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# Petrographical investigation of granite for quarry operation in a localised area of Ado Ekiti, South-western Nigeria

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## ABSTRACT

Twelve rock samples of granite are collected from the deposit located at the site of the Federal Polytechnic, Ado Ekiti. The samples are thin sectioned and petrographically studied at X80 magnification under crossed and plane polarised light. The studied rocks are dominantly porphyritic in texture while the mineral composition are basically quartz, biotite, plagioclase feldspar and hornblende at estimated percentages occurrences of 34.12%, 25.51%, 12.82%, 10.23% respectively. However, microcline, opaque and orthoclase occur at minor amounts of 9.30%, 4.20% and 3.82% respectively. The granite at this localised area would be suitable for quarry operation in view of the aforementioned textural and mineralogical observation.

Key words: Quarry operation, granite, biotite, orthoclase, porphyritic, texture, opaque.

## INTRODUCTION

Quarries are open pit mines that are used to get rocks and minerals from the ground. They are often used to cut stones from the ground in large pieces or blocks e.g Dimension Stones. Granites, being one of the most common igneous rocks and best known [1] partly because of its natural beauty, which is enhanced when it is polished and partly because of its abundance; are desirably used in quarry operations. Granite is a widely occurring type of intrusive, felsic igneous rock that is granular and crystalline in texture [2]. Granite is an igneous rock that is basically composed of quartz, feldspar, mica (biotite) and variably, hornblende .According to the Wikipedia, granite is nearly always massive (lacking internal structure), hard and tough, and therefore, has gained wide spread uses as a construction stone. Ado Ekiti, the study area, is located in the South-western part of Nigeria that is underlain by rocks of Precambrian Basement Complex which are majorly made up of granites, biotite granites and migmatite complex. According to [3];the deformational and metamorphic events that later accompanied the rocks occurred during the Pan-African Orogeny. The granite deposit is located within the Federal Polytechnic, Ado-Ekiti, at between latitude  $5^{\circ} 10^{\circ}$  to  $5^{\circ} 15^{\circ}$  to the east of Greenwich Meridian and latitude  $7^{\circ} 30^{\circ}$  to  $7^{\circ} 40^{\circ}$  of the equator, with an elevation of 500m above sea level. Uses of granites in building construction, dimension stoning and stone polishing have been recorded from all the main Basement Complex area in Nigeria [4], including Ado Ekiti. It is therefore necessary to exploit for more deposits of granites in the town in order to cater for the current high rising demand for granites. However, for a good quarry operation, detailed petrographical investigation of the granite must be carried out in order to obtain information about its physical properties which would help in the proper selection of site equipment. Petrography is the microscopic study of rocks, minerals or man-made materials. It is the microscopic identification of interrelationships of mineral grains in the fabric of a rock [5]. It is a powerful tool for investigating the composition, microstructure and inter-componental relationships of a wide variety of natural and synthetic materials. Used alone, or in combination with other investigative techniques, it can be of tremendous value in many areas of the minerals and construction industries. Petrography, would be used in this study to identify the textural and mineral contents of the granite deposit in Ado Ekiti. These would also serve in proposing the suitability of the Ado Ekiti Granites for Quarry operations.[6]in their petrographical assessment of the usability of Ado-Ekiti granitic rocks for dimension storing, suggested that the abundance of microcline in some granites in Ado Ekiti at 60% occurrence would make the rocks to be highly resistance to wears and other degradation factors, making them recommendable for dimension stoning. According to [7],texturally, porphyry are observed when relatively large crystals (phenocryst) are embedded in finer ground mass (the same mineral may be present in both phenocryst and ground mass). [8], also described aphanitic rocks of porphyritic texture with glassy groundmass but large, more or less euhedralphenocrysts. Granitic rocks could holdmyrmerkite, chlorite and gem minerals like tantalite, garnet, zircon, apatite etc. Granites are very abundant in the organic belt and less abundant in the Caledonides and rare in the Alps. Pegmatite and aplite are enriched in the minimum melting constituents of granite and poor in the high melting constituents like ferro-magnessian minerals and calcic plagioclase. [9], who performed a petrogeochemical analysis of granitic rocks in Ado-Ekiti,observed that the presence of olivine and orthopyroxene in the sampled granitic rocks indicate that the rock is either charnockitic, gabbroic, doleritic or granular. This also is characteristic of basic granitic rocks. The presence of myrmerkite in a granitic rocks at the margin of other granitic deposits especially porphyritic biotite and biotite-hornblende-granite. It was demonstrated that a multiplicity of metamorphic and deformational events occurred during the Pan-African Orogeny.

