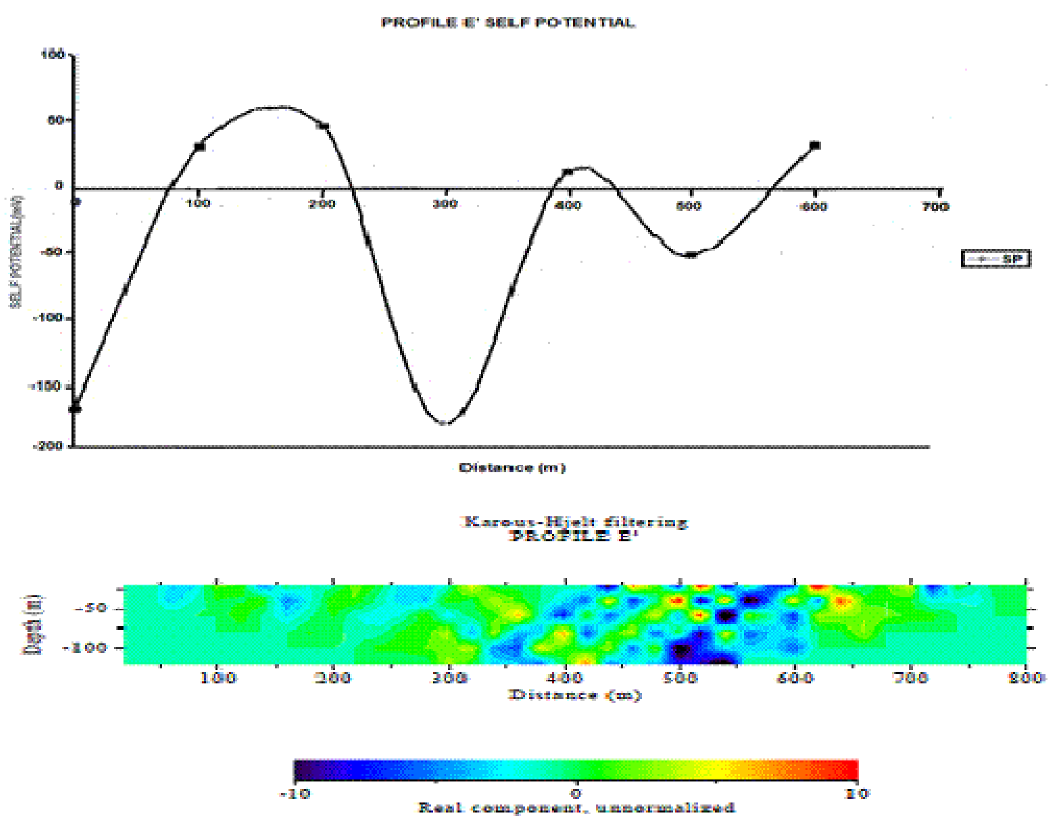

Figure 9. Profile E[1]; (a) S.P graph (b) E.M filtering

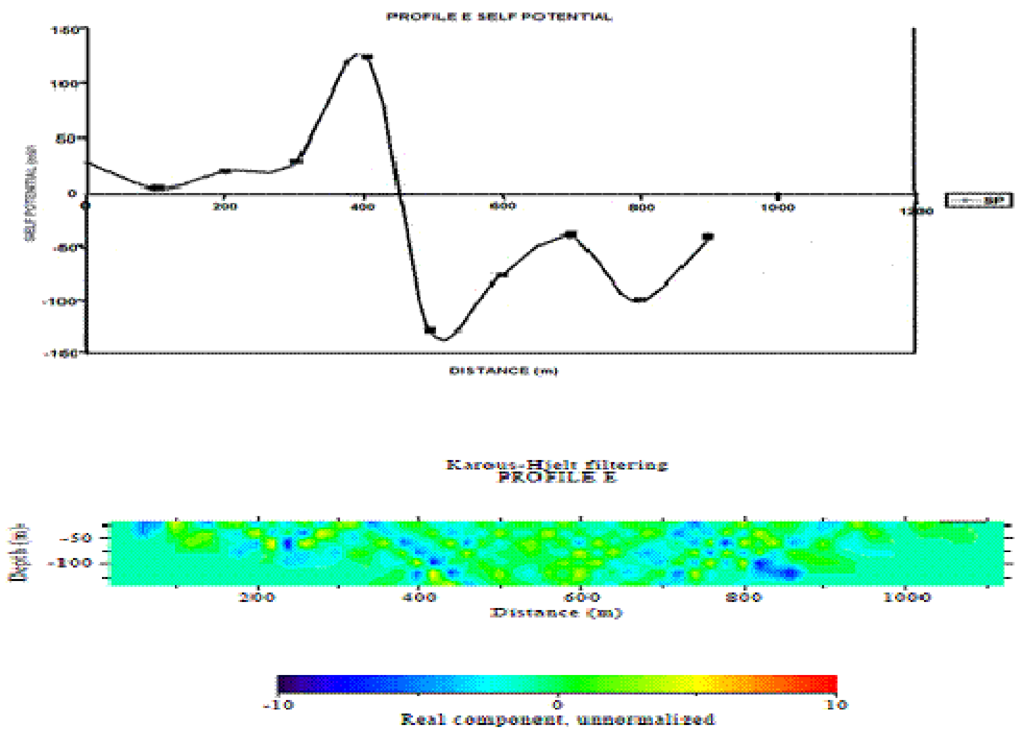

Figure 10. Profile E; (a) S.P graph (b) E.M filtering

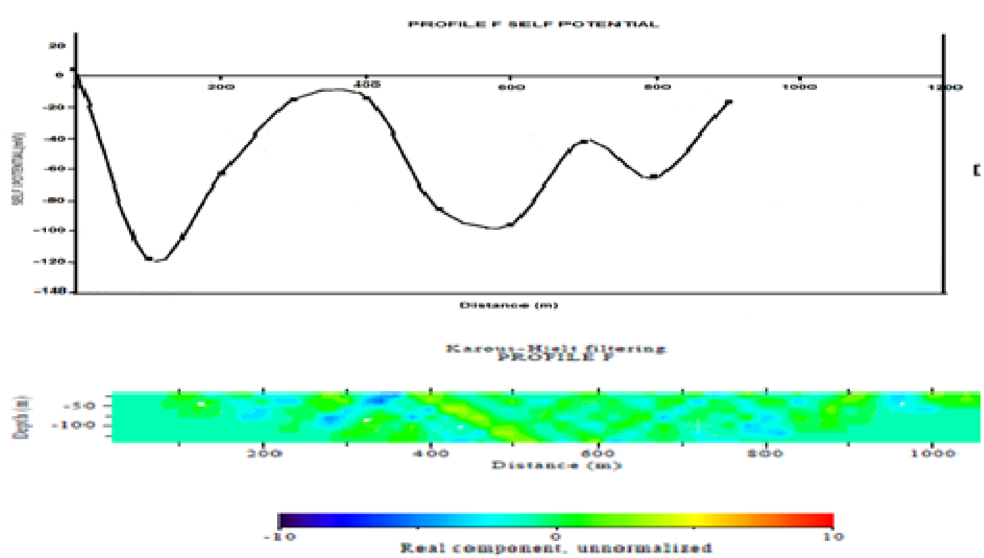

Figure 11. Profile F; (a) S.P graph (b) E.M filtering

Inoceramus Specie in rock unit confirms a lower Turonian age (Reyment, 1965).

There exist various sedimentary structures like mud cracks and joints. The joints are predominant within the Pb-Zn region, having the mineral veins running through the joints. Hobbs et al, (1966) showed that the joints are probably radial or cross cutting and may be associated with the post – Albian folding which is typically connected with N.W-S.E compressive stress.

The geologic map of the study area is shown on figure 2.

