PETROGRAPHIC STUDIES OF ROCK IN KAM QUARRY, KWARA STATE

By

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Certification

This is to certify that this project was carried out and submitted by **BAWA,ISIAQ IDRIS**of Matric number **HND/23/MPE/FT/001**to the Department of Minerals and Petroleum Resources Engineering, Kwara State Polytechnic, Ilorin in partial fulfilment of the Requirement for the Award of Higher National Diploma in Mining Engineering Technology.

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Dedication

I am delighted to dedicate this project to Almighty GOD, the creator of all universe who gave me the grace and opportunity to complete my HND program and this research, may His name be glorified.

Acknowledgements

I give all the glory and adoration to Almighty GOD, the beginning and the End, for his greatest protection and love given to me as a privilege to start and complete this research work.

I wholeheartedly extend my special thanks to my amiable supervisor Dr. Reuben Obaro for his professional guidance and support towards the success of this project.

I also deeply appreciate my parents, I also my gratitude goes to my sponsor, my father, my boss which is MR BAWA ISMAILA YAKUB, HUSAMAT ADAMA. And my gratitude goes to both my parent Mr Isiaq and Mrs Muslimat, Husamat funmilayo, Umar soliubawa and My homies which is Husamat Suleiman, and other my families members and this gratitude goes to my number one friend in school Isaac oseme, and Abdulfatai sodiq aka biggibanty, for his support and my dedication also goes to our project coordinator and HOD and other lecturers in our department...

And I sincerely appreciate all our friends and colleagues throughout this program. May God bless you all...

Abstract

Petrographic studies have been used to determine structural features and mineralogical constituents of rocks in Kamquarry. The materials and methods used include desk study, field mapping and laboratory analysis. The desk study involved review of previous reports on the Precambrian Basement complex of North central Nigeria.The field mapping was carried out using visual survey with detailed investigation on outcrops found in the study area while the laboratory analysis was carried out using modern petrographic microscopes combined with digital cameras connected to the computer for detailed photomicrographs of fresh representative samples of Migmatite Gneiss tagged Sample A, Porphyritic Granite tagged Sample B and Biotite Granite labelled Sample C in an open-cast mine site. The results shows detailed brittle structures such as joints while the ductile structures includes foliations and folds such as assymetrical fold. The petrographic analysis of three (3) samples revealed that the Migmatite Gneiss, Porphyritic Granite and Biotite Granite consist of significant amount of quartz, plagioclase and alkali feldspar, microcline, biotite, hornblende and other accessory minerals.Economically, the sampled rocks (Migmatite Gneiss, Porphyritic Granite and Biotite Granite) in the studied area have good potentials for engineering purposes. The petrographic analysis examined indicate that mineral distribution quality are essentially made up economic minerals quartz, feldspar, biotite, muscovite and other accessory minerals. It is important to reiterates that these minerals are conspicuously present in all the rocks and it is evidenced that the minerals presents are randomly distributed in accordance to their lithological variations. It is noteworthy that the various rock types mapped conform to what has been reported in previous literatures and it evidently supports the geology of both North-central and South-western Basement Complex of Nigeria.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Petrographic study of rock is a branch of petrology that focuses on the detailed description of the rock. It involves detailed description of mineral contents, as well as the textural and structural relationship within the rock in that area (Akindele, 2011). Petrography is defined as the science of describing and classifying rocks. It involves the mineral processes of formation, ongoing, distribution, classification and uses. The most important aspect of petrographic study of rocks in an area involve the detailed analysis of the constituent minerals of the rocks by optical mineralogy in thin section making use of the petrographic microscopic which of course is critical to the understanding of the origin of rocks. A petrographic analysis is critical when trying to learn about a rock, reservoir or formation of interest. However, the scale of investigation depends on the importance of the particular sample of interest. To fully describe and characterize a rock taking varying stages of analysis it must begin with an exposed outcrop (Freeman, 2005). Petrographic studies are for understanding the geology of the study area. It can also help understand metamorphism and thus temperature and pressure conditions in an area, which might seem similar when looking at a microscopic scale that accompany the geological data with the help from mineralogy, micro textures, mineral colour, grain boundaries and deformation. It also enhances previous geological history combined with technical analysis. The petrographic information can be used for prospecting for crushed bedrock with good technical properties for production of aggregates used for road and concrete.

Petrographic studies can also be used to get information on the structural features, mineral composition and textures. The purpose of this study is to give a detailed observation onstructural features, petrographic description of rocks by examining the mineralogical constituents.

1.2 Aim of the Study

The aim of this project is to carry out detailed petrographic study of rocks in Kam quarry in Kwara state

1.3 Objective of the Study

The objective of this study includes:

i. to examine the petrographic study of rock.

ii. to determine the mineralogical constituents of rock

iii. to establish its importance for industrial purpose.

1.4 Statement of Problem

Considering the vast application of rock for industrial purposes, poor knowledge on petrographic study and mineralogical composition of the rock has led to its under utility. This project seeks to address this situation.

1.5 Justification of the Study

This project will give clearer and detailed information on the petrographic study of rock in the area of the study.

1.6 Scope of the Study

The scope of this project will be restricted to collection of different rock samples from Kam quarry, Kwara State. The project is limited to field work and laboratory analysis.

CHAPTER TWO

LITERATURE REVIEW

2.1 Review of Previous Literatures

Numerous authors has reported studies on petrographic analysis of rock. Mugerwa (2015) disclosed that field petrographic study of rock stimulates the efficient identification of ore alteration, rock type, mineralogical composition, and other geological features in a studied area. Akindele (2011) reported that some of the igneous rock samples contain a segregated portion consisting of calcite. This subjected to be a secondary mineralization along fracture or cavities resulting from hydrothermal crystallization. Ezepue et al. (2003) worked on evaluation of rocks and concluded that the megascopic study is the description of different rock type of the study area in hand specimen which was facilitated with the photograph of the outcrop. The mineralogy unit, texture, structure, mode of occurrence and field relationships is quite important. Lundgren (2012) found out that the petrographic compositions as well as the physical and chemical study suggest that the concentration and grain size of constituent minerals distributed within the rock. Constitute detailed information of petrographic study of rock. Dada (2006) also reported that petrographic description start with geological field mapping and concluded thatpetrography reveals the mineral identification and relationships between mineral grains of a rock with petrographic light microscope. The process of origin, formation, classification of minerals, there utilization as well as geographical distribution.

