RESEARCH Vol. 14, March, 2018

ISSN 2278–5485 EISSN 2278–5477

DISCOVERY Science

Structural control of Fe-Mn mineralization in Buya-Taka Lafia and their environs, Northwestern Nigeria

Nnabo PN[3☼], Bamigboye OS[1], Adekeye JID[2], Adedoyin AD[2], Owoyemi OO[1]

1.Department of Geology and Mineral Sciences, Kwara State University, Malete Nigeria
2.Department of Geology and Mineral Sciences, University of Ilorin, Ilorin, Nigeria
3.Department of Geology, Ebonyi State University, Abakaliki, Nigeria

Article History
Received: 25 January 2018
Accepted: 04 March 2018
Published: March 2018

Citation
Nnabo PN, Bamigboye OS, Adekeye JID, Adedoyin AD, Owoyemi OO. Structural control of Fe-Mn mineralization in Buya-Taka Lafia and their environs, Northwestern Nigeria. *Discovery Science*, 2018, 14, 1-8

ABSTRACT

The schist hosted Fe-Mn mineralization in the southernmost part of Zuru schist belt has not been appraised structurally, this work therefore aimed at evaluating the control of these mineralizations. To achieve this aim, the area was mapped geologically; structural data were taking, processed and interpreted. From the Rosset plots of the joints, fault and foliation plane direction, NW and NE directions were conspicuous. These directions were in line with the observed mineralization directions on the geologic map. From the integration of field mapping observation, it is concluded that the brittle structures control the Fe-Mn mineralization in Kaoje and its environs.

Keywords: Mineralization, Structural Control, Kaoje, Goethite, Manganite

1. INTRODUCTION

Nigerian terrain is enriched with lots of mineralizations. These mineralizations have different characteristics that include their host rocks, metal associations, modes of emplacement, controls of mineralization and origin. Fe-Mnmineralizations have been reported in the northwestern part of Nigeria (Bamigboye et al., 2015, Bamigboye, 2016, Akinlolu, 2007, Okorie, et al., 2007). These mineralizations occur in relatively linear pattern. The study area is located in the northwestern Nigeria and it is bounded by Longitudes 3˚55΄E and 4˚10΄E and Latitudes 11˚00N and 11˚ 15΄N covering an area of $676km^2$ (Figure 1). The Mn oxide mineralization (manganite) is hosted by schist while the Fe-oxide (goethite) mineralization is hosted by sedimentary rocks. Pockets of goethite mineralization are also present at the contact between the schist and the sedimentary rocks in this area (Bamigboye, 2016). Similarly, the manganite mineralization is supergenetic in origin but the goethite mineralization is hydrothermal. This goethite mineralization was remobilized as a result of changing Eh-pH condition and is now hosted by the sedimentary rock in the area (Bamigboye, 2016). This work is aimed, therefore, at evaluating the control of the Fe-Mn oxides mineralization in Buya-Taka Lafia and their environs, northwestern Nigeria.