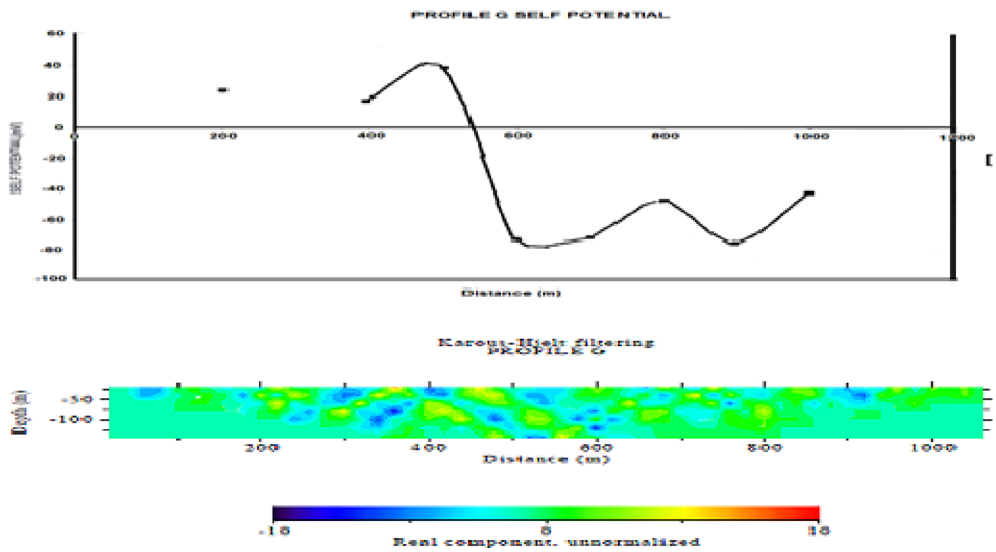

Figure 12. Profile G; (a) S.P graph (b) E.M filtering

MATERIALS AND METHODS

The ABEM terrameter SAS 300 was used to measure the S.P while the ABEM WADI, VLF type 9133001869 was used to measure the E.M.

The SP profiling was done at intervals of 100m. The values were analyzed and the anomalies indicated. The Electromagnetic profiling was carried out in same field to obtain more precise points/veins of occurrence. The magnetic field direction is a paramount vector signal which was considered, hence the plotted profiles taking the east - west direction except otherwise indicated. The filtered real data and filtered imaginary data for both the vertical and horizontal measurements were obtained from the raw real and imaginary values respectively.

The filtered real in the graphs were plotted with Karous-Hjelt and Fraser program. This was placed line in line with the S.P graph to create room for better comparison and interpretation.

The graphs/interpretation of the data are shown in figures 5 to 15 .The overburden thickness of the earth - soil over the galena and sphalerite deposits was estimated from the figure 4.

Estimation of overburden thickness from S.P data using half- width from SP data

VP = h = X /1.732

VP = the anomaly

X = m-n i.e. X = 4.5-1.5

The result obtained from the mathematical expression is given in table 1.

RESULT AND DISCUSSION

The negative anomalies of S.P record is correlated to the Karous Hjelt filtered result of E.M in all the profiles. The red and yellow pigments of these plots indicate the viable mineral veins of the study area. The other pigments of blue and green are of little or no economic value. At profile A, the mineral vein is at 100m, 300m and 600m with the electrical values of 90mV, 80mV, 15mV and 30mV respectively as seen in the S.P graph and when further plotted with Karous Hjelt filtering, the yellow and red pigment which indicates the positive anomaly are seen at points 100m, 200 – 250, 600 – 650m confirming the signals of SP points.

Profile B shows the needed pigments at 250m, 650m and 700m respectively. The extensive rice farms in the study area distorted some profile measurement such as in Profile D thus leading to an uncompleted chart of such profiles. The profile E^1 runs with significant red pigment while profile E has dispersed yellow pigment, indicating a yield of average mineral vein when compared with profile E^1 and D. Comparing all the profiles in blocks A and B , the value obtained shows that profiles A, E^1, L and M are the most viable while profiles D, B, E and G are less prolific. The viability is low for exploitation. The least viable profiles are K and F, showing absence or very low Pb-Zn content.