2.2 Composition of Rock

Rocks are hard, coarse grained rock making up most of the earth. It consist chiefly of three minerals; Quartz, Alkali, Feldspar (which contain aluminum and silica) and plagioclase feldspar (which contain sodium and calcium). It also contain small amount of minerals such as hornblende and biotic mica. This minerals composition usually gives granite a Red, pink, gray or white dark mineral grains visible throughout the rocks. The chemical composition of granite is typically 70-77% silica, 11-13% alumina, 3-5% alumina, 3-5% potassium oxide, 3-5%soda, 1%lime, 2-3% total iron and less than 1% magnesia and titanium

2.3 Physical Properties of Rock

Igneous rock formed by cooling and crystallization of molten magma beneath the earth surface. It is composed of mineral constituent of orthoclase, feldspar, quartz and some amount of mica, it consist of more than 10% free quartz normally or average of 25%. Feldspar. Most orthoclase and microcline is of appreciable amount, when the grain size is between 0.5 mm -0.05mm, it is called micro granite, when the grain is less than 0.05mm, it is known as Rhyolite. Rocks is visibly homogeneous in texture. The following are the physical properties of igneous and metamorphic rocks; Hardness 6-7 on minor scale, density 2.6 kg/cm^3 - 2.8kg/cm^3 compressive strength 140 N/mm^2-210N/mm^2 , includes of rupture 15 N/mm^2 , average wear less than 1% water absorption 0.1% -0.6% porosity quite low (less than o.61) weather impact resistant.

2.4 Chemical Properties of Rocks

Rocks are mainly composed of feldspar, quartz along with different other minerals. In vary percentages which are affirmed as follows:

Chemical properties of granite and metamorphic has a variety of oxides which are contain in different percentage which include silica (SiO_2) range between 70-77% alumina, (Al_2O_3) range between 1-3% Iron (Fe_2O_3) range between 1-2% magnesia (MgO) range from 1% - 5% titian range list than 1% (0.38%) in quantities water (H_2O) range 0.03% in quantities.

2.5 Mineralogical Properties of Rock

Rocks are possibly the most common igneous rock type known to the general public, it is name for it granular or Phaneritic texture as crystal that tend to be easily seen, although they are generally small. It is the rock that has been used for centuries for many different purposes such as building materials and durability, beauty and abundance make it a preferred choice of stone over must stones.

Rock molten rock or magma that would form granite and it staged the earth's crust but instead manage to erupt on the surface of the earth form a rock called rhyolite. If granite type has crystals that grow larger than a large pebble (roughly 3cm or about 1inche across). Then it is called pegmatite. The minerals that are found in granite are formally quartz, plagioclase, feldspar, potassium of K-Feldspar, horn blend and micas. Quartz is usually the last mineral to crystallize and fill in the extra space between the other minerals. Quartz hardness, lack of chemicals reactivity and near lack of cleavage give granite a significant amount of it desirable durable properties. The quartz will appear gray but is actually colorless and reflecting and fusing the colors of the white and black minerals surrounding it. The plagioclase feldspar are usually white with porcelaneous luster. The K-Feldspars are generally the one that gives granite its black varieties as well. The micas are generally muscovite (silver) Biotite (black or brown) or Lepidolite(violent or pink) and provide granite with black pepper portion of the famines and distinctive salt and pepper look to classic granite.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Geology of Nigeria

Nigeria lies within the mobile belt of Africa and is bordered at the Western part by West Africa craton, and Congo craton at the Southeastern part and Atlantic Ocean at the South. Geologically, the Basement Complex covers about 50% of the total surface of Nigeria (Fig.2.1). It composed of the following lithostructural units. The Migmatite-Gneiss complex (MGC) has for long been regarded as basement sensustricto (S.S.) and it is the most widespread of the main rock units in both northwestern and southwestern Nigeria. The various rock types in this complex are exposed in the north central, north eastern, southwestern and a narrow zone parallel to the eastern boundary of the country, east of River Benue. Kogbe, (1989). The Younger GraniteComplexes occupies about 5% of the total surface area of Nigeria. It covers an area of about 8600sq km in central Nigeria and located in N-S rectangular province 400km long and 160 km wide. The complexes concentrated on the Jos Plateau area with few numbers scattered in the north and south of the Plateau extending to Bauchi, Kaduna, Kano, Gombe and Nassarawa states. Nigeria is underlain by seven major sedimentary Basin (from the oldest) the Calabar flank, the Benue trough, the Chad, Lullemenden (Sokoto), Dahomey and Niger Delta. Sedimentary succession in this area is of middle Mesozoic to Paleozoic age. Older sedimentary deposit was not preserved, probably because during the Paleozoic (Oyawoye,1959).

