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Geology and petrography of Sabon Garin Kara and environs part of Malumfashi sheet 79 NE Nigeria

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The study area is about 40 km^2 that is (8 km × 5 km) which is located in Gwarzo Local Government area of Kano State part of Malumfashi sheet 79NE which lies within Longitude E07°57'19.5" and E08°00'00" and Latitude N11° 51'30"andN11°47'00. Major rock types identified include medium grained biotite-muscovite granite, coarse grained muscovite-biotite granites, quartz-syenite, and quartz-monzonites. Most of the crystals show subhedral to anhedral form and a perfect cleavage is somehow visible. The interference colours observed under cross-polarized light include blue, dark grey, light grey, some pinkish colour and brown colour which disappear upon the stage rotation. Albite and Carlsbad twinning are seen and used to identify the feldspars. Various structural features were observed with NE- SW trend which represents the final imprint of the Pan-African orogeny.

Key words: Biotite, granite, cross-polarized, twinning.

INTRODUCTION

The Nigerian basement was affected by the 600 Ma Pan-African orogeny and it occupies the reactivated region which resulted from plate collision between the passive continental margin of the West African craton and the active Pharusian continental margin (Burke and Dewey, 1972; Dada, 2006). The basement rocks are believed to be the results of four major orogenic cycles of deformation, metamorphism and remobilization corresponding to the Liberian (2,700 Ma), the Eburnean (2,000 Ma), the Kibaran (1,100 Ma), and the Pan-African cycles (600 Ma). The first three cycles was characterized by intense deformation and isoclinal folding accompanied by regional metamorphism, which was further followed by extensive migmatization. The Pan-African deformation was accompanied by a regional metamorphism, migmatization and extensive granitization and gneissification which produced syntectonic granites and homogeneous gneisses (Abaa, 1983). Late tectonic emplacement of granites and granodiorites and associated contact metamorphism accompanied the end stages of this last deformation. The end of the orogeny was marked by faulting and fracturing (Gandu et al., 1986; Olayinka, 1992) (Figure 1). Within the basement complex of Nigeria four major petro-lithological units are distinguishable, namely: 1. The Migmatite – Gneiss Complex (MGC), 2. The Schist Belt (Metasedimentary

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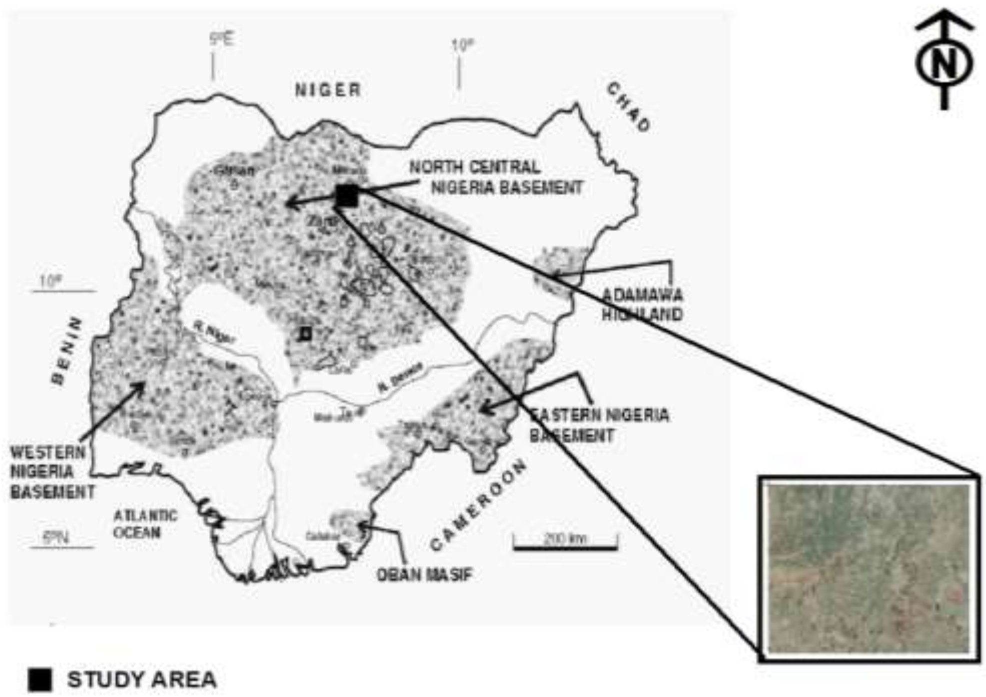