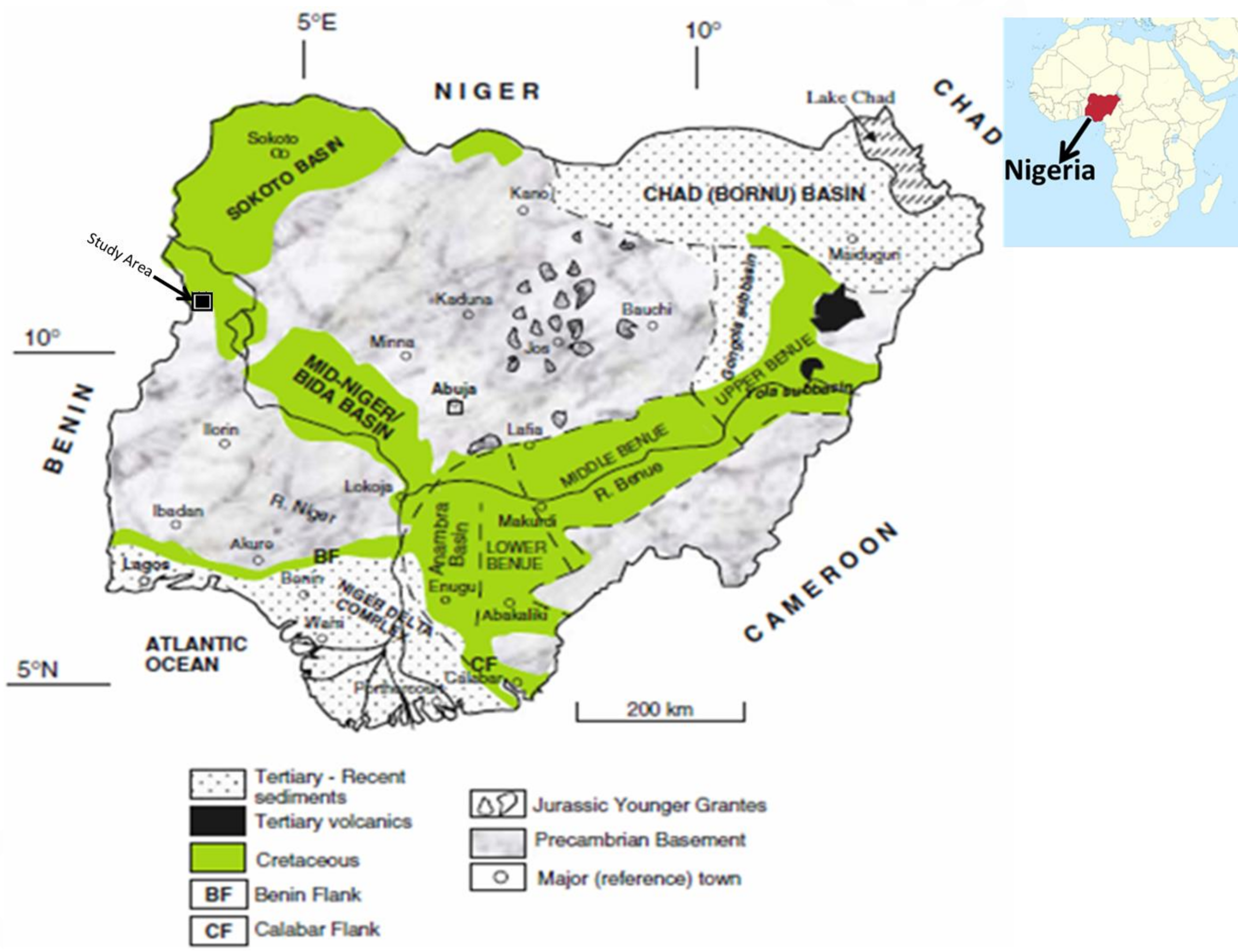

Figure 1 Geological map of Nigeria showing study area (After Obaje, 2009)

2. METHODOLOGY

The approach adopted in this work is divided into two. These are the fieldwork exercise and the data processing with interpretation. During the fieldwork, the area was mapped on grid basis. Rocks and ore samples were taken. Measurements such as strike and dip of foliation planes, fault trace and joint directions were also taken. The acquired data were subjected to plots using Grapher software.