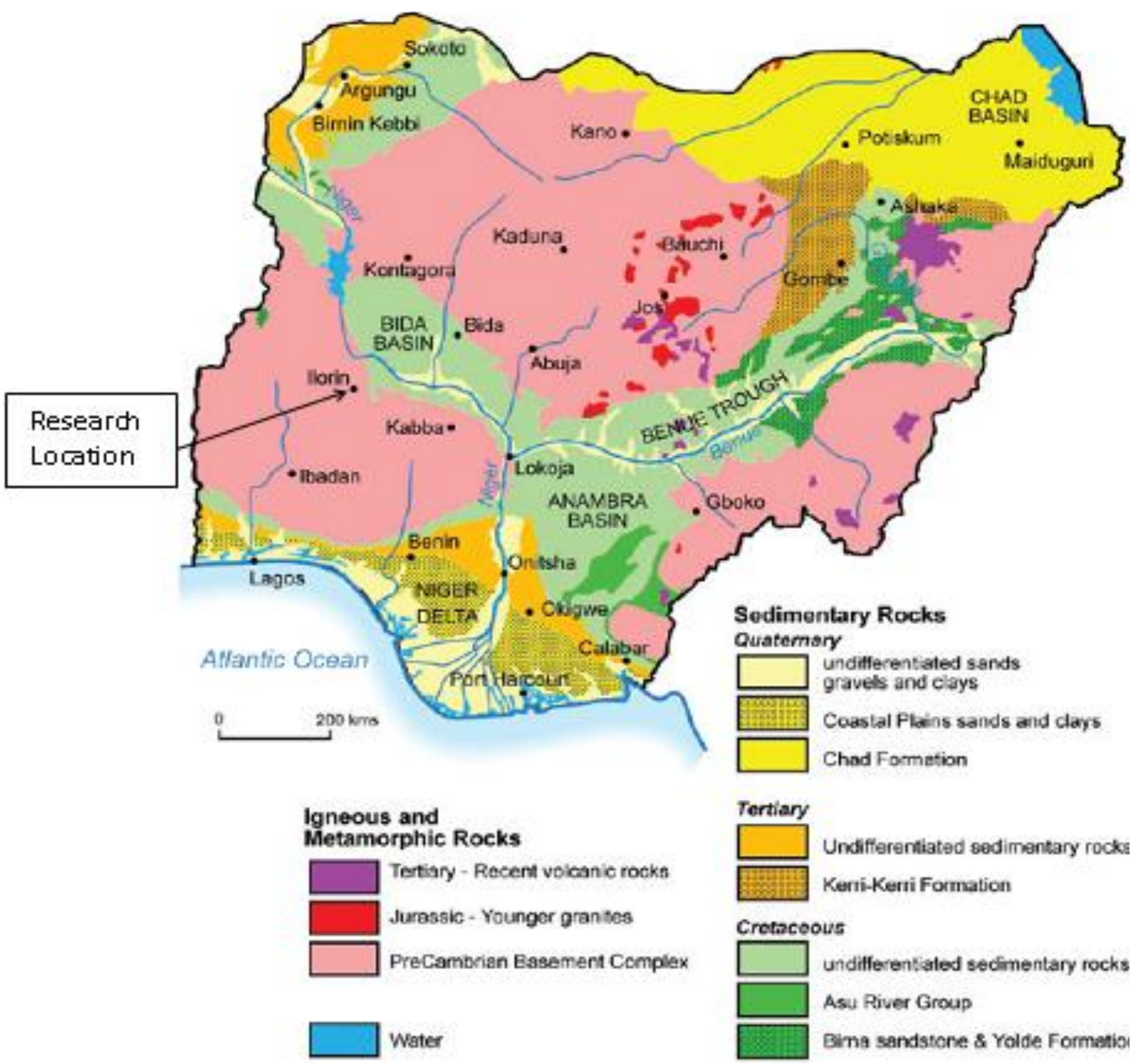

Figure 3.1: Geological Map of Nigeria (Modified After Rahaman, 1988)

3.2 Geology of the Study Area

The study area is Kam Quarry, Ilorin South in Kwara State. It is located within latitude N08^0 33^1.18.2^{11} and longitude E004^0 45^{1}33. 011. Geologically, the area (Fig. 2.2) lies in the Precambrian Basement complex of north central Nigeria and is underlain by rock of metamorphic and igneous type (Figure2.1). However, migmatite predominantly underlies the rocks in the area while other principal rocks include granites and gneisses which are emplaced by Precambrian time and have overtime subjected to tectonic activities characterized by large changes on temperature and resulting in folding and fractures such as joints, faults and fractures within the basement complex rock. (Ibrahim *et al.,* 2012). The mineralogical composition in these rocks include quartz, feldspar, mica (muscovite and biotite), hornblende.