Figure 1. Showing the basement complex of Nigeria.
Source: Obaje (2009).

and Metavolcanic rocks), 3. The Older Granites (Pan African granitoids) and 4. Undeformed Acid and Basic

Study area

The mapped area is about 40 km^2 that is (8 km × 5 km) which is located in Gwarzo Local Government area of Kano state.The area lies within Longitude E07°57 ’19.5” and E08°00’00” and Latitude N11°51’ 30” and N11°47 ‘00”, which forms part of Malumfashi sheet 79 NE and localities within the mapped area includes Jama’a Makuku, Kara and Kadafa (Figure 2). Accessibility is mostly through a major road, which cut across the study area, which starts from Gwarzo town through Getso and Karaye, areas such as Kara, Jama’a Makuku and Dan-Kada were accessed through minor roads, and footpaths, though some of the areas have poor accessibility, therefore, drystream and river channels have to be used to locate some outcrops.

Geology and geomorphology of the study area

Regional metamorphism was one of the events that accompanied the Pan-African deformation (Abaa, 1983). This has resulted in the formation of structures such as faulting and fracturing (Olayinka, 1992), folding, jointing, veins, intrusions, foliation and mineral lineation.The geologic structures in the area generally display the regional North-East trends which represent an imprint of the Pan-Africa orogeny. The effect of compression, shearing and tensional stress on the rock results into series of ductile and brittle deformation structure. The dominant lithology in the mapped area is granite and is igneous in origin, tectonics is the movement of the earth crust resulting to the formation of continents, ocean, basins, plateau and mountain (orogenic and epirogenic mountain). This event result in the incomprehensive forces acting on the basement and leading to reactivation by The Pan-African Orogeny (600 Ma + 150 Ma) and resulting to the magmatism brought about by intrusion of plutonic rock into already existing country rock. Erosion washed away the migmatite gneiss complex exposing the granite.

METHODOLOGY

The technique involved traversing along farms, footpaths and dry river channels to locate outcrops; pacing round and across the outcrops to measure their dimensions. Compass clinometer was used to measure strike of veins, fault dykes and joint of the study area. ARCGIS computer software was used to digitize the geological map. Global positioning system was used to take coordinates of exposure and to locate the actual position of the