Table 1. shows the thickness of overburden which ranges from 12m to 69m.The viable and averagely viable profiles have a reasonable overburden except at profile E^1.

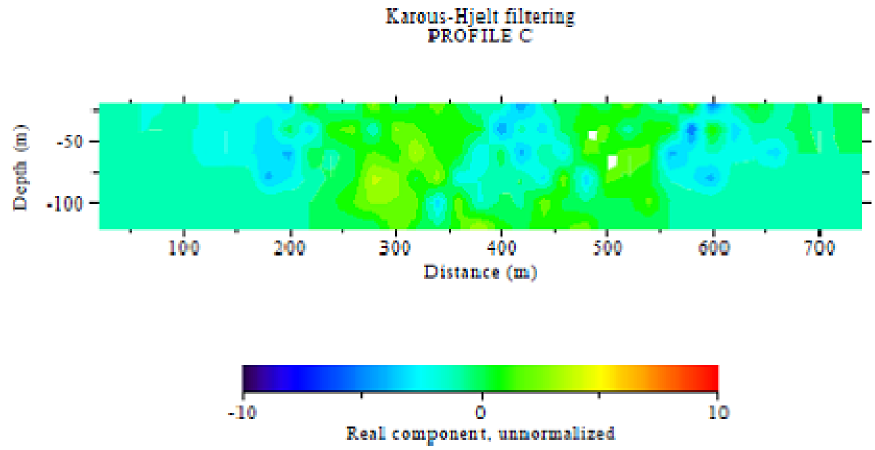

Figure 13. Profile C, E.M graph and filtering

BLOCK B

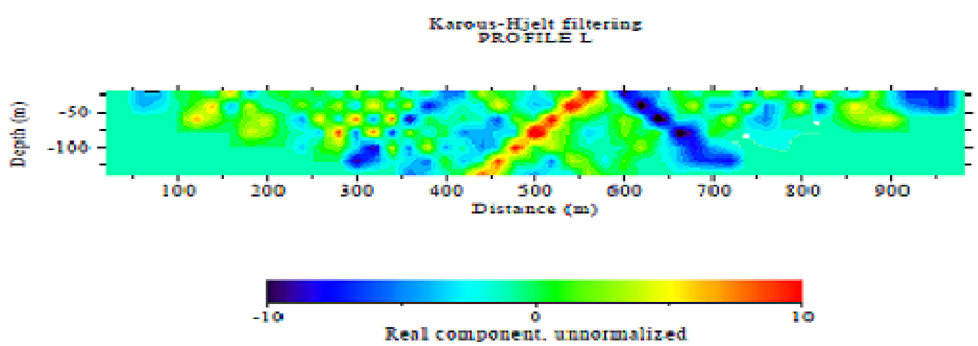

Figure 14. Profile L, E.M graph and filtering

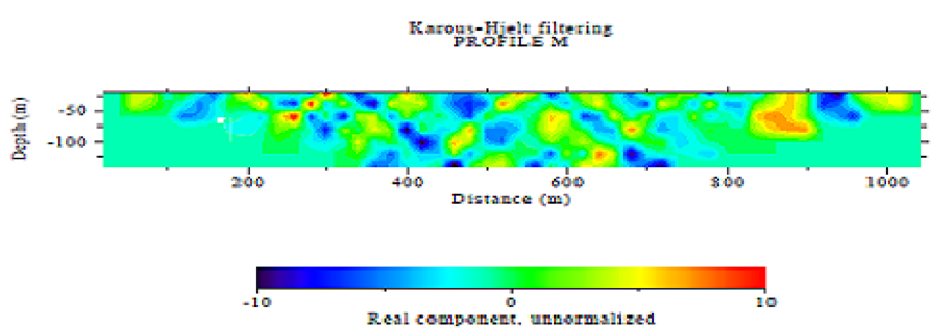

Figure 15. Profile M, E.M filtering

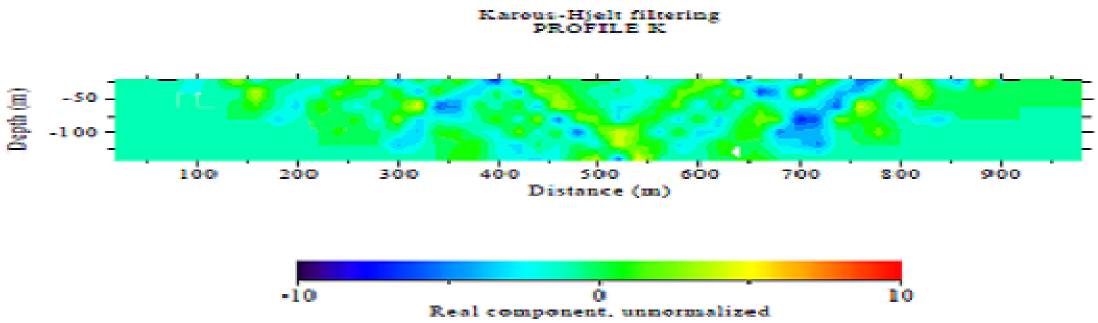

Figure 16. Profile K, E.M graph and filtering

Table 1. The overburden thicknesses

	Profile	Anomaly	Overburden thickness (m)
	A	SP_1	57
		SP_2	23
	B	SP_3	57
B\LOCK 'A'		SP_4	69
		SP_5	57
	G	SP_9	40
	E	SP_6	40
	E^1	SP_7	40m
		SP_8	12m

CONCLUSION

The study has shown that profiles A,E^1,L and M of both Block A and Block B have very good signals indicating enormous reserves of sulfides, while profile B,D,E and G are rated on moderate yield. Profile F, C and K are non-viable. The highly viable and the averagely viable profiles are recommended for exploitation of the sulfide ore and since the average overburden thickness is beyond 40m, an underground mine design is recommended for the exploitation of the ore veins.

REFERENCES