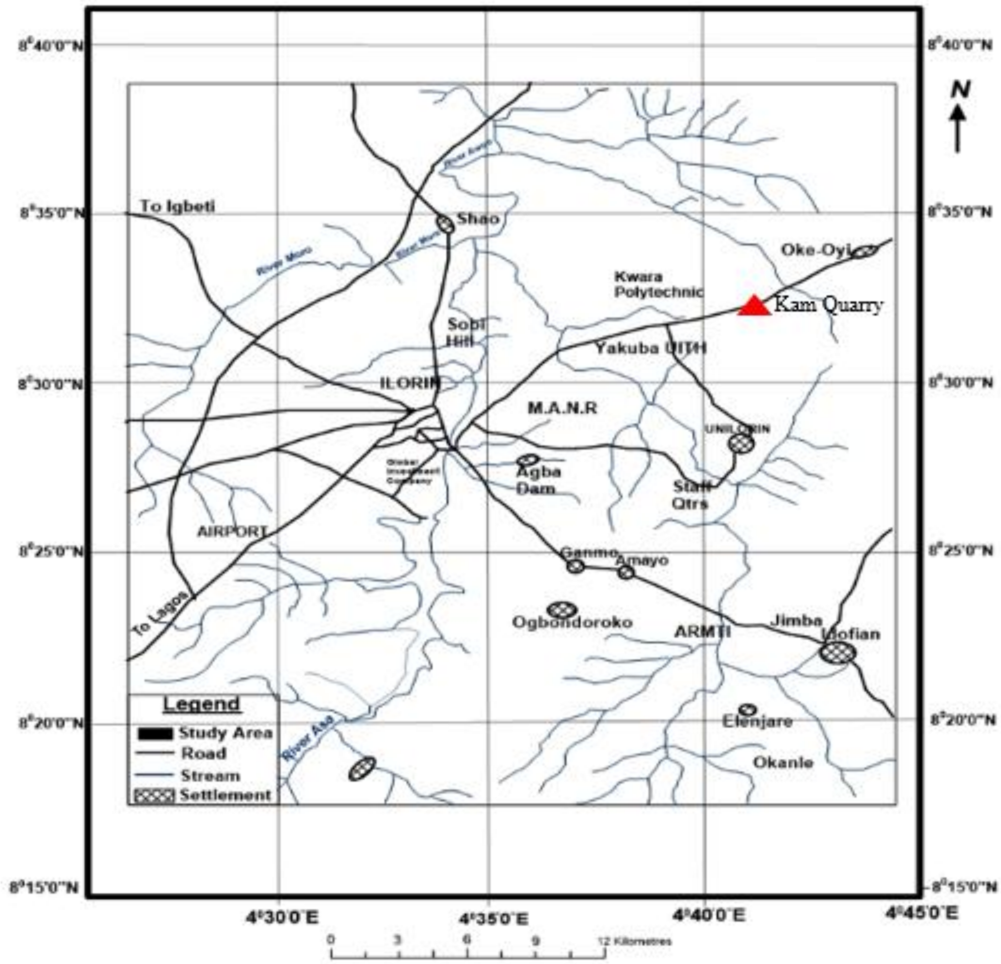

Figure 3.2: Location Map of the Study Area (modified after Olasehinde*et al.*, 1998)

3.3 Sample Collection

Fresh representative samples of Migmatite Gneiss tagged Sample A, Porphyritic Granite tagged Sample B and Biotite Granite (Sample C) were collected on the open-cast mine site on outcrops. Structural features were observed based on tectonic activities and visual studies were also carried out to identify the different types of rocks. The Global Positioning System was used to take the coordinate of the different locations where the samples are taken. Other equipment used includes hammer, chisel, sampling bags, paper tape and marker. The three sample were separated in different sample bags and transported to University of Ilorin, Geology and Mineral Sciences Laboratory for detailed analysis.

3.4 Sample Preparation

The laboratory analysis was carried out on three different types of rocks labeled Sample A (Migmatite Gneiss), Sample B (Porphyritic Granite) and Sample C (Biotite Granite). The petrographical analysis carried out include thin section analysis and optical observations. During the preparation of thin sections analysis for all the samples, a thickness of 1.0 cm of a square shape of each of the rock sample was cut with the cutting machine. Applying emery cloth and caborundum powder, the specimen is further flattening to a thickness of about 0.04 mm. This flattened specimen is overlaid by the boiled Canada basalm and it is covered with a cover slip and left for about a day, then it is washed, rinsed with spirit and later with water. A total of six (6) thin sections (2 slides from each rock sample) were prepared from the samples for effective analysis and control. The analyses were subjected to microscopic examinations. Petrographic studies of the selected samples were made with the aid of a polarizing microscope. Some of the major minerals were observed under the microscopic examinations.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Structural features

This chapter is concerned with the description, spatial representation and analysis of structural features produced by the displacement or deformation of rocks. Structural features are formed as a result of rock resistance to stress. It reflects extent of tectonic events that have affected the area.

The structural features may be primary that is formed during the formation of rocks such as horizontal layering or secondary which is formed after primary structures or after the rock has being formed, this include folding, fracturing etc.

4.2 Classification of structures

The structural features observed in the area are classified into two main groups. These are:

i. Brittle structures

ii. Ductile structures

4.2.1 Brittle structures

These are structures that are formed from breaking of rocks in response to stresses higher than their elastic limit. They are developed when the rocks loses its cohesion in response to application of stress resulting in marked discontinuities called fractures and may be seen as joint or faults.

4.2.2 Joints

This is a fracture without apparent movement or displacement parallel to the plane of the surface (Plate 4.1). Joints were seen on the field trending in different directions. Joints occur in virtually all the mapped areas and some of the veins observed were believed to have been formed as minerals precipitate within these joints to form veins.

Plate 4.1: Joint

4.3 Ductile Structures

Ductility is the ability of a rock to undergo large strains without resulting in marked discontinuities of the entire rock mass. Ductile behavior of rocks is a function of temperature and strain rate. The ductile features observed in the mapped area are folds, foliation, and lineation.

4.3.1 Folds

Fold is a bend in planar surface as a result of compressional force. It is said to be a ductile structure due to its resistance to breakage during the application of stress (Plate 4.2). They occur as folded veins and folded alignment of minerals segregated into light and dark bands. Observable fold on the field is Asymmetrical fold.

Plate 4.2. Asymetrical fold

4.3.2 Foliation

This is a repeated or penetrative planar feature in a rock which may be defined by fabric, compositional layering or pervasive fracture (Plate 4.3). They are mostly common in metamorphic rocks. They are also parallel alignment of textural and structural features of rock.

Plate 4.3. Foliations

4.4 Results of Petrographic studies of the Thin Sections

The results based on petrographic studies of the thin sections revealed the various mineral distributions such as quartz, biotite, hornblende and feldspar (orthoclase, plagioclase and microcline). The quartz and feldspar constitute almost 88% of the thin section with other accessory minerals in both plane polarized and cross polarized light.

4.5 Discussion on Petrographic Studies of Migmatite Gneiss

The migmatite gneiss is the oldest type of rock in the study area. According to Abba (1983) gneiss occurs as the most widespread lithological unit in basement terrains and the imprints of the Pan – African deformation were evident by regional metamorphism, migmatization, extensive granitization and gneissification which produce syntectonic granites and homogeneous gneisses. It is common and appears to demonstrate undifferientiated pattern within the area. They are depicted generally by alternating light and dark coloured bands. The felsic bands of the rock consist of quartz, plagioclase and orthoclase feldspar with large percentage composition while the hornblende, muscovite or biotite constitutes smaller percentage of minerals in mafic bands. Based on mineral assemblages, quartz is however a dominant minerals while others such as feldspar and biotite are also making up a vital part. It has textural classification of fine to medium grained. In addition, the rock has undergo numerous orogenic cycles which has essentially lead to large scale deformation (Obaje, 2009). The imprints has been widely reported in the Precambrian rocks of Nigeria (Rahaman, 1989). The macro and micro structures is as a result of fracturing (Olayinka, 1992) such as folding, jointing, veins, intrusions, foliations and mineral lineations which were found in the study area.