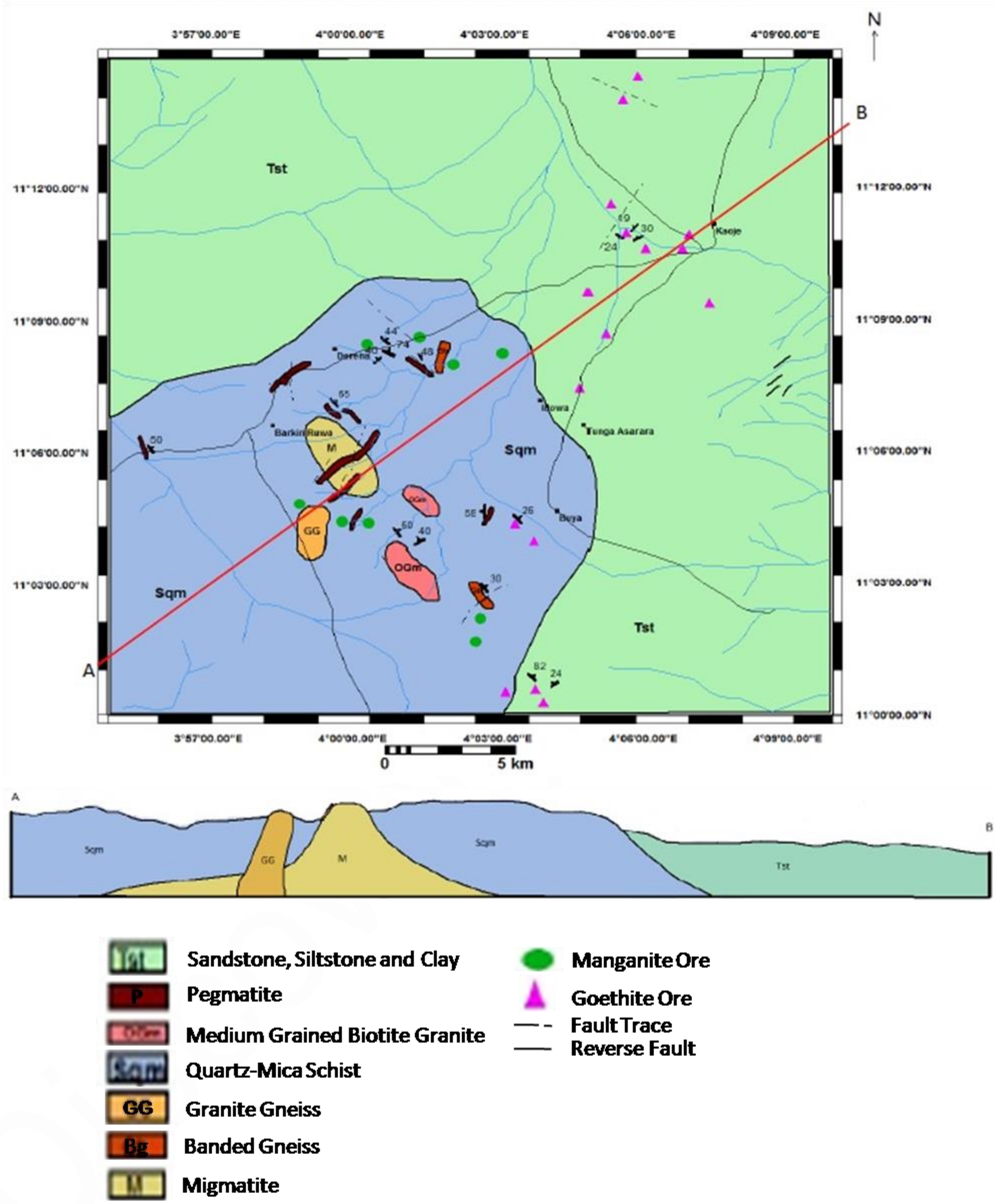

Figure 2 Geological Map of Kaoje and its Environs (part of Bani Sheet 94SE and Kaoje Sheet 95SW)

Geology of the area

The geology of the study area is made-up of the crystalline and sedimentary rocks. The crystalline rocks are the migmatite, gneisses, quartz-mica schist and the granite. Pegmatites and quartzites occur as minor rocks in the study area. The migmatitic rock occurs as pocket of rocks within the schist (Figure 2). This rock type is seen southeast of Barkin-Ruwa and along Barkin-Ruwa – Buya axis. It is composed essentially of quartz, biotite and sodic feldspar. The gneisses seen in the study area are divided into two. These are the banded gneiss that are characterized by the conspicuous alternating bands of felsic and mafic minerals and the granite gneiss. The granite gneiss has poorly defined alternating bands of felsic and mafic minerals. The quartz-mica schist covers about one-fifth of the study area. This rock occur essentially as a low lying stream cut exposure in the southwestern part of the studied area. The Mn-oxide (manganite) mineralization occurs as black ores and sometimes brown, and folded laminated body within the schist. These ore bodies have been fractured. The fault seen is strike-slip with displacement magnitude in the range of 1 to 7cm. The ductile structures that are associated with the Mn-oxides include synclinal, anticlinal and recumbent folds. The magnitude of the fold closure and their nomenclature are defined mostly by the associated quartz vein. The granitic rock is seen towards the southern part of the area studied. It has a dorsal fin shape from the northern part of the exposure close to Barkin-Ruwa.

