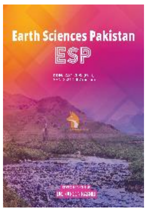
ZIBELINE INTERNATIONAL™
PUBLISHING
ISSN: 2521-2893 (Print)
ISSN: 2521-2907 (Online)
CODEN: ESPADC

Earth Sciences Pakistan (ESP)

DOI: http://doi.org/10.26480/esp.01.2022.36.42



RESEARCH ARTICLE

CHARACTERISATION OF GOLD-ASSOCIATED BASE METALS IN ITAGUNMODI, ILESHA SCHIST BELTS, NIGERIA, TO ASCERTAIN THEIR ORE BODY FORMATION TRENDS

Michael T. Asubiojo[a*], Kazeem O. Olomo[a], Olawatoyin K. Olaleye[b], Joshua B. Olatunbosun[a]

[a]Department of Earth Sciences, Adekunle Ajasin University, Akungba Akoko, Nigeria
[b]The Federal University of Technology, Akure, Nigeria
[*]Corresponding Author Email: michael.asubiojo@aaua.edu.ng

ARTICLE DETAILS

Article History:

Received 09 June 2022
Accepted 14 July 2022
Available online 20 July 2022

ABSTRACT

The analysis of the discovered base metal elements in Itagunmodi, Southwest, Ife-Ilesha schist belts, Nigeria, with a case study of Amuta, was carried out to ascertain the likelihood of these elements forming ore bodies that might sustain mining activity in the area alongside gold. The aim is to determine the economic viability potentials of the detected base metals' mineralisation to support mining activities in the study area. The geochemical analysis results indicated that the concentrations of these elements copper (Cu), nickel (Ni), lead (pb), and zinc (Zn) are substantial in the majority of the locations when compared to the area's typical concentrations. When the copper 614.2, nickel 705.1, lead 47.1, and zinc 987.8 threshold values were compared to their recoverable concentrations, it was determined that these elements, with the exception of lead in location 4, are not anomalous in the area. When these elements' concentration factors were compared to their usual crustal abundance values, it was determined that they are not enough concentrated to form ore bodies in the studied location. Electrical geophysical methods utilizing induced polarization were used to determine the locations of selected stream samples. The results from the five locations typically indicated a significant IP signature with chargeability values ranging from 8 to 18 msec, confirming the occurrence of base metals mineralization in the study region. This indicates that the ore deposit is uneven and distributed within fault/fracture zones. As a result, the detected base metals' mineralisation potentials in the study region are not economically viable to support mining activities. Thus, it is concluded that, while the studied area is mineralized in base metals, its ore body formation propensity is extremely low, and thus cannot sustain economically viable mining activities.

KEYWORDS

Characterisation, Thresholds, Crustal Abundance, Concentration Factors, IP Effect

1. INTRODUCTION

The evident presence of artisanal gold miners in Itagunmodi, together with the various research initiatives conducted in the area, demonstrates that Itagunmodi is a good reconnaissance area for gold mining.

When searching for gold in stream sediments, it is frequently more efficient to look for the geographical distribution of gold-associated mineral components rather than for gold itself, as gold is frequently found in association with other elements. There are other metals in Itagunmodi that are not precious metals like gold, but rather occur in the area as gold-associated elements. These base metals, more frequently referred to as trace elements, receive little or no attention, with the majority being classified as gangue minerals and tailings, despite their potential economic viability if thoroughly examined and analyzed. The purpose of this study is to critically evaluate these gold-associated base metals in Itagunmodi, using Amuta as a case study, in order to ascertain their ore bodies' formation trend from which they can be mined economically. The objectives include determining the degree of enrichment (concentration factors) and the concentration contents of the components in question in comparison to their typical crustal abundance and threshold values. To create an ore body, the element(s) in question must be enriched much beyond their crustal abundance (Evans, 1993).

The geochemical and geophysical features of four gold-associated base metals (trace elements), namely Lead (Pb), Zinc (Zn), Copper (Cu), and Nickel (Ni), were analyzed to assess their mineralisation potential and ore-forming tendency. Base metals are non-ferrous metals with a wide range of industrial uses. Unlike precious metals, when exposed to air and moisture, base metals tend to oxidize, corrode, and tarnish over time. Nonetheless, they are significantly more cost effective to employ because they are frequently more abundant in nature and perhaps easier to mine. With this study, the economic viability potentials of the detected base metals' mineralisation in the study area will be determined by knowing their ore bodies' formation trend that can support mining activities.

Akinola et al., (2013) recently assessed the geochemical profiles of major and trace elements in the Itagunmodi drainage network in order to gain insight into the drainage network's vulnerability as a result of inadequate sanitation and waste disposal. Aderonke et al., (2011) published an article on the trace element concentrations in soils in the Ife-Ijesa region of southwest Nigeria. Asubiojo et al., (2022) used the mineralisation potentials of Itagunmodi as control to determine the mineralisation potentials of Osu, both in Ilesa schist belt, southwest Nigeria. Other scholars have discussed the contamination and pollution of trace elements

Quick Response Code	Access this article online	
	Website: www.earthsciencespakistan.com	**DOI:** 10.26480/esp.01.2022.36.42

Cite the Article: Michael T. Asubiojo, Kazeem O. Olomo, Olawatoyin K. Olaleye, Joshua B. Olatunbosun (2022). Characterisation of Gold-Associated Base Metals in Itagunmodi, Ilesha Schist Belts, Nigeria, to Ascertain Their Ore Body Formation Trends. *Earth Sciences Pakistan, 6(1): 36-42.*

in many places of the world (Jingzhao et al., 2019; Ayari et al., 2021; Erasto et al., 2021; Antwi-Agyei et al., 2009).

Despite the abundance of study on trace elements and other metals, no author has focused exclusively on the characterization of base metals in terms of concentration levels and ore bodies' formation trend for probable exploitation reasons in Ilesha schist belts, which is the subject of this research.

The quantities of trace elements linked with gold mineralization in the research region were determined using the X-ray Fluorescence (XRF) technique in this study. Trace elements are elements that occur at extremely low concentrations of a few parts per million or less in a given system, and their analysis using the X-ray fluorescence (XRF) technique is widely regarded as one of the simplest and most accurate analytical methods for determining the composition of elements in various types of materials. This is because the X-ray fluorescence (XRF) technology has no effect on the mineralogy or particle size of the sample being analyzed, resulting in extremely precise and accurate analytical results.

Electrical method is a geophysical technique that is frequently employed in mineral exploration. It depends upon the nature of the earth's current flow and how it is observed on the planet's surface. Electrical methods are classified into numerous categories according to the parameters measured, including self-potential (SP), induced polarization (IP), and resistivity. Magneto-Telluric (MT) and Control Source Audio Magneto-Telluric (CSAMT) technologies are also available.