4.6 Petrographic Description of some of the Prominent Minerals in the Migmatite Gneiss

The studied thin section with the aid of petrological microscope and slides were analyzed under plane polarized light and crossed nicol. The studied minerals include quartz, feldspar, biotite and hornblende.

4.6.1 Quartz (SiO_2)

The quartz is colourless in plane polarized light and shaped in euhedal. In coss polarized light, the quartz is colourless, reddish and conchoidal fracture with anhedral shape (Plate 4.4 and 4.5). It also display pleinchoism crystal of quartz that exhibit low relief and sometimes exhibit undulose extinction indicative of deformation or straining (Obini and Omietimi, 2020).

4.6.2 Plagioclase Feldspar ($Na_2AlSi_3O_8.Ca_2Al_2Si_2O_8$)

The feldspar mineral observed are plagioclase feldspar which is clearly from Albite twining characteristics (Ojelokun and Fawole, 2019) which is as a result of angle parallel to the large crystals in plane polarized light is colourless (Plate 4.4) but it demonstrate first order grey colour when the polar is crossed. It can be characterized from other types of feldspar because of its polysynthetic twining visible in the crystal. Some of the plagioclase in the slides occur as phenocryst (Plate 4.5).

4.6.3 Orthoclase Feldspar

The orthoclase feldspar under plane polarized light and crossed polarized light (XPL) appears cloudy and colourless (Plate 4.4 and 4.5). The crystals have low relief and are anhedral in shape.

It is often colourless crystals with grey and reddish. The darker portion in the thin section suggest weathered feldspar with no definite cleavage.

4.6.4 Microcline Feldspar

The microcline feldspar exhibit a crystal system known as triclinic. This mineral is colourless under plane polarized light (PPL) and appears milky white under cross polarized light (XPL) with higher relief to quartz and orthoclase plate (Plate 4.4 and 4.5). The physical and chemical composition of microcline feldspar can be compare with the orthoclase feldspar. A thin section study implies large anhedral to subhedral microperthitic microcline with good polysynthetic crosshatched crystals with elongated crystals that exhibit subhedral habit.

4.6.5 Muscovite $(KF)_2(Al_2O_3)_3(SiO_2)_6$

The muscovite appears colourless under plane polarized light (PPL) (Plate 4.4) and has a pale green appearance under cross polarized light (XPL) (Plate 4.5) which makes it pleochroic. It exhibit parallel extinction with high relief and perfect cleavage in all direction. However, many of the crystals has twining and those near to the extinction shows position display appearance which is characteristics of mica family.

4.6.6 Biotite $(Mg,Fe)_3\ AlSi_3O_{10}(OH,F)_2$

The colour of the biotite is between grey to brown colouration with subhedral to anhedral shape and has no twining. It has a directional cleavage. The mineral plate does not have extinction angles but form interstitial lamellae which may occur as linear aggregates with alteration to chlorite. It exhibits different pleonchoic orientation. The biotite has some inclusion of accessory minerals like zicon, rutile and apatite (Plate 4.4 and 4.5). It has strong birefringence under crossed polarised light, interference colour of dark green with symmetrical extinction and polysynthetic twinning.

4.6.7 Hornblende ($Ca_2(MgFe)_5(AI_2Si)_8O_{22}(OH)_2$)

The colour of hornblende under plane polarized light is greenish black and it also displays pleochroism from green to brown.Under plane polarized light, a few of the hornblende crystals showed the characteristics shape and two cleavages. Under crossed nicol, twinning was seen in a few hornblende crystals and the highest interference colour seen is a second-order blue.

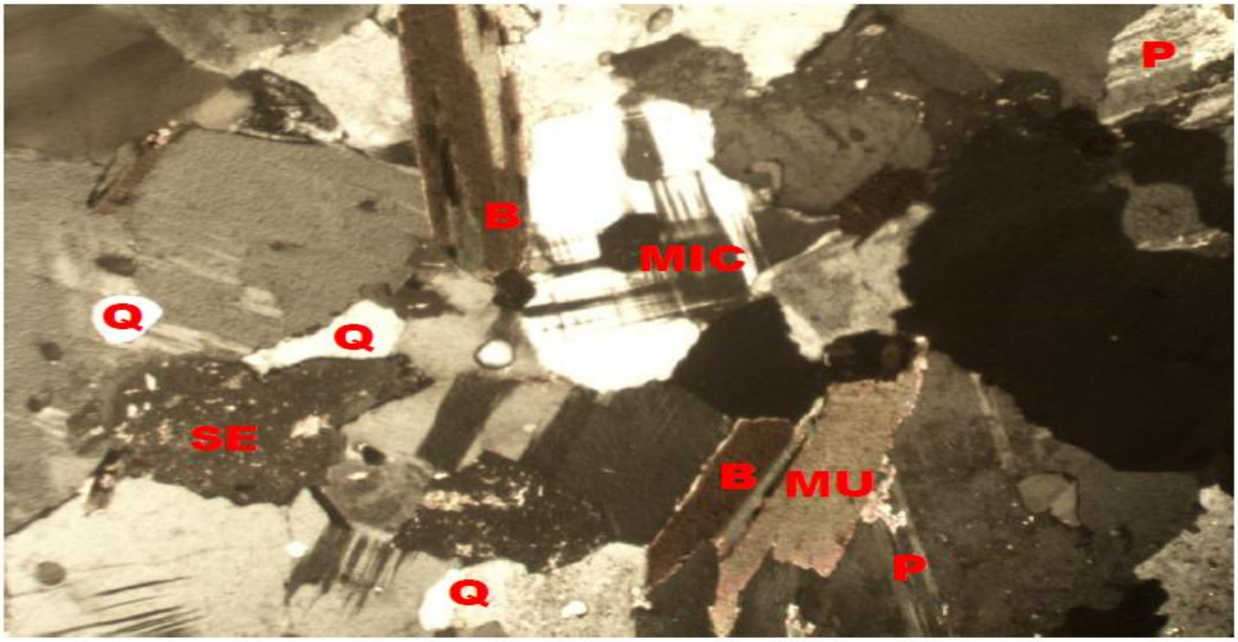

Plate 4.4: Photomicrograph of migmatite gneiss under Crossed Polarized Light (XPL), showing quartz (Q), biotite (B), plagioclase feldspar (P).