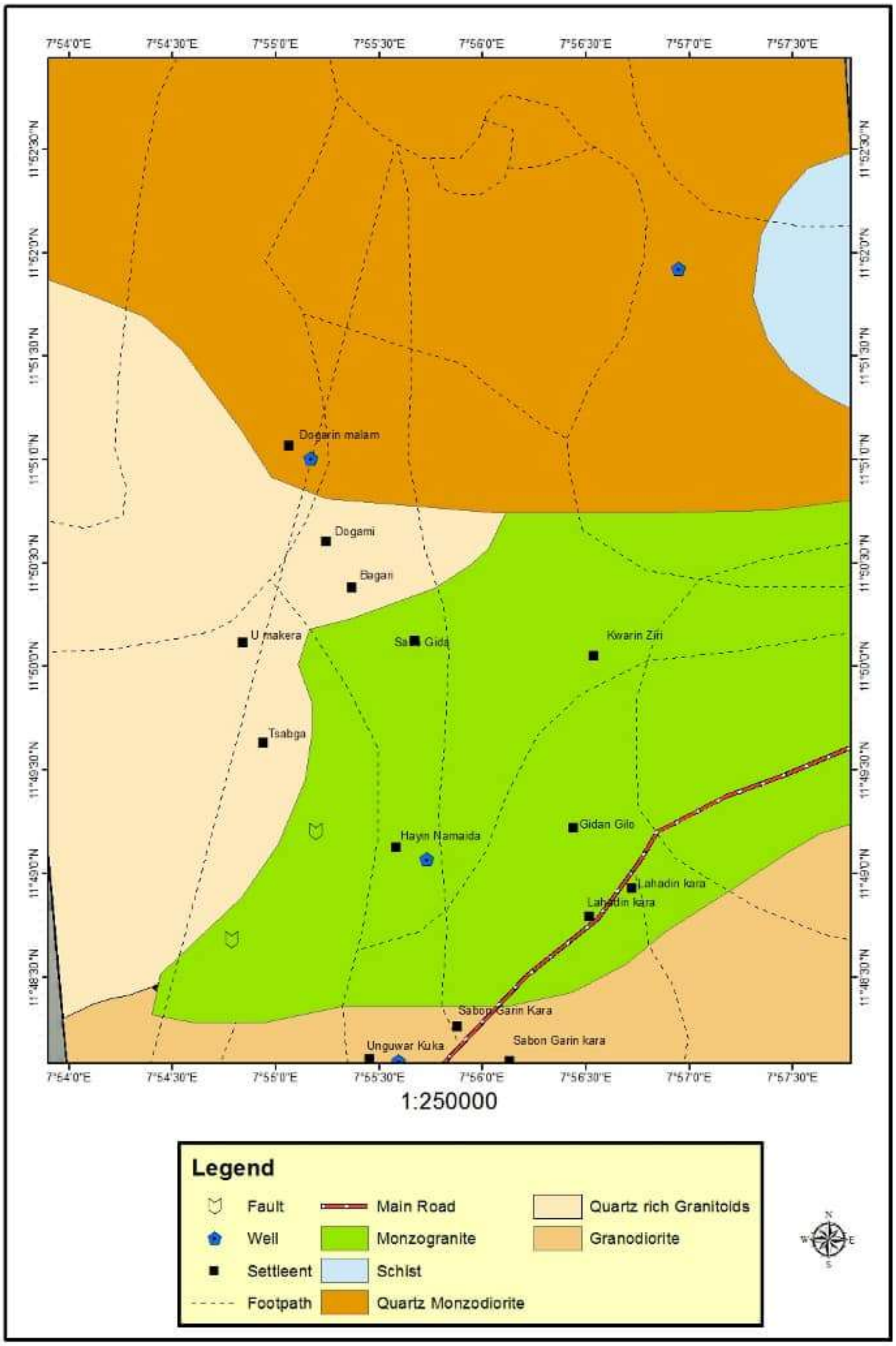


Figure 2. Geologic Map of the study area.

outcrop. Hand lens was used to examine the texture, shape and proportion of individual mineral grains in the samples. A more detailed petrographic study was carried out in the laboratory, samples were viewed with the petrographic microscope under plane and cross polarized light to identify mineralogical features of the rock samples on a microscopic scale.

(a) Joint observed along longitude N 110 47’ 50” and latitude E 070 59’ 25” c
area.

(b) Faults observed along two locations (N 110 47’ 50” and E 070 59’ 30”) a
51’30” and E 070 59’ 25”) of the study area.

(c) Fold observed along longitude- N 110 48’ 18” and latitude E 070 58’ 36” of
area.

(d) Quartz Vein observed along longitude- N 110 51’ 03” and latitude E 07
respectively.

Figure 3. Structures within the study area.

RESULTS AND DISCUSSION

Structural geology

The study shows strong relationship between the structures and the orogenic episodes which affected the study area. The major structures observed in the mapped area comprise of joints, faults, folds, and veins (Figure 3). Fractures in most rock exposures have a North–South trend and some are filled with crystals of minerals such as quartz and feldspar. Faults in the study area are not well exposed but their effects on rocks and some quartz veins are observed. Folds are not well developed in the area.

The Quartz veins were found along fractures or cracks on the granite exposure, well visible and highly resistant to weathering. Trends of veins were recorded and the major stress were in the NE-SW direction which is in conformity with the Pan African orogeny. The effect of metamorphism is high in the area, and also resulted in the transformation of many granitic rocks to laterites. Based on the observations on the degree of metamorphism, the study area is affected greatly by regional metamorphism, which is also said to have resulted to The Pan-African orogeny.