Akande SO, Mucke A, Umeji AC (1990). Mineralogical Textural and Paragenetic Studies of the Lead-Znc-Copper.Implications, J. Min.Geol.,V.26,P.2.Ores in the lower Trough Benue and their Genetic.

Barringer AR (1962). A new Approach to Exploration-the INPUT airborne electrical pulse prospecting system. Min. Cong. J. 48, P.49-52.

Beck WA (1964). Loading and Transportation at Zinc-Lead Mines, The Eagle-Picher Co. Jo Daviess County, 111 and Lafayette County. Bu Mines Inf. Circ. 8208, 31pp.

Bogue RG (1952). The Lead-Zinc Deposits at Ishiagu, Ogoja Province,Nigeria: G.S.N.Rpt. No.1016.

Dobrin M (1960). Geophysical Prospecting. Mc Grav-Hill New York.

Ezepue MC (1984). The geologic setting of Lead-Zinc deposits at Ishiagu, Southeastern Nigeria. J. Afr. Earth Sci., 2:P.87-101.

Geol. Surv. Of Nigeria (1957). Minerals and Industry in Nigeria, Fed. Govt. Printer, Lagos.

Kogbe CA (1989). Geology of Nigeria (Second Revised Edition). Abiprint and Pak Limited Ibadan, Nigeria.

Olade MA (1976). The genesis of lead-zinc Deposits in Nigeria's Benue Rift (Aulacogen) – a re-interpretation. J. Min. Geol. 13 (2): 20-27 .

Ukaegbu VU, Akpabio IO (2009). Geology and Stratigraphy of Middle Cretaceous Sequences Northeast of Afikpo Basin, Lower Benue Trough, Nigeria.The Pacific Journal of Science and Technology. V.10,Num.1.

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