Due to its rapid and low-cost surveys in mineral target investigations, induced polarization (IP) is a critical geophysical survey technique for base metal prospecting. This assertion has been demonstrated in the work of (Chapman and Mortensen, 2016; Dentith and Mudge, 2014; Zonge et al., 2005). The IP electrical method is used to determine the presence of polarization on the surface of metal minerals beneath the earth's surface. Polarization occurs as a result of an electrolyte-metal mineral reaction mediated by inductive currents. It has the benefit of detecting disseminated ore deposits that cannot be identified using other electrical methods, as well as scattered and irregular sulfide minerals. As a result, this approach is ideal for obtaining base metal resources associated with gold mineralization. The primary objective of mineral exploration is to collect as much information as possible in the shortest feasible period and at the lowest possible cost. There are further geophysical methods that are frequently employed in mineral exploration; selecting an appropriate approach is dependent on the physical qualities of the mineral target, such as its host rocks, geological context, and topographical circumstances (Zhang et al. 2017). As demonstrated in the works of (Mamo 2013; Mostafaei and Ramazi 2018). Previous research demonstrating its relevance to base metal targets includes the work of White et al., 2001, who applied 3D IP modeling to copper exploration in New South Wales, Australia. Yang et al., (2008) integrated ER and IP in the exploration of base metal deposits in China. Taha et al., (2009) used IP to explore for gold deposits in Egypt's eastern desert other study integrated induced polarization and electrical resistivity methods for copper exploration in Iran (Ramazi and Jalali, 2014); also explored for gold deposits in Indonesia using 3D induced polarization modelling (Halim et al., 2017); Morriera et al., (2018) used a 3D model of IP and resistivity for copper exploration in Brazil. The existence of economically valuable base metal minerals in the research region has not been publicly publicized (Olomo et al., 2018). As a result of the aforementioned, the purpose of this current research is to determine the presence of base metal minerals in Itagunmodi, a portion of the Ilesha schist belt gold deposit in southern Nigeria, utilizing geologic and geophysical techniques to determine their ore bodies' formation trend. The research will act as a resource for potential investors and the government in order to increase revenue.

2. GEOLOGICAL ENVIRONMENT

The study region is located in Itagunmodi Ilesa (Figure 1), between latitudes 08^{0} 33' 37" and 08^{0} 34' 42" north and longitudes 06^{0} 81' 27" and 06^{0} 82' 23" east, with an average elevation of 350 meters (Table 1). Itagunmodi is located within the South-western Nigerian basement complex, in the western portion of the West African craton of the late Precambrian to early Palaeozoic Pan-African Orogeny (Rahaman, 1976).

According to recent study, Nigeria's Basement complex consists of six rock groups, one of which being the schist belts (Rahaman, 1988). Often referred to as younger metasediments, this category of rocks consists of pelitic to semi-pelitic schist, quartzite, metaconglomerate, calc-silicate rocks, marble, and mafic to ultramafic rocks. The schist belts are infolded into the migmatite-gneiss-quartzite complex and occupy the N-S trending synformal troughs. They are believed to hold significant economic mineral reserves and are the most developed in Nigeria's western region (McCurry, 1976; Oyawoye, 1964). According to a research, the schist belts dictated the structural tendency of Nigeria's Basement Complex (Rahaman, 1988). In Nigeria, schist belts include the Zungeru-Birnin Gwari, Kushaka, Karaukarau, Kazaure, and Wonnaka schist belts; and the Anka, Zuru, Iseyin-Oyo River, Ife-Ilesha, Igarra, Toto Muro, Egbe-Isanlu, and Jakura-Lokoja schist belts. Amuta, Itagunmodi the study area falls within the Nigeria's Ife-Ilesha southwest schist belts.

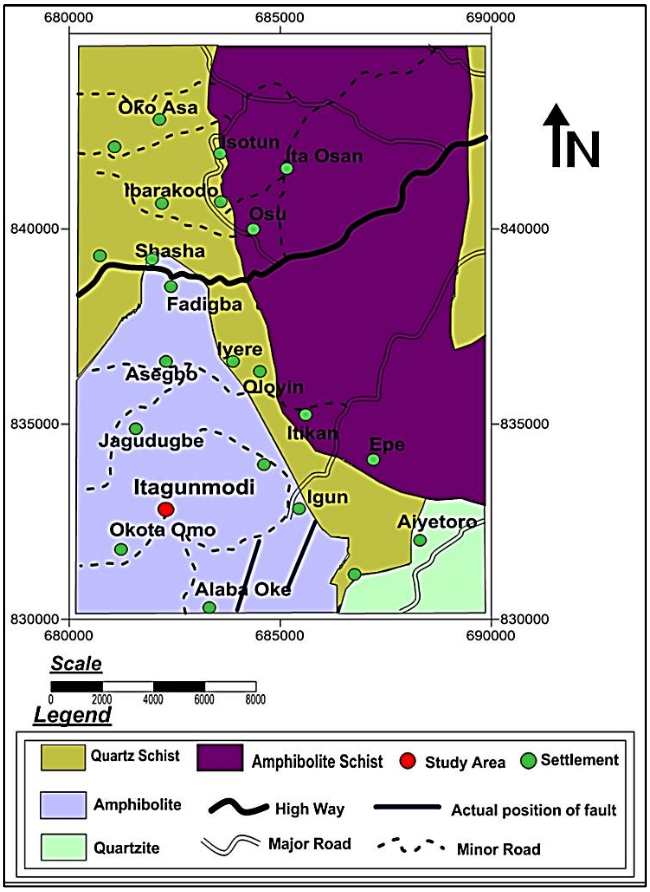


Figure 1: Geological Map showing the location of the study area.

Table 1: Geographical Coordinates of the Sampling Points in The Study Area.