The sedimentary rocks define the highest elevation in the study area. These rocks are essentially clastic in nature and essentially include sandstones, siltstone, silty sandstone and sandy siltstones. Other rock types include kaolinite, kaolinitic claystone and claystone. Some of these are finely laminated and cross laminated with pinch-out structure in the northeastern part of the area while some are massive especially in the northwestern part of the area. The Fe-oxides (goethite) occur mainly as sedimentary cappings. Other occurrence of this brown, banded Fe-oxide is also seen within the sedimentary beds. It occurs between the sandstone close to Custom Checking Points that is approximately 1km south of Kaoje along Kaoje-Idowa road.

3. STRUCTURAL GEOLOGY

The structural features identified in the study area are divided into two groups. The first group is the curvilinear expression of once planar features while the second group are zones of discontinuity with or without movement. Figure 3 shows the lineament from the Landsat and the mapped faults in the area. The fault mapped in the area range from dip slip (reverse) faults to multiple faulting where strike-slip faults are seen associated with dip-slip fault (Figure 4). In the dip slip fault, the downward displacement of the footwall is 30cm. This is seen in the sandstone southeast of Kaoje and the fault plane strike is NNW-SSE. The strike slip fault has a displacement magnitude of 3cm to about 40cm but the displacement magnitude in the crystalline rocks and manganites inclusive is within 1cm and 15cm.