Petrography

This part describes the different rock units in terms of their petrographic examination using thin sections. The various rock samples were labeled as; L1, L2, L3, L4, L5 and L6, and were analyzed macroscopically with the aid of the eyes and hand lenses to see minerals which are visible, as well as other features observable, before later subjecting the slides to thin-section studies under the microscope to ascertain the minerals, and other important attributes after which each sample was named based on the field and petrographic study using the QAP (Quartz, Alkali, Feldspar, Plagioclase). Diagram to classify igneous rocks based on minerologic composition (Figure 4). The essential minerals are found to be; quartz, plagioclase, feldspars, biotite, muscovite and chlorite and based on the QAP diagram plot, the various rock samples were named as; L1- medium grained biotite-muscovite granite, L2- coarse grained muscovite-biotite granite, L3- quartz-syenite, L4- coarse grained muscovite-biotite granite, L5- quartz-monzonite, and L6- quartz-monzonite.

Modal analysis

Based on the petrographic observation, the modal composition of the minerals (quartz, plagioclase, feldspars, biotite, muscovite and chlorite) (Figure 4) were then estimated by viewing the minerals under both plane and cross polarized light for each sample, which are shown in Figures 4 and 5.

Medium grained biotite-muscovite granite

Under plane polarized light, the minerals are colourless and generally show a low-medium relief, and most of the crystals show subhedral to anhedral form. A perfect cleavage is seen at right hand side toward the center of the slide. Also, observations Under Cross polarized Light shows the interference colours greenish blue, dark grey, light grey, and brown colour which disappear upon the stage rotation. Albite and Carlsbad twinning are seen and

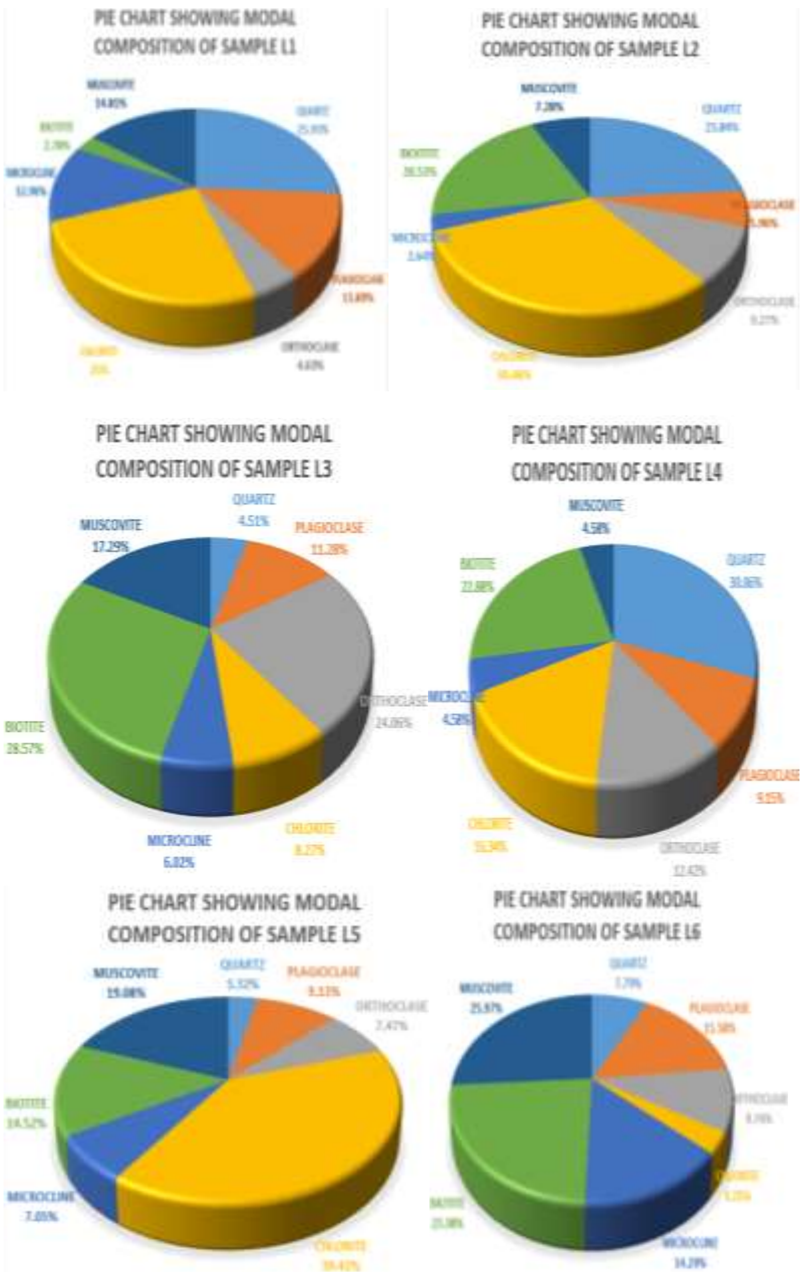
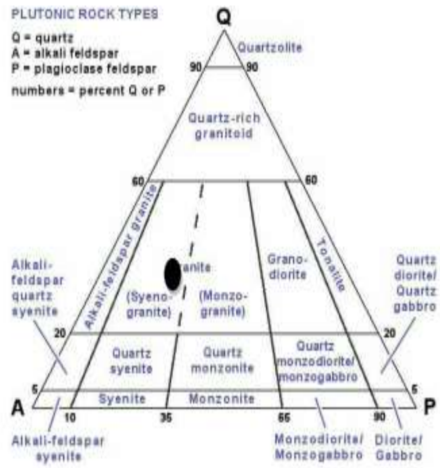