Sample code (sample location)	Latitude N	Longitude E	Locations	Elevation
SL 1	$08^{0}\ 33^{I}\ 44^{II}$	$06^{0}\ 82^{I}\ 18^{II}$	Itagunmodi	355m
SL 2	$08^{0}\ 33^{I}\ 37^{II}$	$06^{0}\ 82^{I}\ 23^{II}$	Itagunmodi	354m
SL 3	$08^{0}\ 33^{I}\ 52^{II}$	$06^{0}\ 81^{I}\ 27^{II}$	Itagunmodi	348m
SL 4	$08^{0}\ 33^{I}\ 47^{II}$	$06^{0}\ 81^{I}\ 54^{II}$	Itagunmodi	348m
SL 5	$08^{0}\ 34^{I}\ 42^{II}$	$06^{0}\ 81^{I}\ 45^{II}$	Itagunmodi	347m

3. MATERIAL AND METHODS

3.1 Geochemical Analysis

Five samples of stream sediment were obtained with the assistance of artisanal miners along the Amuta gold-bearing stream channel in Itagunmodi. The depth ranges for sample collection were randomly chosen between 1 and 3m. The coordinates and altitudes of the sampling points were taken and recorded (Table 1). The gathered samples were utilized to conduct a ge ochemical analysis of the study region using the X-Ray fluorescence (XRF) analytical technique for determining the composition of trace elements. The analysis of x-ray fluorescence was performed at the National Agency for Science and Engineering Infrastructure (NASENI) in Akure, Ondo State, Nigeria. The average concentration means, threshold values, and the concentration factors of the detected base metals in the research area were calculated statistically using the element concentration values acquired from the XRF analysis. The mean of the average concentration is the value above which the element is considered significant. The threshold value is the reference value against which the values of each element in the research regions are compared, and over which the element concentration is considered abnormal, while the Concentration Factor (C.F.) is the value that must be greater than the element's crustal abundance to produce an ore body.

These parameters are stated mathematically as follows:

1. Average concentration Mean:

$$C_{mean} = \frac{\sum Cn}{nl} \qquad (1)$$

Where: Cn = individual element concentration, and

nl = number of locations

2. Threshold = C_{mean} + 2SD (2)

According to Reimann, *et al* (2005)

Where: C_{mean} = Mean concentration of the elements

SD = Standard Deviation of the element composition

3. Concentration Factor (C. F) = $= \frac{(Ce)Sediment}{(Nca)\ element}$ (3)

Where: $(Ce)_{Sediment}$ = Element concentration at a given location

$(N_{ca})_{Element}$ = Normal Crustal Abundance of element.

Copper 70ppm, Nickel 80ppm, Lead 16ppm, and Zn 132ppm crustal abundance were taken from Dineley et al., 1976.

3.2 Geophysical Analysis

Induce polarization (IP) surveys were conducted utilizing an SAS 1000 resistivity meter. This was accomplished by increasing the inter electrode spacing around a fixed array centre. Schlumberger arrays with an AB/2 of 1 meter and a maximum of 150 meters were used. Along the five places where soil samples were collected for geochemical analysis, readings were taken. The chargeability was plotted against the electrode spacing AB/2 using Microsoft office excel.

4. RESULTS AND DISCUSSION

4.1 Geochemical Analysis Result

The results of the identified base metals that were analysed in the study area are summarily presented in Table 2, and are discussed on location basis as follows.

Table 2: Trace Elements Geochemical Analyses Results (ppm) of The Study Area

Trace Elements	SL1 (ppm)	SL2 (ppm)	SL3 (ppm)	SL4 (ppm)	SL5 (ppm)	Min	Max	Mean	Crustal Abundance (ppm)	Threshold Value (ppm)
Cu	330	424	371	601	322	322	601	409.6	70	614.2
Ni	693	474	564	530	503	474	693	552.8	80	705.1
Pb	22	0	0	51	18	0	51	18.2	16	47.7
Zn	598	794	890	858	650	598	890	758	132	987.8

Location 1

The four identified base metal elements occurred in this area in a variety of part per million (ppm) amounts (table 3). Copper (Cu) content is 330 parts per million, Nickel (Ni) 693 parts per million, Lead (Pb) 22 parts per million, and Zinc (Zn) 598 parts per million. When these concentrations were compared to the average value for each element (Table 2; Figure 2), it was discovered that Cu and Zn are less abundant, whereas Ni and Pb are more abundant, indicating their significance. When the concentration values were compared to their threshold values (Table 2; Figure 3), it was discovered that all elements appeared at a magnitude or tendency less than their threshold levels, and so were not anomalous. When the concentration factors for these elements were compared to their crustal abundance (Table 3; Figure 4), it was determined that none of the elements is sufficiently enriched to produce an ore body capable of supporting the elements' mining activities. A study reported that in order for ore bodies to occur, the concentration factor must be significantly greater than the element's crustal abundance (Evans, 1993). As a result, it is assumed that location 1 is mineralised with these elements at a lower magnitude than is required to support mining activities.

Table 3: Recovered Concentrations and The Concentration Factors of Elements in Location 1

S/N	Element	Content (PPM)	Concentration Factor (PPM)	Crustal Abundance (PPM)
1	Copper (Cu)	330	4.71	70
2	Nickel (Ni)	693	8.66	80
3	Lead (Pb)	22	1.38	16
4	Zinc (Zn)	598	4.53	132