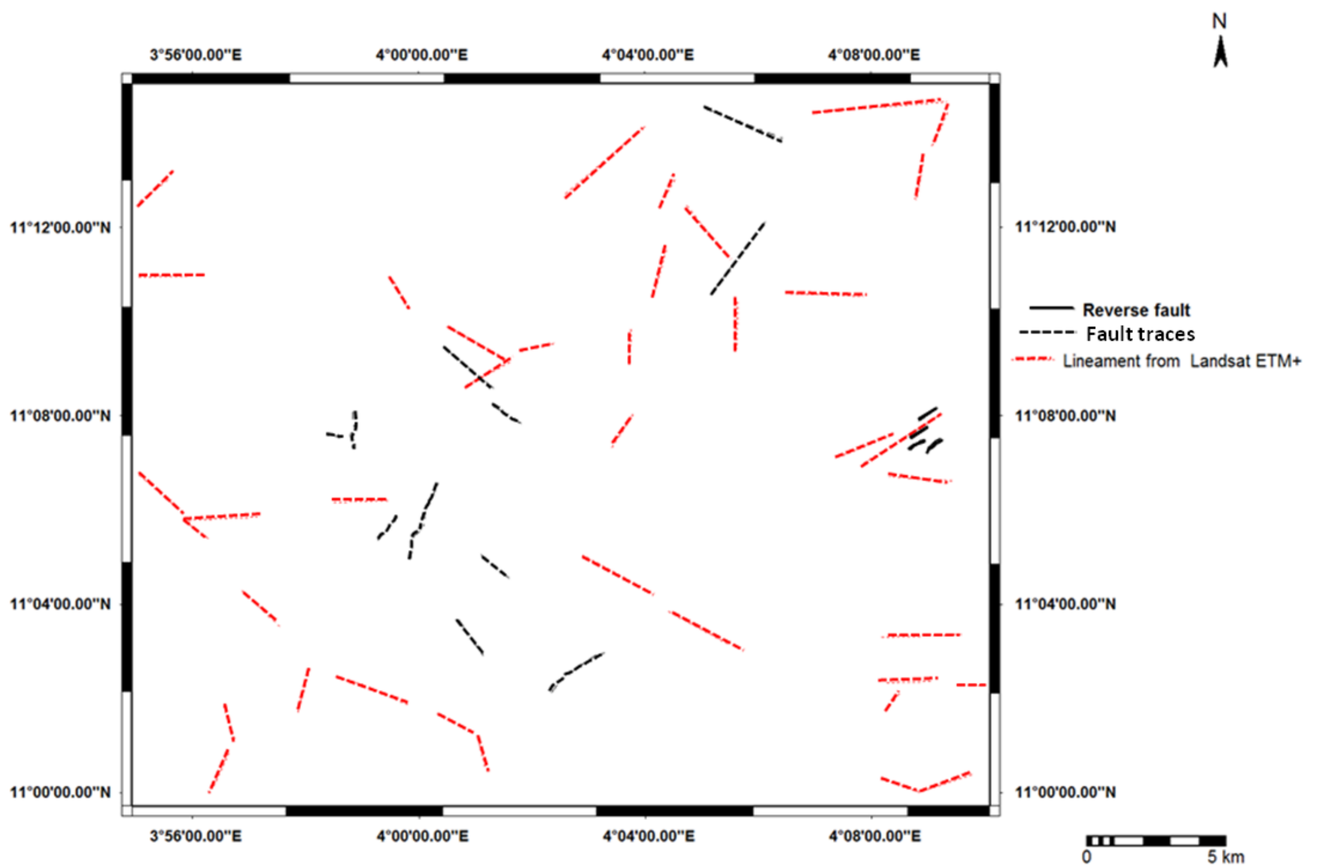

Figure 3 Landsat image showing lineaments and the reverse faults in Kaoje and its Environs

Figure 4 Field Photograph showing finely laminated siltysandstone northwest of Kaoje

Joint is another brittle structure seen in this area. The strike of the fracture planes include 056˚, 060˚(2), 044˚, 004˚(2), 054˚, 032 ˚, 034˚, 018 ˚, 162 ˚, 104 ˚, 170 ˚, 118 ˚, 172 ˚, 094 ˚, 048 ˚, 134 ˚, 114 ˚, 230 ˚, 226 ˚, 260 ˚ among others. These planes especially those that trend in 134˚ , 120˚ (2), 132 ˚, 122 ˚, 072 ˚, 106 ˚, 166 ˚, 146 ˚ and 120 ˚ have been exploited by the quartz veins. Figure 5 shows the Rose diagram of the joint directions.