Figure 4. Pie Chart showing modal composition for each sample.

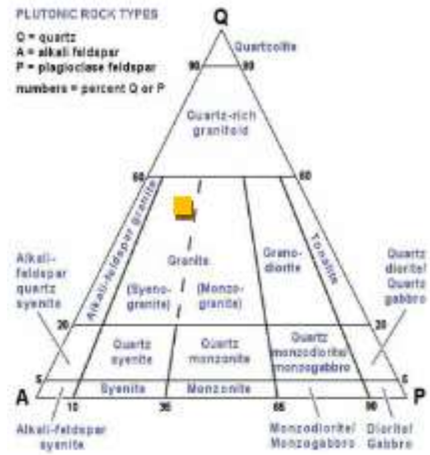
used to identify the feldspars that is, Plagioclase and Orthoclase (Figure 6). A polysynthetic twinning is seen and used to identify Microcline. While, chlorite possesses a thin nature and bluish colour which disappears upon rotation under the cross polarized light.

Coarse grained muscovite-biotite granite

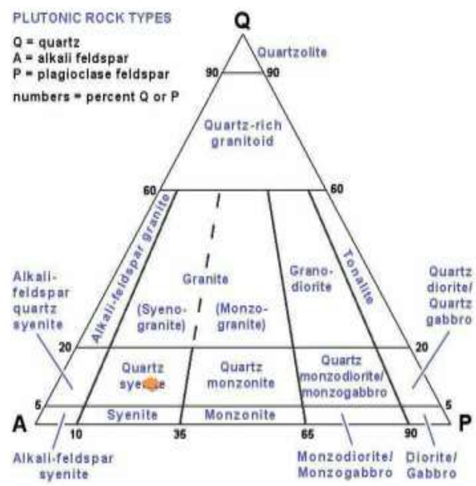
The minerals here also are colourless and generally show a low-medium relief. Most of the crystals show subhedral to anhedral form and a perfect cleavage is somehow visible (Figure 7). The interference colours observed under cross-polarized light include blue, dark grey, lightgrey, some pinkish colour and brown colour which disappear upon the stage rotation. Albite and Carlsbad twinning are seen and used to identify the feldspars that is, Plagioclase and Orthoclase. A polysynthetic twinning is seen and used to identify Microcline. Chlorite possesses a thin nature and bluish colour which disappears upon rotation under the cross polarized light and the brownish colour was used to