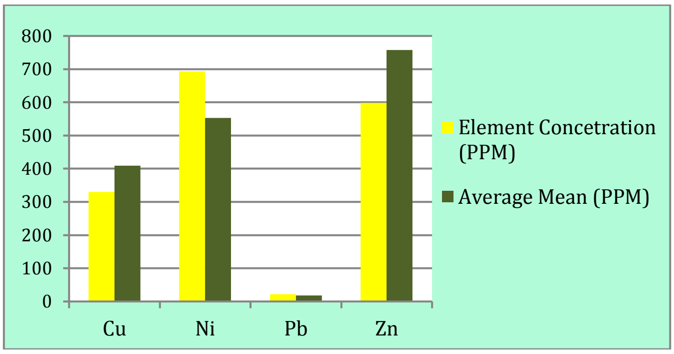


Figure 2: Graph of element conc. versus average mean in Location 1

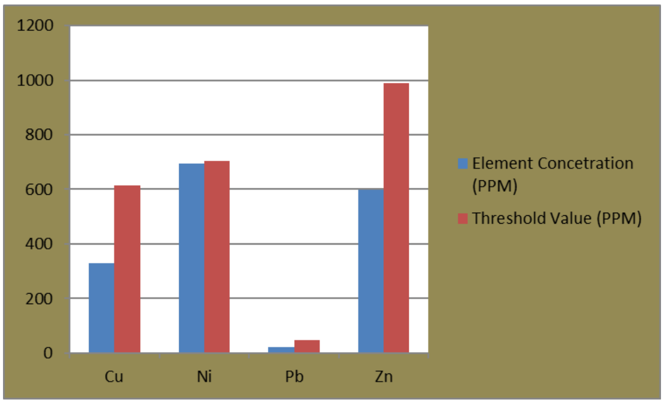


Figure 3: Graph of element conc. versus threshold value in Location 1

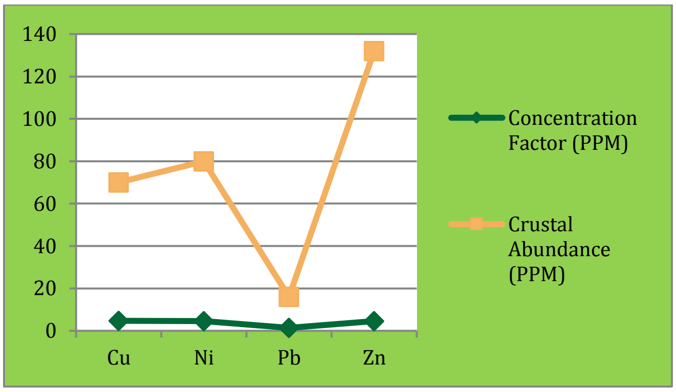


Figure 4: Graph of conc. factor versus crustal abundance in Location 1

Location 2

The concentrations of the indicated elements in parts per million (ppm) are as follows: copper (Cu) 424, nickel (Ni) 474, zinc (Zn) 794, and lead (Pb) 0ppm. By comparing the concentrations and average values of these components (table 2; figure 5), it was determined that Cu and Zn occurred above normal, whereas the remaining elements were below average. This demonstrated the importance of Cu and Zn in this site. When concentration levels were compared to threshold values (Table 2; Figure 6), it was determined that all elements appeared at a magnitude or tendency less than their threshold values, indicating that they were not anomalous. When the concentration factors for these elements were

Cite the Article: Michael T. Asubiojo, Kazeem O. Olomo, Olawatoyin K. Olaleye, Joshua B. Olatunbosun (2022). Characterisation of Gold-Associated Base Metals in Itagunmodi, Ilesha Schist Belts, Nigeria, to Ascertain Their Ore Body Formation Trends. *Earth Sciences Pakistan, 6(1): 36-42.*

compared to their crustal abundance (Table 4; Figure 7), it is cleared that none of the elements is sufficiently concentrated to produce an ore body capable of supporting future exploitation. As a result, it is concluded that the mineralisation of these elements in location 2 is insufficient to enable mining activities for the elements.

Table 4: Recovered Concentrations and The Concentration Factors of Elements in Location 2

S/N	Element	Content (PPM)	Concentration Factor (PPM)	Crustal Abundance (PPM)
1	Copper (Cu)	424	6.06	70
2	Nickel (Ni)	474	5.93	80
3	Lead (Pb)	0	0	16
4	Zinc (Zn)	794	6.02	132

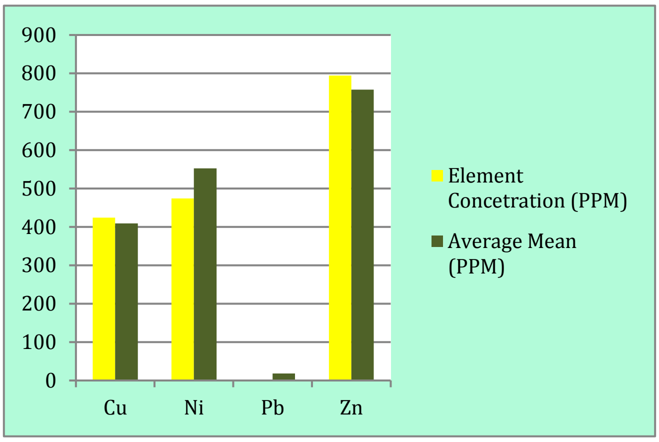


Figure 5: Graph of element conc. versus average mean in Location 2

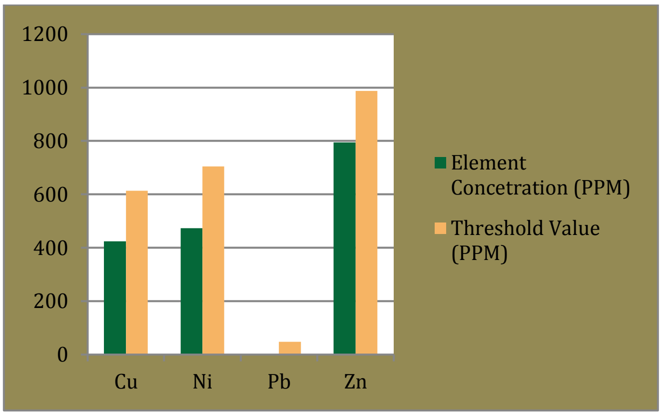


Figure 6: Graph of element conc. versus threshold value in Location 2

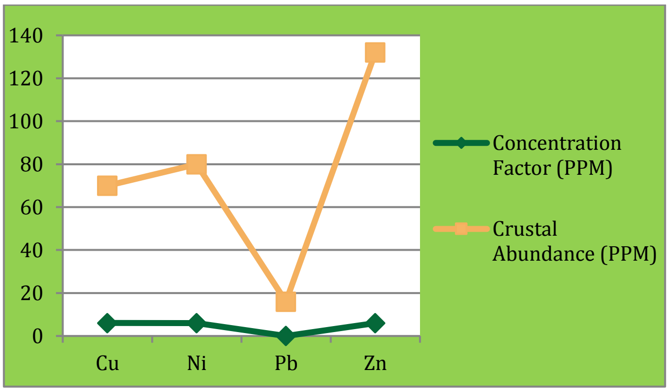


Figure 7: Graph of conc. factor versus crustal abundance in Location 2

Location 3

Copper (Cu) is 371ppm, Nickel (Ni) is 564ppm, and Zinc (Zn) is 890ppm in location 3, whereas Lead (Pb) is 0ppm (Table 5). When the concentrations and average means of these elements were compared (Table 2; Figure 8), it was discovered that Ni and Zn occurred above normal, whereas the remaining elements occurred below average. This demonstrated the importance of Ni and Zn in this site. When concentration data were compared to threshold values (Table 2; Figure 9), it was determined that all elements appeared at a magnitude or tendency less than their threshold values, indicating that they did not occur as abnormal. When the concentration factors for these elements were compared to their crustal abundance (Table 5; Figure 10), it is cleared that none of the elements is sufficiently concentrated to create an ore body conducive to further exploitation procedures. The mineralisation potentials of these elements in site 3 are judged to be less than what is required to support mining activities.