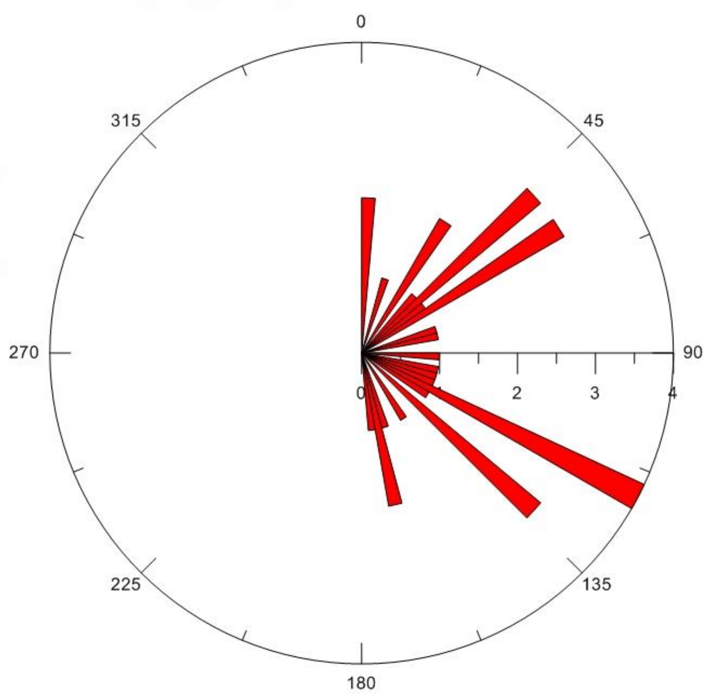

Figure 5 The joint directions in Barkin-Ruwa – Derena and their Environs

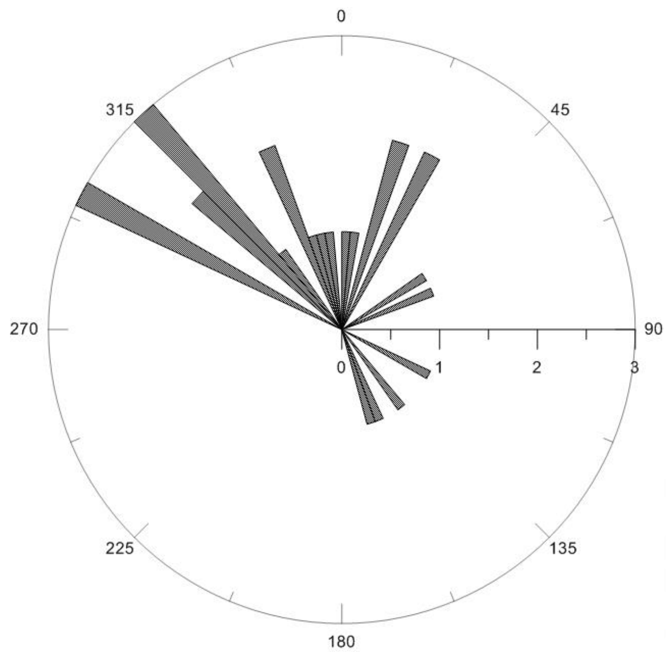

Figure 6 Rosset plot of foliation planes measurement in Barkin-Ruwa – Derena and their Environs.

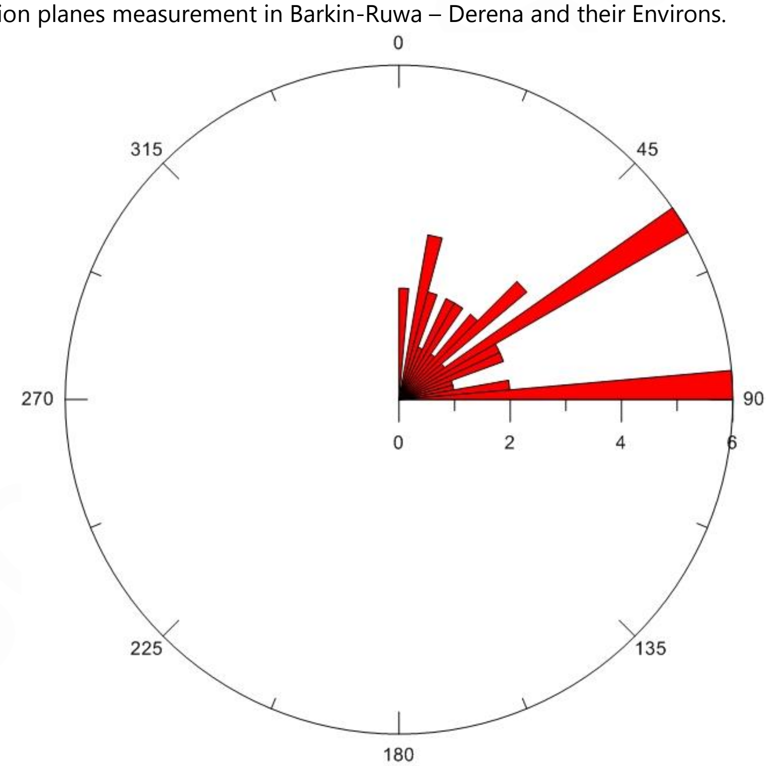

Figure 7 Rosset plot of lineament of LandSat data from Barkin-Ruwa – Derena and their Environs

The ductile structures are the foliation planes, as well as chevron, synclinal, anticlinal, ptygmatic and recumbent folds. The chevron folds are associated with the brown folded manganite ores, south of Barkin-Ruwa and close to Buya mainly while the synclinal folds are seen in both the manganite ores and the gneisses, for example, about 2km east of Barkin-Ruwa. In the manganites, the quartz veins define the type and magnitude of the fold closure but the alternating bands of leucosome and melanosome does this in the gneisses and migmatites. The strike and dip of the foliation planes are 060˚/30˚NW, 019˚/30˚NW, 142˚/24˚SW, 314˚/44˚NE, 306˚/48˚NE, 004˚/56˚NW, 162˚/60˚SW, 026˚/46˚SE, 116˚/50˚SW, 066˚/64˚NW, 028˚/36˚SE, 336˚/30˚NE, 010˚/42˚SE, 342˚/32˚NE, 336˚/82˚NE, 312˚/30˚SW, 320˚/38˚SW, 300˚/34˚SW, 020˚/22˚SE, 354˚/42˚NE, 322˚/60˚SW, 158˚/26˚SW, 316˚/64˚NE, 300˚/60˚NE, 300˚/50˚NE, 320˚/70˚SW, 350˚/65˚SW and 145˚/34˚SW. From the Rosette plot (Figure 6), the dominant direction is NW-SE while primitive direction is NE-SW.