### MATERIALS AND METHODS

Petrographical analysis were carried out on twelve rock samples of granite collected from the granite deposit at the Federal Polytechnic at Ado Ekiti (Fig.1). The deposit covers an area extent of 26550m<sup>2</sup> with an average elevation of 458m above sea level. Rocks of the site are dominantly greyish to dark greyish in colour and medium to coarse grained. The rock samples were finished into thin section (slides) at the Geology Laboratory of the Department of Geology at ObafemiAwolowo University, Ile-Ife, Osun State. Each of the samples were sectioned with diamond coated cutting wheel. The sections were set in epoxy resin and polished to a 1mm diamond paste finish.A fragment of each rock, not more than 8-10mm in thickness were obtained from a hand specimen using a geologic hammer. One surface of the chip is grounded smooth by using 120F,220F and 3F grade carborundun abrasive. This surface is glued to a microscope slide that measure 30mm by 30mm and up to 1mm thickness by Lakeside 70c which is supplied in short rod and must be melted on a hot plate at temperature of between 85°C and 100 °C. The other side of the rock fragment is now cut from its original thickness of 5-10mm to about 1mm with a Diamond Saw .This latest size is later reduced to 200microns by using 100microns size Carborundun .A 60micron size Carborundun is later used to reduce the size from 0.2mm to 0.1mm, a stage where quartz and feldspar show bright second order interference colour under Cross Polars .The final grade of grinding is from 0.1mm to 0.03mm.This is accomplished by using 12microns size Carborundun. It is carefully done to attain the thickness of 30microns, while maintaining a uniform thickness over its whole area .At such a standard thickness, Canada Balsam diluted in Xylene is used in mounting the transparent rock onto the microscope slide. One must ensure that no air or gas bubble is trapped between the Cover Glass and the rock. This Thin Section for each rock is studied under petrographic microscope at X80 magnification under both plane and cross polarisation (Plate1-12).

#### RESULTS

**3.1** Average estimated percentages occurrences of the minerals that are present within the studied granite deposit are presented in form of Pie Chart(Fig. 2):



Figure 2: Pie Chart of estimated average percentage occurrence of minerals in the granite

**3.2** Fields of view of the Petro graphical Analysis of the granite deposit (Plate 1-12)



Cross Polar (X80)



PlanePolar(X80)

**Mineral Content**; Quartz ,Biotite, Plagioclase ,Hornblende , Opaque mineral TEXTURE;PORPHYRITIC PLATE 1;PETROGRAPHY OF THE ADO EKITI GRANITE



CROSS POLAR (X80)



PLANE POLAR(X80)

Mineral Content;Quartz,Biotite,Hornblende,Plagioclase, TEXTURE;PORPHYRITIC PLATE 2:PETROGRAPHY OF THE ADO EKITI GRANITE



CROSS POLAR(X80)



PLANE POLAR(X80)

Mineral Content;Quartz,Biotite,Hornblende,Plagioclase TEXTURE;PORPHYRITIC PLATE3;PETROGRAPHY OF THE ADO EKITI GRANITE



CROSS POLAR(X80)



PLANE POLAR(X80)

Mineral Content;Quartz,Biotite,Hornblende,Opaque,Orthoclase TEXTURE;GRANULITIC PLATE 4;PETROGRAPHY OF THE ADO EKITI GRANITE