Table 5: Recovered Concentrations and The Concentration Factors of Elements in Location 3

S/N	Element	Content (PPM)	Concentration Factor (PPM)	Crustal Abundance (PPM)
1	Copper (Cu)	371	5.3	70
2	Nickel (Ni)	564	7.05	80
3	Lead (Pb)	0	0	16
4	Zinc (Zn)	890	6.74	132

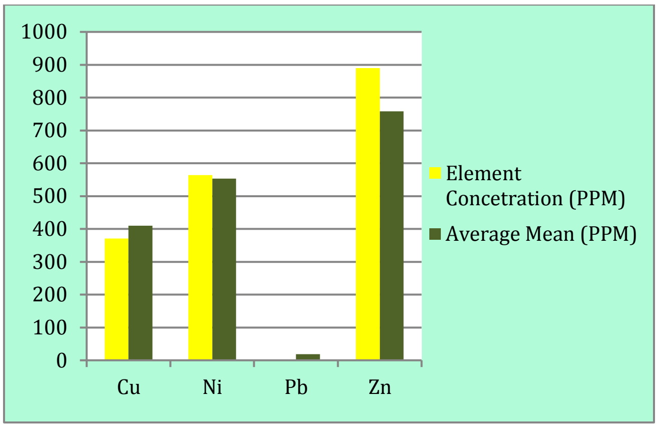


Figure 8: Graph of element conc. versus average mean in Location 3

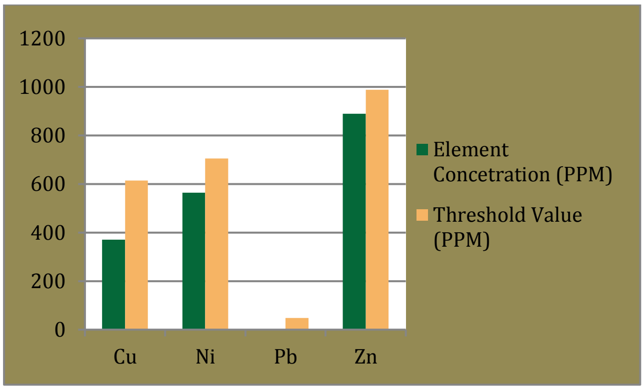


Figure 9: Graph of element conc. versus threshold value in Location 3

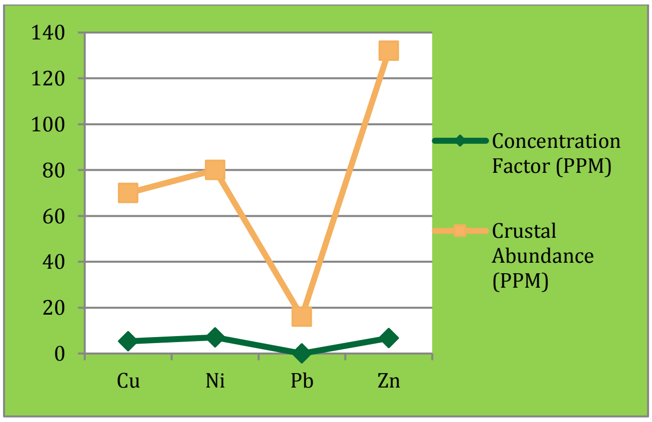


Figure 10: Graph of conc. factor versus crustal abundance in Location 3

Cite the Article: Michael T. Asubiojo, Kazeem O. Olomo, Olawatoyin K. Olaleye, Joshua B. Olatunbosun (2022). Characterisation of Gold-Associated Base Metals in Itagunmodi, Ilesha Schist Belts, Nigeria, to Ascertain Their Ore Body Formation Trends. *Earth Sciences Pakistan, 6(1): 36-42.*

Location 4

Copper (Cu) is 601, Nickel (Ni) is 530, Lead (Pb) is 51, and Zinc (Zn) is 890 in parts per million (Table 6). Comparing the concentrations and average means of the elements at this area (Table 2; Figure 11), it was discovered that Cu, Pb, and Zn have values that are greater than the average mean values for these elements, although Ni has a value that is less than the average. This demonstrated the importance of Cu, Pb, and Zn in this site. Concentration levels compared to threshold values (Table 2; Figure 12) demonstrated that Cu, Ni, and Zn occurred at concentrations lower than their respective thresholds, however Pb occurred at concentrations greater than its respective threshold, and was thus classified as anomalous. When the concentration parameters for these elements were compared to their crustal abundance (Table 6; Figure 13), it was determined that none of the elements is sufficiently enriched to create an ore body conducive to further exploitation activities. With the exception of Lead (Pb), which may be further investigated in the area; it is assumed that the mineralisation potentials of these elements in site 4 are less than what is required to support mining activities.

Table 6: Recovered Concentrations and The Concentration Factors of Elements in Location 4

S/N	Element	Content (PPM)	Concentration Factor (PPM)	Crustal Abundance (PPM)
1	Copper (Cu)	601	8.59	70
2	Nickel (Ni)	530	6.63	80
3	Lead (Pb)	51	3.19	16
4	Zinc (Zn)	858	6.5	132