4. DISCUSSION

The study area has two types of mineralizations, these are the Mn-oxide (manganite) and the Fe-oxide (goethite). These oxides are restricted to rocks of different lithologies. For example, the manganites are restricted to the quartz-mica schist while the goethites are hosted essentially by the sandstones with the exception of those goethites that are relatively massive seen at the fringes of the schist that are in contact with the sedimentary rocks at the southern part of the study area. Even though there is close relationships in the chemistry of these ores, their association with different lithologic units in the area may be suggesting differences in the processes that has aided the concentration of these ores in their present locations. Bamigboye (2016) have explained that these ores are of different origin. The manganite was said to be a product of supergenetic processes while the goethites are of hydrothermal but was later remobilized to the sedimentary rocks under a physico-chemical conditions that favoured this.

Occurrences of both the goethite and manganite mineralizations are also relatively linear but in different directions. If the best lines of fit are drawn across these ores on the geological map of the area (Figure 2), the manganite ore best lines of fit will trend essentially in the NW-SE direction while those across the goethite trend in the NE-SW direction. These directions are closely related respectively to the prominent and surbordinate directions of the foliation planes in the area (Figure 6) and the joint directions (Figure 5). The converse is true when the measurements of the data of the lineaments' from LandSatwere plotted on the Rose diagram. The directions are in the NE-SW (Figure 7) but are still related to the direction of the goethite ores. This similarity in the direction of these ores shows that besides the lithologiccontrol on the mineralizations, weak zones (structure) in the rocks in this area also control these mineralizations. These trends were similarly reported in the soils around this area by Bamigboye et al., (2015). In their report, it was said that the manganite related ore elements in soil around Kaoje and their environs has their positive anomalous zones trending in the NW-SE while those that are associated with the goethite trends essentially in the NE-SW direction (Figure 8 and 9). Although no structural evidence was given, comparing the trends from the Rose diagrams with their isograde plots suggest an enrichment of the ore elements that are associated with the two ore types along different directions and hence, control on these mineralizations.