Plate 4.5: Photomicrograph of migmatite gneiss under Plane Polarized Light (PPL) showing the various shades of colours of mineral grains, Quartz (Q), Biotite (B), Plagioclase feldspar.

4.7 Discussion on Petrographic Studies of Porphyritic Granite (Sample B)

Porphyritic granite is the second most abundant rock type in the study area and it exhibits the characteristics of both slow and rapid rates of cooling magma. This has resulted to large or giant crystals of minerals (Phenocrysts) due to slow cooling, nevertheless, it has been subjected to further rapid cooling as the magma eventually move to the surface to form finer groundmass in which the Phenocryst are embedded to form porphyritic texture (Saad and Baba, 2017). The major mineral constituents that occur include quartz, biotite, hornblende and plagioclase feldspar. The quartz in the porphyritic granite is euhedral in shape and it displays undulose extinction. The biotite exhibits different pleonchronic orientation. The biotite has some inclusion of accessory minerals like zircon, rutile and apatite. The plagioclase feldspar occurs as phenocrysts with lamellar twinning within the groundmass. Accessory minerals in the rock include zircon, apathite, magnetite and titanite (Plate 4.6 and 4.7)

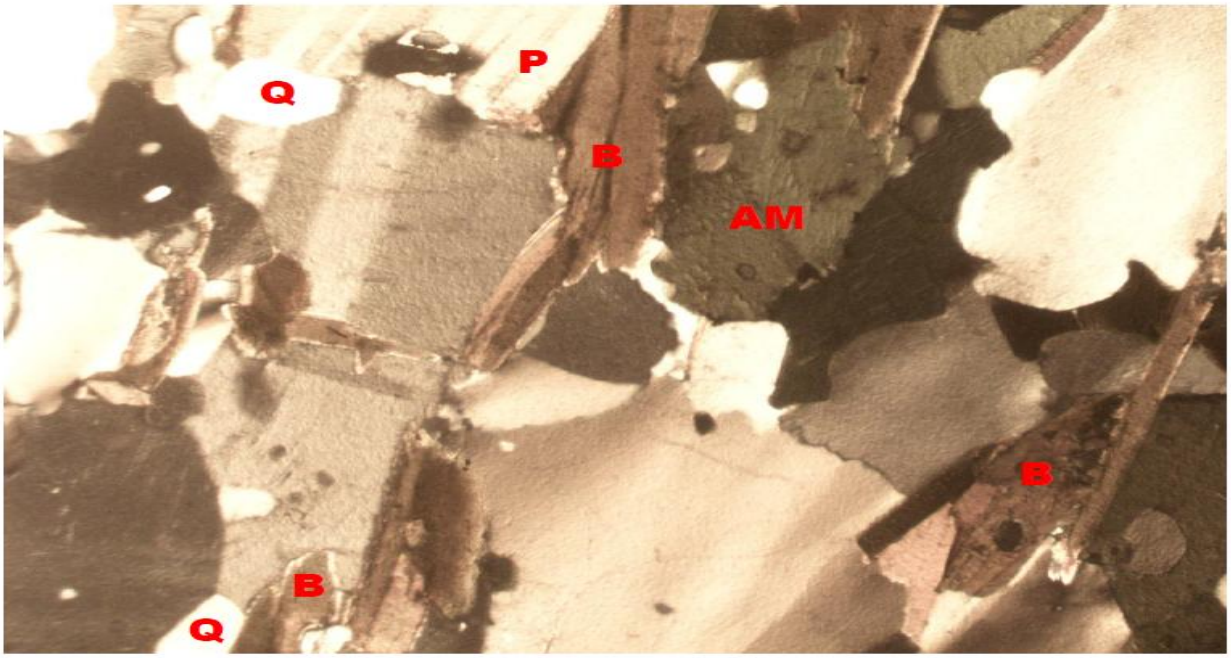

Plate 4.6: Photomicrograph of porphyritic granite under Crossed Polarized Light (XPL), showing quartz (Q), biotite (B), plagioclase feldspar (P).