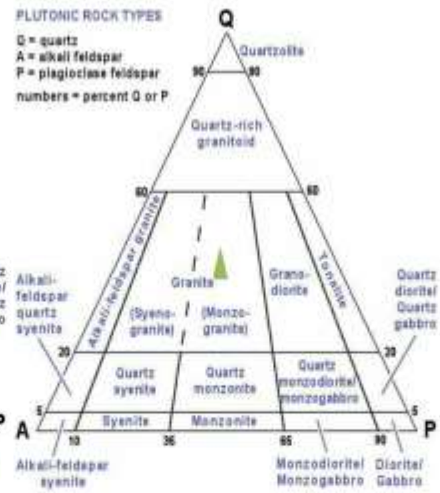
(a) Plot for sample L1



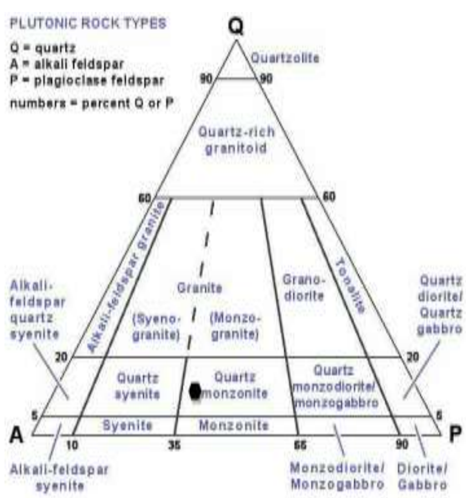
(b) Plot for sample L2



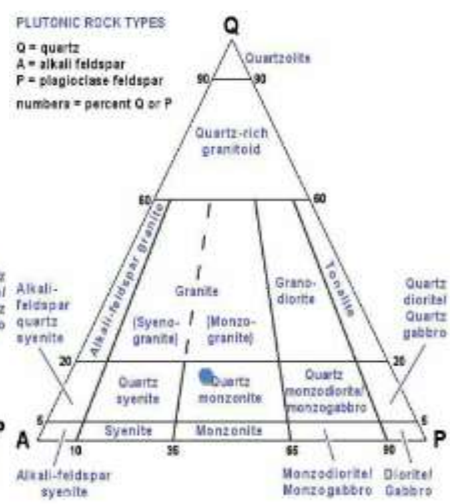
(c) Plot for sample L3



(d) Plot for sample L4



(e) Plot for sample L5



(f) Plot for sample L6

Figure 5. Classification of granitic rocks in QAFP (Quartz Alkali Feldspar Plagioclase) diagram according to their mineral constituents (after Streckeisen 1976).

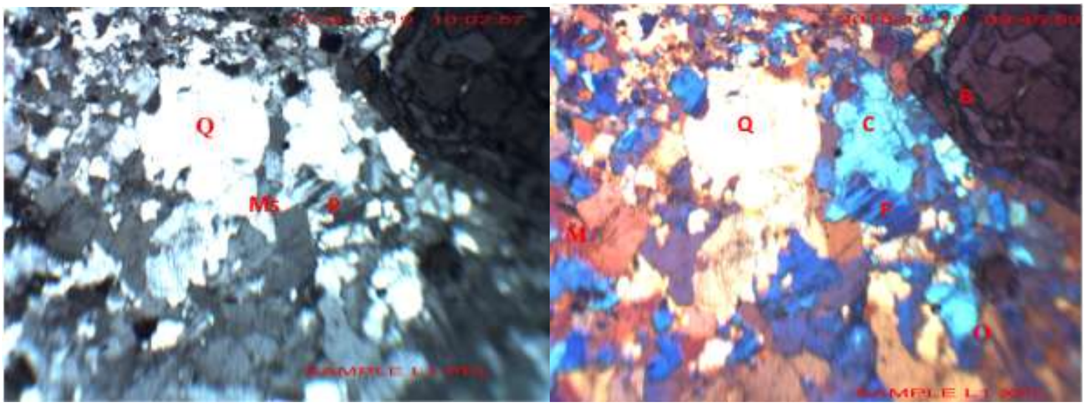


Figure 6. Photomicrograph of medium grained biotite-muscovite granite (L1) under under plane polarized light and crossed polarized light.
Q=Quartz, B=Biotite, O=Orthoclase, C=Chlorite, P=Plagioclase, M= Microcline, Ms=Muscovite.