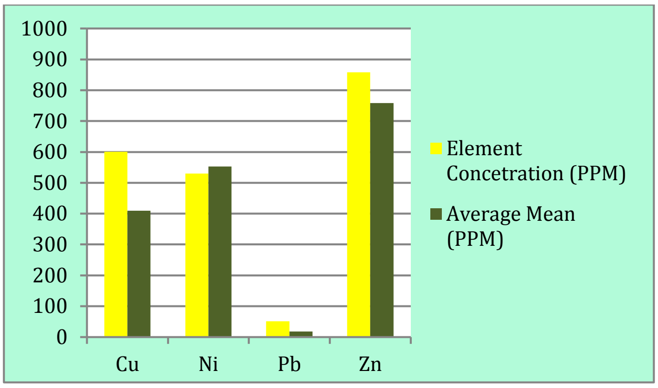


Figure 11: Graph of element conc. versus average mean in Location 4

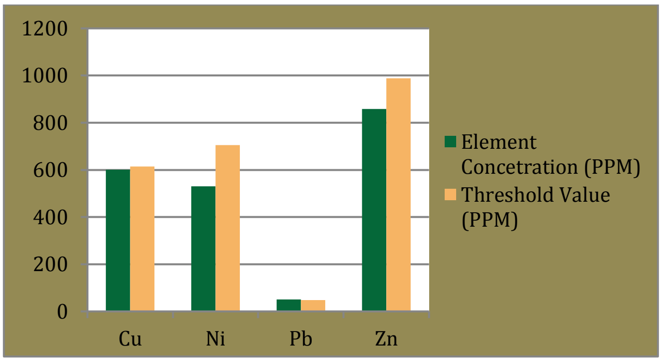


Figure 12: Graph of element conc. versus threshold value in Location 4

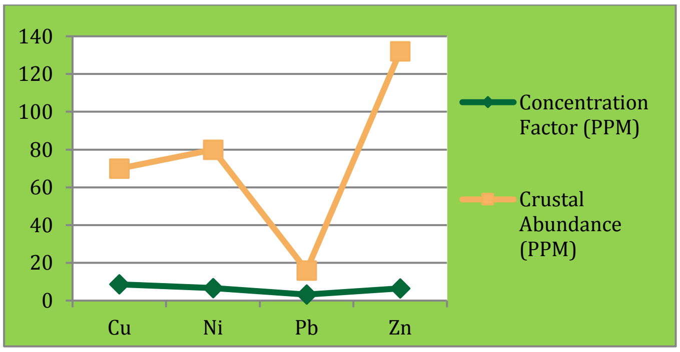


Figure 13: Graph of conc. factor versus crustal abundance in Location 4

Location 5

Copper (Cu) 322, Nickel (Ni) 503, Lead (Pb) 18, and Zinc (Zn) 650 are the detected components at this location (Table 7). When the concentrations and average means of these elements were compared (Table 2; Figure 14), it was discovered that all of the elements occurred at concentrations lower than their average values. When concentration values were compared to threshold values (Table 2; Figure 15), it was determined that all elements occurred at a magnitude or tendency less than their threshold values, indicating that they were not anomalous. When the concentration factors for these elements were compared to their crustal abundance (Table 7; Figure 16), it was determined that none of the elements is sufficiently enriched to form an ore body suitable for further exploitation. As a result, it is concluded that the mineralisation of these elements at location 5 is not of sufficient magnitude to support mining activities.

Table 7: Recovered Concentrations and The Concentration Factors of Elements in Location 5

S/N	Element	Content (PPM)	Concentration Factor (PPM)	Crustal Abundance (PPM)
1	Copper (Cu)	322	4.6	70
2	Nickel (Ni)	503	6.29	80
3	Lead (Pb)	18	1.13	16
4	Zinc (Zn)	650	4.92	132

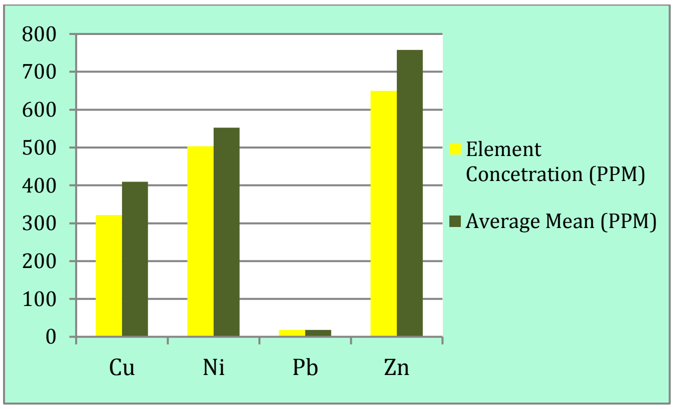


Figure 14: Graph of element conc. versus average mean in Location 5

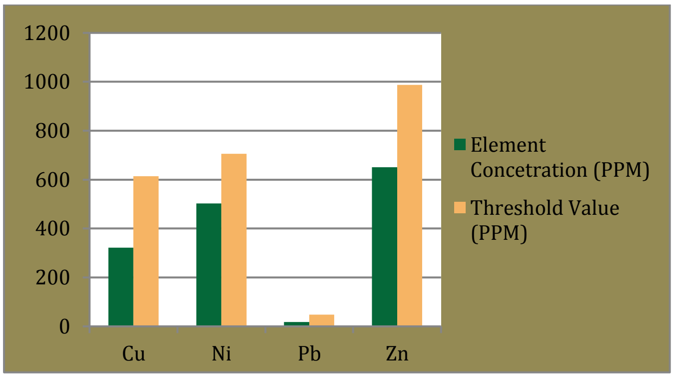


Figure 15: Graph of element conc. versus threshold value in Location 5

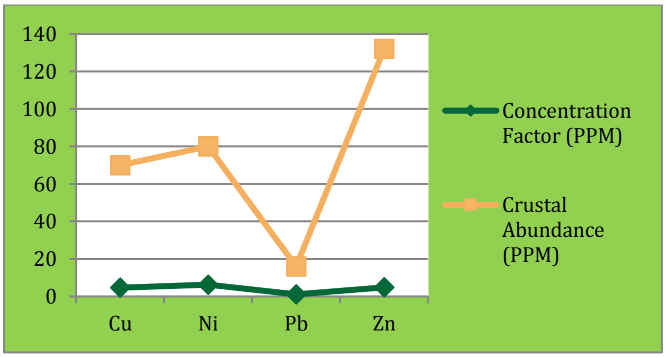


Figure 16: Graph of conc. factor versus crustal abundance in Location 5

Cite the Article: Michael T. Asubiojo, Kazeem O. Olomo, Olawatoyin K. Olaleye, Joshua B. Olatunbosun (2022). Characterisation of Gold-Associated Base Metals in Itagunmodi, Ilesha Schist Belts, Nigeria, to Ascertain Their Ore Body Formation Trends. *Earth Sciences Pakistan, 6(1): 36-42.*

4.2 Geophysical Observations

IP was used to effectively validate the geochemical analysis findings. A strong IP effect is a target hallmark for base metal deposits, indicating the presence of dispersed ore.

The IP profile shown in Figure 17 corresponds to the location 1 of a stream sample. Between 0 and 14m, a low chargeability is seen. Between 40 and 80meters, a considerable increase in IP value is observed. At 80m, it becomes significant, indicating the presence of possible base metal mineralization. The IP profile depicted in Figure 18 is for location 2. At distances between 1 and 16, a low chargeability value (0 - 5msec) was observed. From 18 to 100 m, a strong IP effect is found, with IP values ranging between 8 and 12msec. The substantial IP impact is indicative of a potential base metal ore deposit. A profile of an IP address at point 3 is depicted in Figure 19. At a distance of 100m, a strong IP signature with an IP value of 7msec is seen, but at a distance of 1-95m, a low chargeability with an IP value range from 2 to 4msec is noted. Figure 20 illustrates the boundary between the mineralized and non-mineralized zones at site 4. At a distance of 40 meters, the base metal mineralized zone is visible with an IP value of 8 milliseconds. Additionally, there is a significant increase in IP values between 95 and 100m, with values greater than 9msec. The IP profile of site five is depicted in Figure 21. At distances of 1-16m, the non-mineralized zone exhibits low chargeability (less than 6msec), but the putative high chargeability mineralized base metal zone is seen at distances of 50m, 90m, 120m, and 140m.