CROSS POLAR(X80)



PLANE POLAR(X80)

Mineral Content;Quartz,Plagioclase,Biotite,Hornblende TEXTURE;PORPHYRITHIC PLATE 5; PETROGRAPHY OF THE ADO EKITI GRANITE



CROSS POLAR(X80)



PLANE POLAR(X80)

Mineral Content;Biotite,Quartz,Plagioclase,Hornblende,Microcline,Opaque TEXTURE;PORPHYRITHIC PLATE 6; PETROGRAPHY OF THE ADO EKITI GRANITE





CROSS POLAR(X80)

PLANE POLAR(X80)

Mineral Content;Quartz,Biotite,Plagioclase,Hornblende,Orthoclase,Opaque TEXTURE;GRANULITIC PLATE 7; PETROGRAPHY OF THE ADO EKITI GRANITE



CROSS POLAR(X80)



PLANE POLAR(X80)

Mineral Content;Biotite,Quartz,Plagioclase,Hornblende,Opaque TEXTURE;PORPHYRITIC PLATE 8; PETROGRAPHY OF THE ADO EKITI GRANITE







PLANE POLAR(X80)

Mineral Content;Biotite,Quartz,Plagioclase,Hornblende,Opaque TEXTURE;PORPHYRITIC PLATE 9; PETROGRAPHY OF ADO EKITI GRANITE



CROSS POLAR(X80)



PLANE POLAR(X80)

Mineral Content;Quartz,Plagioclase,Biotite,Hornblende TEXTURE;PORPHYRITIC PLATE 10; PETROGRAPHY OF THE ADO EKITI GRANITE



CROSS POLAR(X80)

PLANE POLAR(X80)

Mineral Content;Quartz,Plagioclase,Hornblende,Biotite,Orthoclase,Opaque TEXTURE;GRANULITIC PLATE 11; PETROGRAPHY OF THE ADO EKITI GRANITE



CROSS POLAR(X80)



PLANE POLAR(X80)

Mineral Content;Biotite,Quartz,Microcline,Plagioclase TEXTURE;PORPHYRITIC PLATE 12; PETROGRAPHY OF THE ADO EKITI GRANITE

### DISCUSSION

In the Pie Chart (Fig.2),Quartz occurs at the highest percentage concentration (34.12%),while Orthoclase occurs at the least percentage concentration of (3.82%).Granites belong to such range of mineral composition .According to [1];in their classification of igneous rocks, phaneritic coarse grained granites are to have quartz, potassic feldspar,sodic feldspar as major mineral composition while muscovite,biotite, amphibole are expected to be minor with the rock having light coloured appearance.It is observed that the composition of the studied Ado Ekiti Granite is more or less similar to this . Most of the Thin Sections are Porphyritic in texture.It shows that the studied granite must be plutonic,solidifying deep underground [1].According to them,the Porphyritic Texture must have occurred when magma containing some large crystals changes environment by erupting at the surface making the molten pluton of the lava to cool quickly. Presence of tridymite and cristobalite is suspected in Slide 2 and 12 respectively.Some of the quartz in Slide 2 must have occurred as tridymite, in form of wedge shaped twinned crystals [11].Some of the quartz in Slide 12 must have occurred as cristobalite that is intergrown with plagioclase feldspar and the suspected opaque crystals (Slide 1-11).This occurrence of quartz as tridymite and cristobalite are unstable phases of crystallisation of silica. According to [12], their presence proves nothing as to the temperature of

Fed. Pole

crystallisation. Multiple twining is also exhibited in Slide 12.Presences of opaque crystals in trace amount are also observed in most of the slides.

#### FIGURE 1: Map of The Study Area

#### CONCLUSION

The studied deposit of granite at The Federal Polytechnic, Ado Ekiti would be good for quarry operation. The porphyritic texture coupled with the high amount of quartz and plagioclases would make the granite to be hard and resistance to weathering and erosion.

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