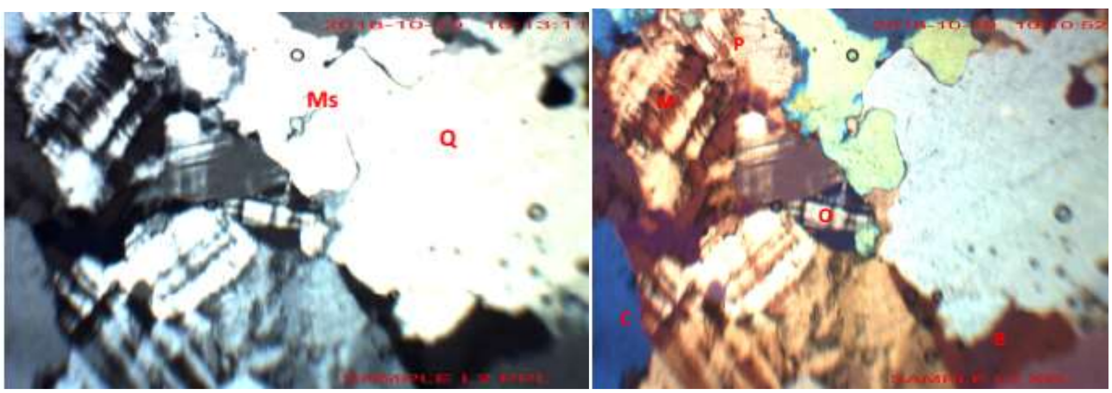


Figure 7. Photomicrograph of coarse grained muscovite-biotite granite (L2 and L4) under under plane polarized light and crossed polarized light.
Q=Quartz, B=Biotite, O=Orthoclase, C=Chlorite, P=Plagioclase, M= Microcline, Ms=Muscovite.

identify the Biotite.

Quartz-syenite

The presence of quartz and feldspar minerals were also present (which gives the rock sample it's bright colour). Some dark minerals are also seen which are either biotite or muscovite minerals (Figure 8). A perfect cleavage is somehow visible. The interference colours observed under cross-polarized light include blue, dark grey, lightgrey, some pinkish colour and brown colour which disappear upon the stage rotation. Albite and Carlsbad twinning are seen and used to identify the feldspars that is, Plagioclase and Orthoclase.

Quartz-monzonite

The rock has a coarse grain texture and Quartz minerals which are also observed together with orthoclase feldspar minerals which gives the rock it's whitish colour (Figure 9) and the dark coloured minerals are biotite and muscovite minerals. Also, Myrmekite was observed clearly which consist of an intergrowth of plagioclase and quartz.

Conclusion

Lack of proper understanding of the geology of the area leads to improper evaluation of the potential the study area. Nevertheless, detailed geochemical studies should also be carried out in order to get a broader understanding of the geologic and geochemical histories as well as mineralogical potentials of the area. Economically, there is a need to carry intensive study on the metasedimentary structures surrounding the study area so as to unravel the petrogenetic evolution, emplacement time, tectonic set up, their relationship and mineralization potential.