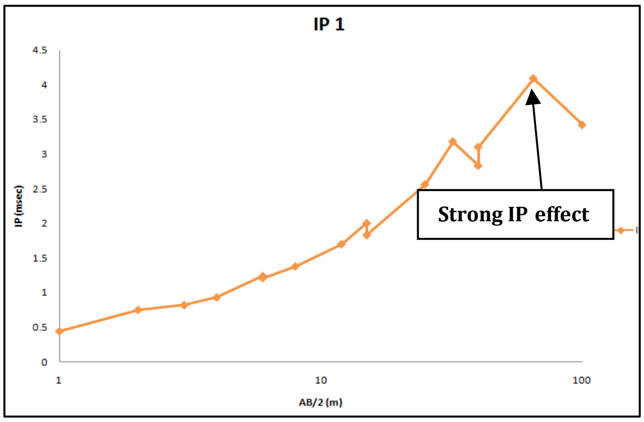


Figure 17: IP profile along location 1

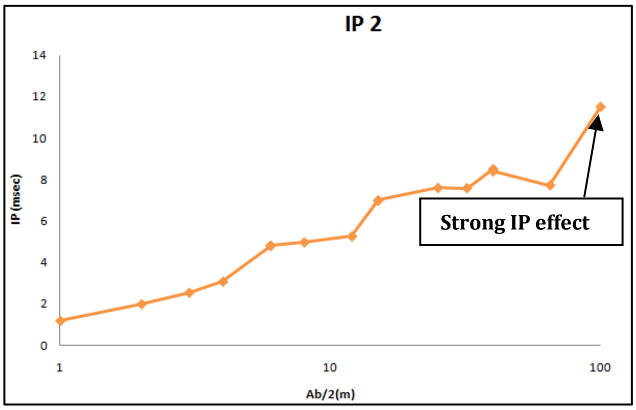


Figure 18: IP profile along location 2

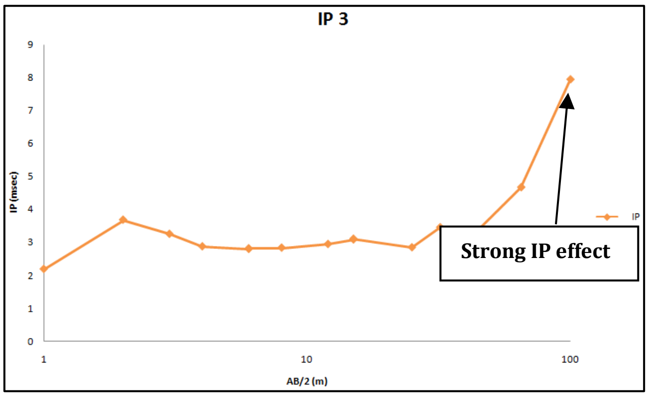


Figure 19: IP profile along location 3

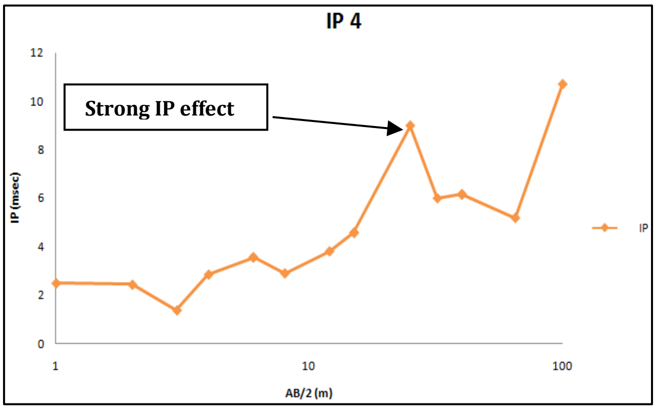


Figure 20: IP profile along location 4

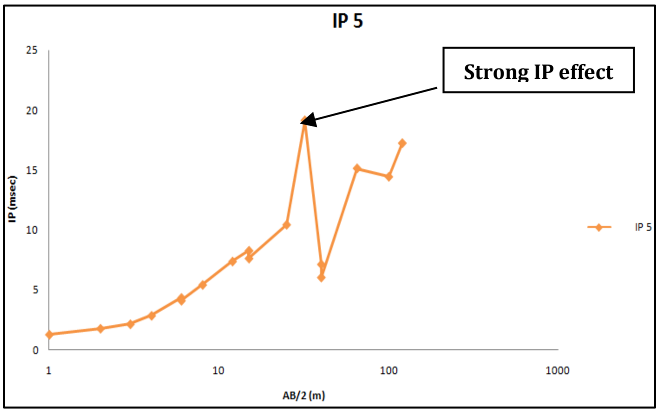


Figure 21: IP profile along location 5

5. CONCLUSION

Utilizing both geochemical and geophysical methods of analysis allowed for the estimation of the ore bodies' formation trend of the discovered base metals' mineralisation that can support mining activities in the research region. This was accomplished by using both of these methods.

According to the findings of the geochemical investigation, the concentrations of the identified base metals in the area under study are significant in comparison to the average concentration values obtained in a number of different locations. With the exception of location 4, which contains lead (Pb), the mineralization potential of these ores is not regarded aberrant due to their lower concentration levels in comparison to their threshold values. However, location 4 does include lead (Pb), which is deemed aberrant. It was established that the concentration factors of these base metals are not enough enriched to form ore bodies when compared to their usual crustal abundance. This conclusion was reached as a result of the comparison. This is due to the fact that an ore body can only form if the element or elements in question are enriched to a level that is significantly higher than their abundance in the crust. The presence of base metal mineralization was confirmed by geophysical data, which provided additional support for the geochemical conclusion. The mineralization of base metals was distinguished by a powerful IP influence, which took the form of a high chargeability and was exhibited in the rock. Except for lead, which is recommended for further investigation utilising rock samples from the area. Hence, the mineralization potentials of the detected base metals in the Itagunmodi area are not economically viable to support mining activities. The exception to this is lead, which is recommended for further investigation.

REFERENCES

Amaral, E.J Pryol, W.A., 1977. Textural and compositional studies of sediments from parts of Albian, Bima sandstone, Upper Benev trough, Nigeria. Journal of geography and geology Vol.63, No.1, pp.1-38.

Asubiojo, MT; Olomo, KO; Ajidahun, J; Oyebamiji, TO., 2022. Controlled method of determine gold mineralization potentials in an unexploited area; a case study of Itagunmodi and Osu, Southwest, Nigeria. Earth Sciences Malaysia, 6(2), pp. 50-59.