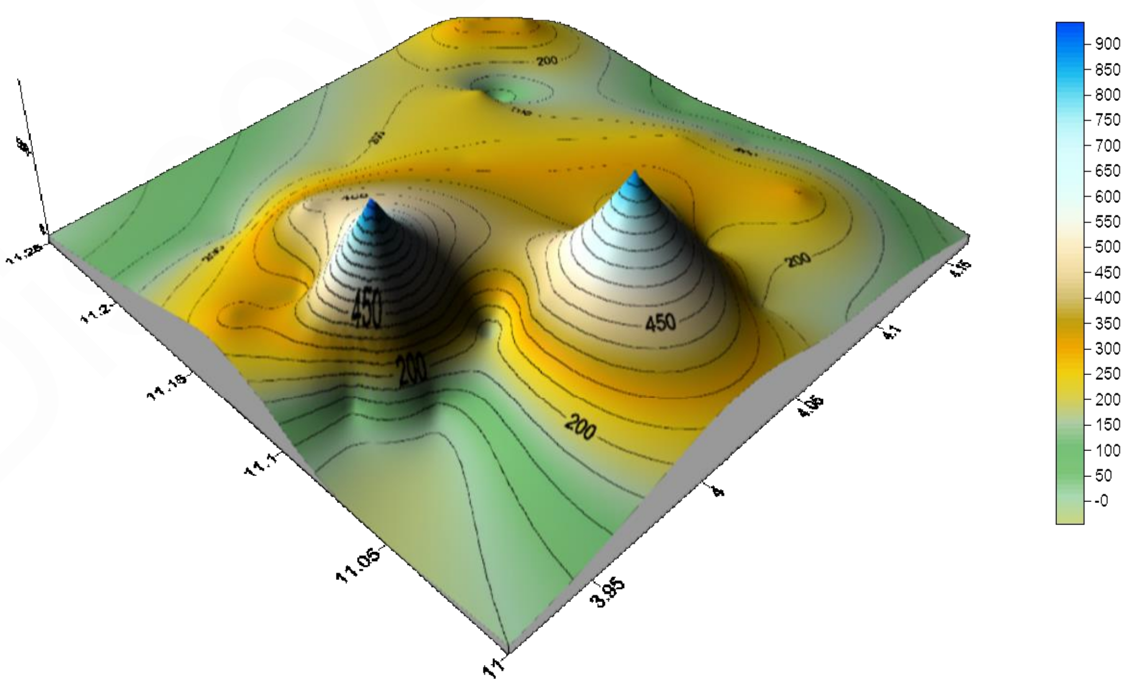

Figure 8 3D isograde plot of Mnfrom soil samples

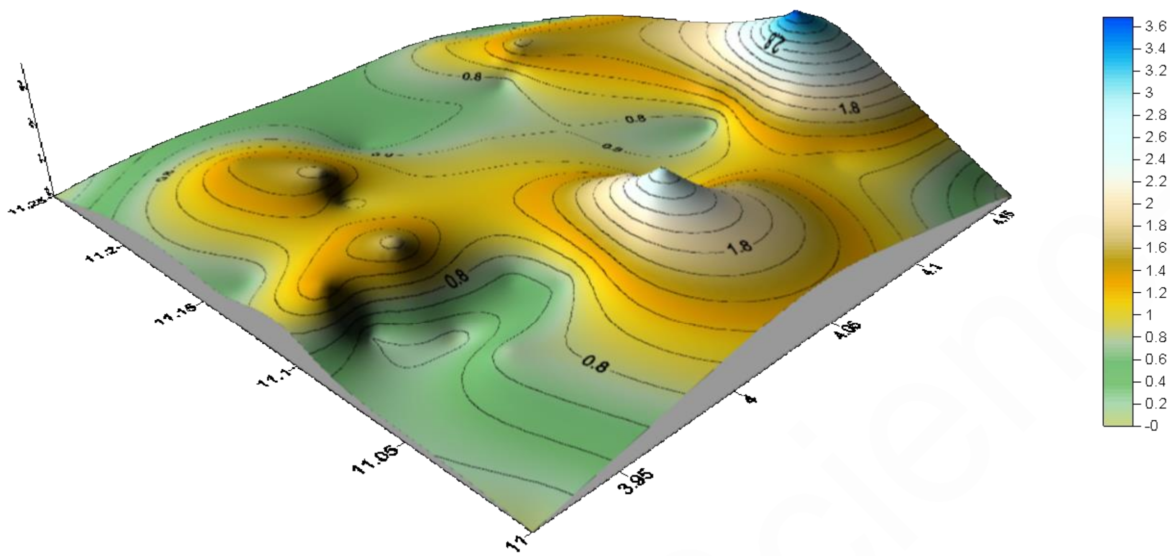

Figure 9 3D isograde plot of Fe from soil samples

5. CONCLUSION

From the integration of the field evidences, geological map and Rosset analyses, it is concluded that the manganite-goethite mineralizations are controlled by the lithology and structures within the rocks. These zones are the foliation planes and the brittle surfaces such as joints and/or faults.

REFERENCE

1. Akinlolu, F. (2007). Exploration and Resource Estimation of the Manganese Deposit in Kaoje, Kebbi State. NGSA Report. 70p.
2. Bamigboye, O. S. (2016): Geochemistry and Origin of Fe-Mn Mineralizations in Kaoje and its Environs, Northwestern Nigeria. A Ph.D. Thesis submitted to University, of Ilorin, Ilorin, Nigeria. 211p.
3. Bamigboye, O. S., Adekeye, J. I. D., Omorinoye, O. A., Adedoyin, A. D. and Adefila, I. (2015): Soil Geochemical Survey of Kaoje and its Environs, Science Focus, 20(1): 53 – 69.
4. Okorie, I. M., Ayoade, E. O., Okunola, O. W. and Okunlola, O. A. (2009). Manganese Mineralization in Parts of Northwestern Nigeria In: Book of Abstract, 45th NMGS Annual International Conferences, Owerri, Nigeria, p22.