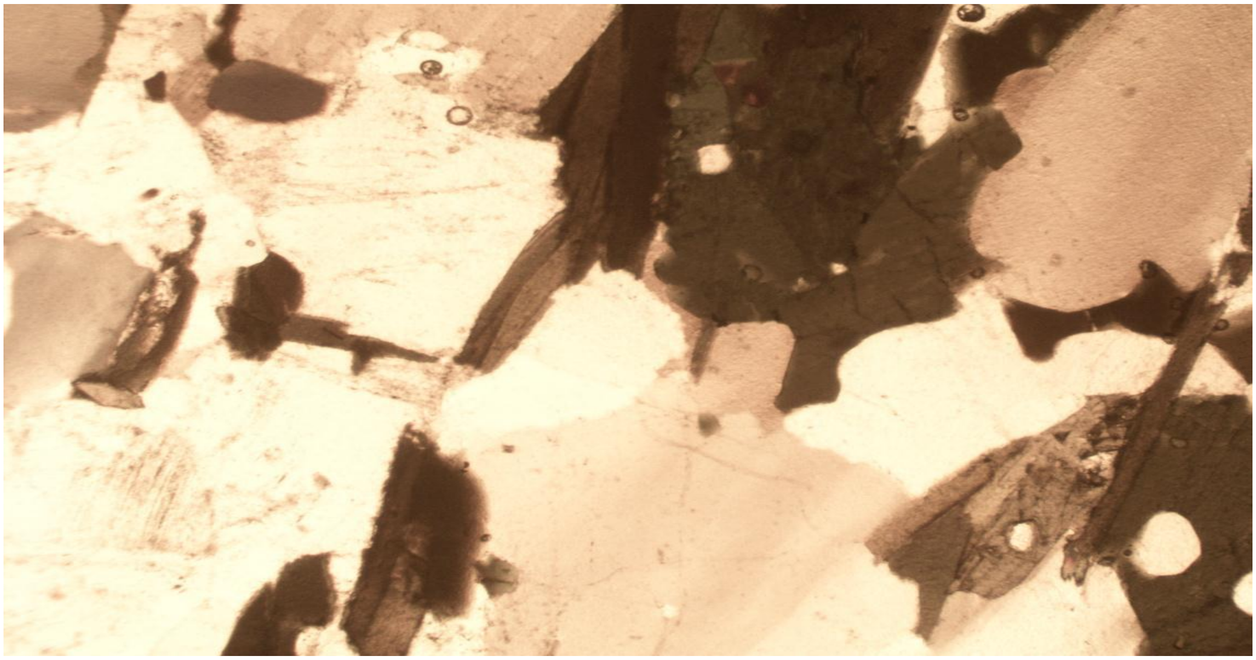

Plate 4.7: Photomicrograph of porphyritic granite under Plane Polarized Light (PPL) showing the various shades of colours of mineral grains, Quartz (Q), Biotite (B), Plagioclase feldspar.

4.8 Discussion on Petrographic Studies of Biotite Granite (Sample C)

The biotite granite is a medium to coarse grained rock. The colour has resulted from the disintegration of biotite to fom chlorite (Aga and Haruna, 2019). Biotite is pleochroic form green to brown and are subhedral in shape (Plate 4.8). The chlorite that occurs within the fractures has light green colouration and occurs mainly in cracks present within mineral matrixes. The crystal form of the chlorite is anhedral and occurs as a different product. However, the quartz in the biotite granite is euhedral to crystal in shape with crypto crystalline inclusions. It displays undulose extinction. This essentially proves that the rocks were highly deformed. The huge tectonic activities that took place or occur might have led to the exposure of the rocks to the surface of the study area. The occurrence of feldspar in the biotite granite is known as plagioclase feldspar and it is an irregular formed perthite with patches of it formed at the surface.The iron oxide occurs as tiny black patches in some biotite crystals and it is less abundant in the sample (Plate 4.9).

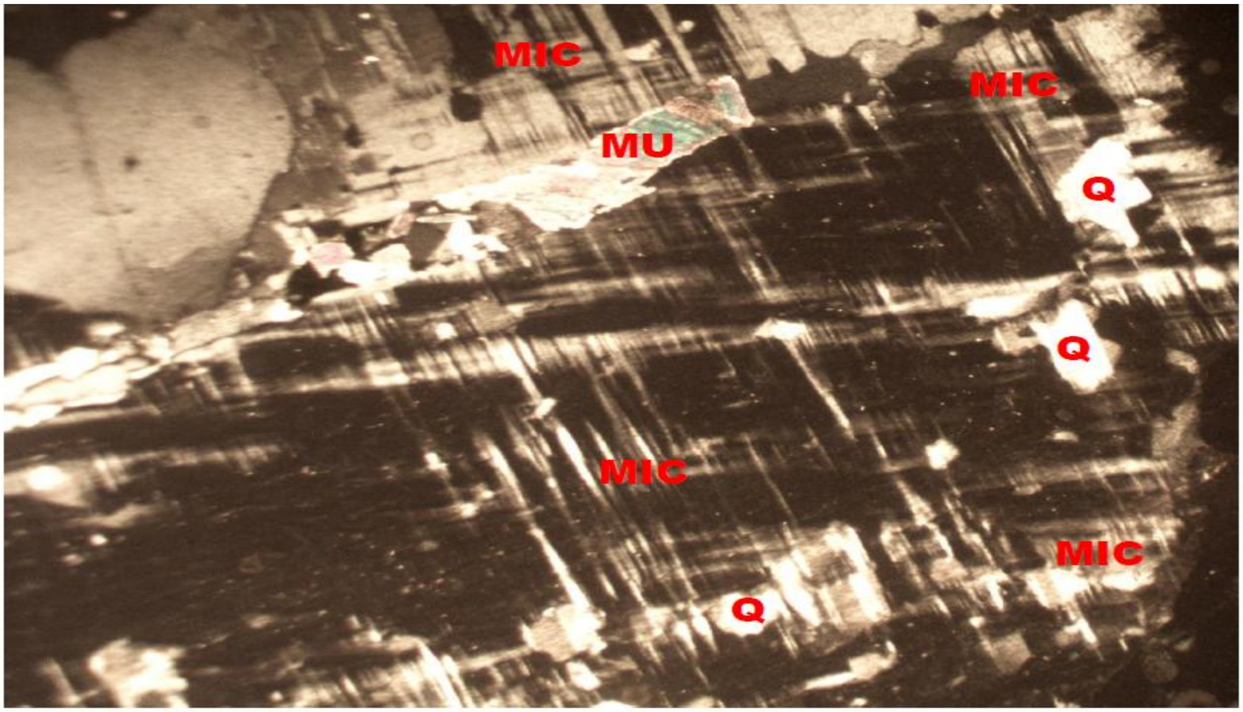

Plate 4.8: Photomicrograph of Biotite granite under Crossed Polarized Light (XPL), showing quartz (Q), biotite (B), plagioclase feldspar (P).