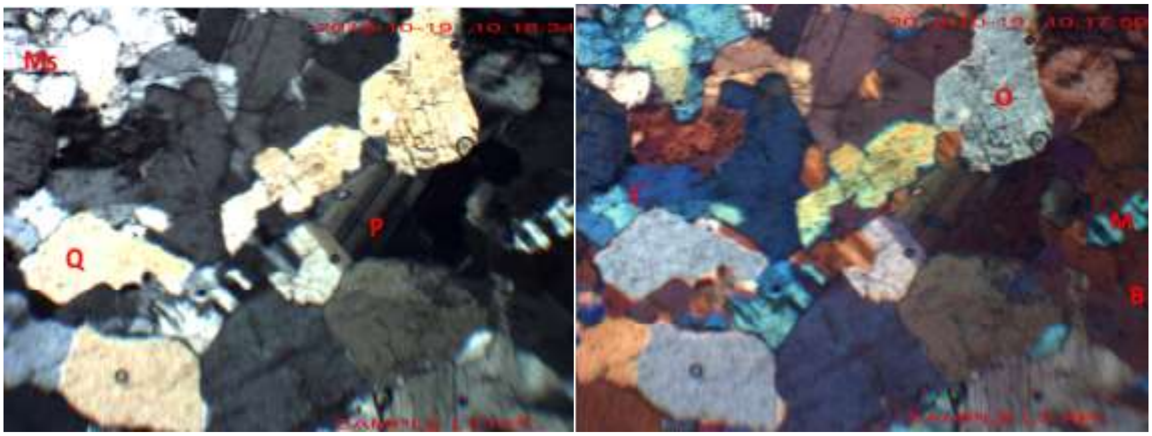


Figure 8. Photomicrograph of quartz-syenite (L3) under under plane polarized light and crossed polarized light. Q=Quartz, B=Biotite, O=Orthoclase, C=Chlorite, P=Plagioclase, M= Microcline, Ms=Muscovite.

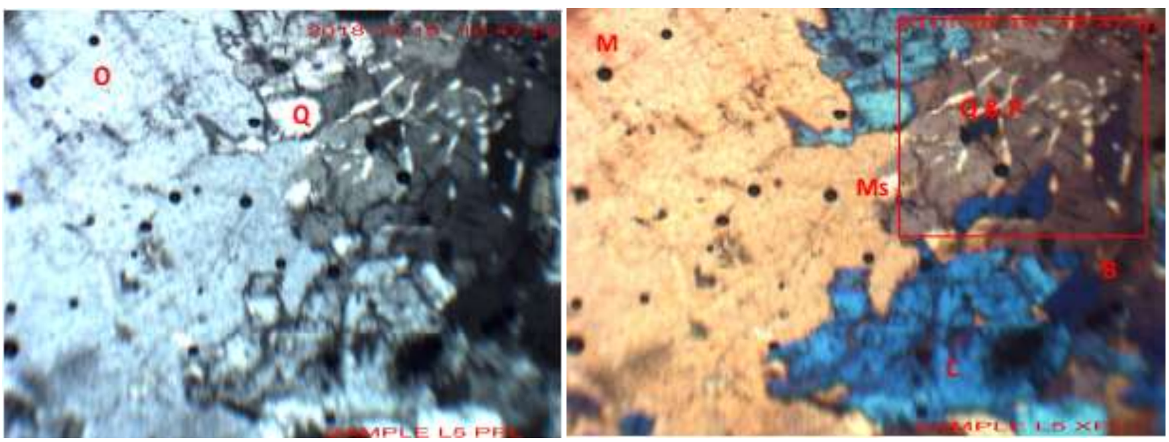


Figure 9. Photomicrograph of quartz-monzonite (L5 and L6) under under plane polarized light and crossed polarized light. Q=Quartz, B=Biotite, O=Orthoclase, C=Chlorite, P=Plagioclase, M= Microcline, Ms=Muscovite.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Abaa SI (1983). The structure and petrography of alkaline rocks of the Mada Younger Granite Complex Nigeria. Journal of African Earth Science 3:107-113.

Burke KC, Dewey JF (1972). Orogeny in Africa. In: Dessauvagie TFJ, Whiteman AJ (eds). Africa geology.University of Ibadan Press, Ibadan pp. 583-608.

Dada SS (2006). Proterozoic evolution of Nigeria. In: OshiO (ed) The basement complex ofNigeria and its mineral resources (A Tribute to Prof. M. A. O. Rahaman). Akin Jinad and Co.Ibadan pp. 29-44.

Gandu AH, Ojo SB, Ajakaiye DE (1986). A gravity study of the Precambrian rocks in the Malumfashi area of Kaduna State, Nigeria. Tectonophysics 126:181-194.

Obaje NG (2009). Geology and Mineral Resources of Nigeria, Springer Books. USA pp. 15-35.

Olayinka AI (1992). Geophysical siting of boreholes in crystalline basement areas of Africa. Journal of African Earth Science 14:197-207.

Streckeisen AL (1976). Classification and Nomenclature of Igneous Rocks. N. Jahrb. Miner. Abh. 107:144-240.