Bates, R.L. and Jackson, J.A., 1984. Dictionary of geological terms, New

Cite the Article: Michael T. Asubiojo, Kazeem O. Olomo, Olawatoyin K. Olaleye, Joshua B. Olatunbosun (2022). Characterisation of Gold-Associated Base Metals in Itagunmodi, Ilesha Schist Belts, Nigeria, to Ascertain Their Ore Body Formation Trends. *Earth Sciences Pakistan, 6(1): 36-42.*

York, Anchor Book, pp. 571

Chapman, R. J., & Mortensen, J. K., 2016. Characterization of gold mineralization in the northern Cariboo gold district, British Columbia, Canada, through integration of compositional studies of lode and detrital gold with historical placer production: A template for evaluation of orogenic gold d. Economic Geology. https://doi.org/10.2113/econgeo.111.6.1321

Cooray, R.G. (1974): Some Aspect of the Precambrian Rock of Nigeria, a review of Journal of mining and geology, pp. 17-43.

Dentith, M., & Mudge, S., 2014. Geophysics for the mineral exploration geoscientist. AusIMM Bulletin.

Emsley John, 2011. Nature's Building Blocks. An A-Z Guide to the Elements, Oxford University Press, New York, 2nd Edition.

Friedman, G.M., 1967. Dynamic processes and statistical parameter compared for size frequency distribution of beach and river sand.J. sedimentary petrol, Vol.37, pp. 327-354.

Halim I., Asyari A., Wijaksana A., Alfadli K., 2017. 3D modeling form induced polarization method for identification of gold deposit exploration in north Minahasa, North Sulawesi, Indonesia. International geophysical conference, Qingdao, China, 17-20 April 2017. DOI: 10.1190/IGC2017- 056

Hubbard, F.H., 1975. Precambrian crustal development in western Nigeria: indications from the Iwo region Geographical. Soc.Am,Bull Vol.86, pp. 548-554.

Mamo T., 2013. Geophysical Models for the Cu-Dominated VHMS Mineralization in Katta District, Western Ethiopia. Natural Resources Research 22(1). DOI: 10.1007/s11053-012-91860.

Mc Curry, P., 1976. The geology of the Precambrian to lower paleozoic rocks of Northern Nigeria-a review in: C.A Kogbe (ed), geology of Nigeria. (1st) Elizabeth publishing company, Lagos. Pp. 15-40.

Moreira CA., Paes RA., Ilha LM., Bittencourt C J., 2018, Reassessment of Copper mineral occurrence though electrical tomography and psedo 3D modeling in camaquas sedimentary basin, Southern Brazil. Pure and Apllied geophysics. https://doi.org/10.1007/s00024-018-2019-2.

Mostafaei K., Ramazi H., 2015. Application of electrical resistivity method in sodium sulfate deposits exploration, case study: Garmab, Iran. Journal of Biodiversity and Environmental Sciences 6(2), pp. 2220–6663.

Obaje, N.G., 2009. Generalized geology map of Nigeria showing the major rocks suits. Geology and mineral resources of Nigeria springer-Verlag Berlin Heidelberg. Vol.32. pp. 219

Olomo, K.O., Olayanju, G.O., Adiat, K.A.N. and Akinlalu, A.A., 2018. Integrated Approach Involving Aeromagnetic and LandSat for Delineating Structures and its Implication on Mineralisation. International Journal of Scientific and Technology Research Volume 7, No. 2. Pp. 208- 217.

Oyawoye, A.O., 1972. The Basement Complex of Nigeria. In: T.F.J Dessauvagie and A.J. Whitement (eds). Ibanda. pp. 66-102.

Oyawoye, A.O., 1965. Review of the Basement Complex Geology of Southern Nigeria in Geology of Nigeria Edited by Kogbe, C.A Elizabeth Pub. Lagos Nigeria. pp. 41-48.

Oyawoye, A.O., 1964. The Geology of the Nigeria Basement Complex Journal of Nigeria. min: Geol. Vol.1 No.1, pp. 87-100.

Rahaman, M.A., 1988. Recent advance in the study of the basement Complex of Nigeria. Precambrian Geology of Nigeria, Geology Surv. Nig. Publ., pp. 11-42

Rahaman, M.A. Ocean. O., 1987. On relationship in the Precambrian magmatic Gneisses of Nigeria. Journal on Min and Geol.Vol.15, pp. 23-33

Rahaman, M.A., 1976. Progressive Polyphasemetamorphism in pelitic Schists around Aiyetoro, Oyo State. Elizabeth publishing company, Nigeria.Vol.1, No.1, pp. 41-56.

Rahaman, M.A., 2003. Nigeria Solid Mineral Endowment and Dust Development in the Basement Complex of Nigeria and Mineral Resources (Oshin, O.) Akin Jinade and Co. Ibadan, Nigeria. Pp. 139-160.

Ramazi H, Jalali M., 2014. Contribution of geophysical inversion theory and geostatistical simulation to determine geoelectrical anomalies. Studia Geophysica et Geodaetica, DOI: 10.1007/s11200-013- 0772-3.

Reimann, C., Filzmoser, P., Garrett, R. G., 2005. Background and Threshold Critical Comparison of methods ovf determination. Science of the Total Environment 346, pp. 1 – 16

Taha A., Ismail A., Massoud U., Mesbah H., Komarov V, Induced Polarization Measurement for mgold exploration at the Estern Desert of Egupt. Bulletin of Earth Sciences of Thailand 2(1), pp. 20 30.

Tanner, W.F., 1991. Suite Statistic: The hydrodynamic evolution of the sediment pool. Pp.225-230, methods and Application of particle size Analysis, Cambridge University press, pp. 368.

Vollum, K. and Sian D., 2006. Using grain sze Analysis as the basic for research project in an Undergraduate sedimentology course. Journal Geoscience Education. Vol.53, No.1, pp. 89-99.

White R., Collins S., Denne R., Hee R., Brown P., 2001. A new survey design for 3D IP inversion modeling at Copper Hill, Exploration Geophysics 32, pp. 152-155.

Yang J, Liu Z., Wang L., 2008. Effectiveness of Natural Field Induced Polarization for Detecting Polymetallic Deposits. Earth Science Frontiers 15(4).

Zhang G., Lu Q., Zhang GB., Lin P., Jia Zh., Suo K., 2017. joint interpretation og geological, magnetic, AMT and ERT data for mineral exploration in the northeast of Inner Mangolia, China, Pure and Applied geophysics, https://doi.org/10.1007/s00024-017-1733-5.

Zonge, K., Wynn, J., & Urquhart, S., 2005. Resistivity, induced polarization and complex resistivity. Investigations in Geophysics. https://doi.org/10.1190/1.9781560801719.ch9

Cite the Article: Michael T. Asubiojo, Kazeem O. Olomo, Olawatoyin K. Olaleye, Joshua B. Olatunbosun (2022). Characterisation of Gold-Associated Base Metals in Itagunmodi, Ilesha Schist Belts, Nigeria, to Ascertain Their Ore Body Formation Trends. *Earth Sciences Pakistan, 6(1): 36-42.*