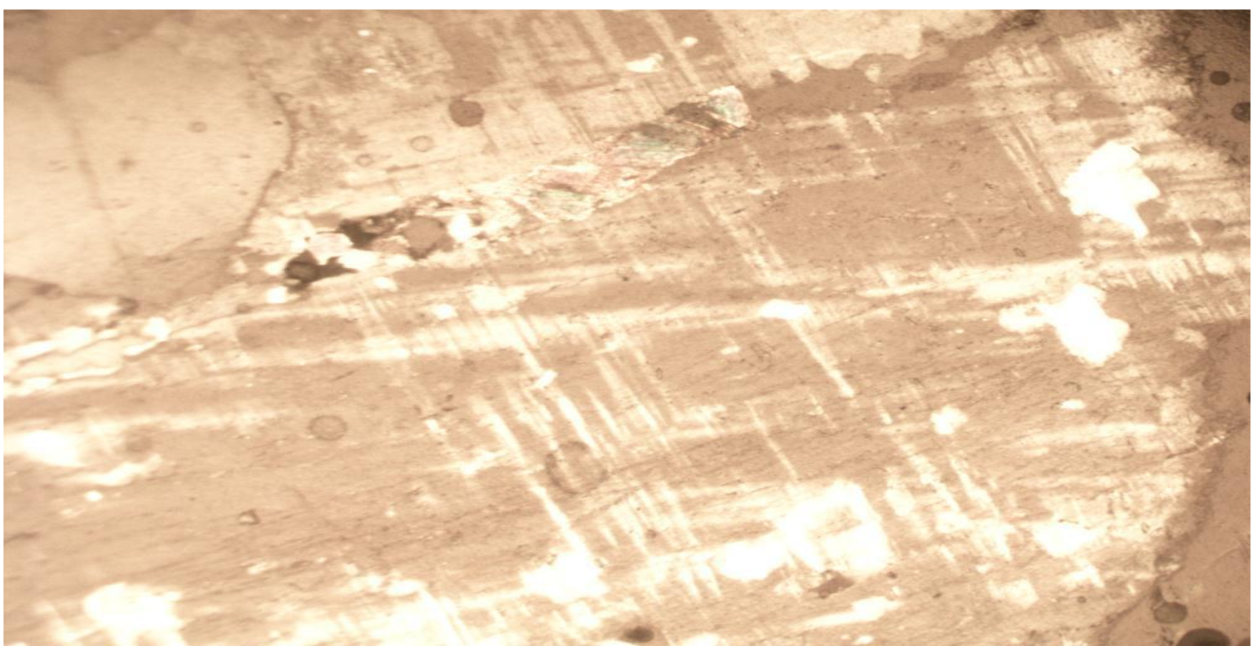

Plate 4.9: Photomicrograph of porphyritic granite under Plane Polarized Light (PPL) showing the various shades of colours of mineral grains, Quartz (Q), Biotite (B), Plagioclase feldspar.

4.9 Economic Potential of the Rocks

Economically, the sampled rocks (Migmatite Gneiss, Porphyritic Granite and Biotite Granite) in the studied area have good potentials for engineering purposes. Industrially, the quartzite can be used as industrial silica sand, silicon and silicon carbide. It can also be used as decorative stone used to cover walls. It is also useful in flooring, star steps and as roofing tiles. It is sometimes used as railway ballast and also in road construction purposes such as bridges, building houses, road pavement etc. The petrographic analysis examined indicate that mineral distribution quality are essentially made up economic minerals quartz, feldspar, biotite, muscovite and other accessory minerals. It is important to reiterates that these minerals are conspicuously present in all the rocks and it is evidenced that the minerals presents are randomly distributed in accordance to their lithological variations (Ajali, 1997). Feldspar can be mined as profit by ceramics and glass industries for making product. The feldspar (plagioclase and orthoclase) can also be mined for fertilizers and cements.

CHAPTER FIVE

Conclusion and Recommendation

5.1 Conclusion

Petrographic studies and geochemical analysis of two different rock samples were carried out in the study area. Petrographically, the granitic rocks in the study area are composed of major rock forming silicate minerals such as quartz, biotite mica, and feldspars. The photomicrographs in the study area shows that the rocks are mineralogically composed of quartz, orthoclase and plagioclase feldspar, albite, microcline and other minor constituents such as hornblende and biotite. Economically, the various rocks in the area have good potentials for engineering purposes. The petrographic analysis examined indicate that mineral distribution quality are essentially made up economic minerals quartz, feldspar, biotite, muscovite and other accessory minerals.

5.2 Recommendation

The federal government should establish and equip the existing laboratories to carry out detailed analysis particularly on petrographic analysis of rocks for engineering construction purposes.

Measures should also be put in place to exploit and explore solid mineral resources in order to enhance industrialization and boost the economy of the country.

References

Akindele, O. O (2011). Geology and Geotectonic Setting of the Basement Complex Rocks in South-Eastern, Nigeria: Implication on Provenance and Evolution, *Earth and Environmental science.* 14, 221-252.

Annor, A.E. (2007). Metamorphic of Pellific Rocks in Revolution to Deformation, Nigeria. *Journal Mining & Geology*, 15. 253-261.

Ayodele, O. S and Ajayi, C. A. (2016). Petrology, Mineralogy and Geochemistry of the Precambrian Rocks around Ikere-Ekiti, Southwestern Nigeria. Journal of Chemical and Petrochemical Technology (JCPT) Vol. 2, Issue 1, Jun 2016, 1-24

Best, M. G. and Christiansen, E.H. (2001). Igneous Petrology. 458pp.Malden, MA: Blackwell Science.

Caby, P. T. (1989). Geochemistry of Basement Rocks From NW Nigeria 19th Annual Report.

Dada, S.S. (2006). Protezoic Evolution of Nigeria, the Basement Complex of Nigeria and its Minerals Resources (A Tribute of Prof. M.A.O Rahman). Akin Junad et al; 19. 269-282.

Ezepue, M.C and Odigi, M. I (2003). Schistose Rocks, SW Nigeria. *Journal Mining & Geology*,Vol 2.0.

Grant, P.A and Dada, O. (1970). The Basement Complex Of Nigeria and it Mineral Resource Ibadan. Pp. 38-43.

James, Z. and Hanulton, M. S. (1969). Geochemistry Characteristics and Petrogenesis. Cont. Min. 95.407-419.

Ibrahim K.O., Olasehinde, P.I., Akinmade, A. O. and Isa, A. (2012). Geological Sounding to Investigate Groundwater Potential of Orisunibare Village in Ilorin South Area of Kwara state, Nigeria. *Journal of Environment*, 1101.0.1 1. Issue 01, pp. 21-25.

Nigeria Geological Survey Agency, NGSA, (2008). Geological and Mineral Resources Map of Nigeria. *Ministry of Mines and Steel Development, Abuja*. Nigeria.

Lundgren, K.O (2012). Detailed Information of Petrographic study of Rock, *International Journal of Applied Science*, Vol 22, pp 1-4.

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