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# Petrology of Ibillo-Mangongo area of Igarra, Edo State, Nigeria

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## ABSTRACT

The study area lies within latitudes  $7^{\circ}24'5''N-7^{\circ}30'N$  and longitudes  $6^{\circ}00'E-6^{\circ}10'5''E$  in Igarra North-West of Edo State, Nigeria. It is underlain in the North by Precambrian Basement Complex and in the South by Cretaceous and Tertiary sediments. The field mapping and petrographic analysis of study area were carried out. Rock samples were collected from Ibillo, Lankpeshi and Magongo areas of the Northern fringe of Igarra. Field and petrographic studies of the area shows that the area is composed of mostly Gneiss-Migmatite complex and Metasediments. The metasediments, gneisses and migmatites are products of multiple periods of regional metamorphism that affected the ancient sedimentary series that covered study area. This metamorphism produced schists, quartzites and calcsilicates. Further metamorphism produced migmatites, gneisses and granites. Gneisses and Migmatites are polymetamorphic rock complexes. The gneisses can be classified into biotite gneiss and banded gneiss. The biotite gneisses show strong foliation and are widespread. The banded gneisses show alternation of light and dark bands.

Keywords: Petrography, Igarra, petrology, Nigeria

### INTRODUCTION

Petrographic study of igneous and metamorphic rock sample obtained from Igarra North-West area of Edo State, Nigeria were carried out (Fig. 1). The Igarra area lies within Latitudes  $7^{\circ}24^{\circ}5^{\circ}N-7^{\circ}30^{\circ}N$  and Longitudes  $6^{\circ}00^{\circ}E-6^{\circ}10^{\circ}5^{\circ}E$  at the northern fringe of Edo State, Nigeria and underlain in the north by Precambrian Basement Complex, and in the south by Cretaceous and Tertiary sediments. The northern part is rich in industrial and metallic minerals, which are currently at various stages of exploitation. The mineral components have strong effects on petrographic expression of the rocks. Detailed petrographic works involve the description of the mineralogical, textural and structural compositions of the rocks as well as the classification of the rocks.

**Location and Accessibility** Igarra lies in the northern part of Edo State and is the headquarters of Akoko Edo Local Government Area .The major highway in the area runs from Auchi through, Sobe Ogbe, Ikpeshi, Igarra to Ibillo. Both the old and new roads were used as access path for the exercise. There are also other major footpaths which are indicated in the accessibility map.

To classify the rocks encountered based on their mineral composition, texture and structure. To determine the petrographic characteristics of the hard rocks and to determine their petrogenesis based on their petrographic features.





Fig. 1: Geologic Map showing the study area

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### MATERIALS AND METHODS

**Geology of the Area** The major regional structural feature in the Igarra Formation is a series of anticlinal and synclinal overfolds with roughly north-south axis. The rocks of the Igarra Formation were affected by the pan African Orogeny which occurred between 700-750 Ma. There are some differences of folding exhibited by the metasediments, migmatite-gness and granite-gness complexes.

The rocks that occur in the Igarra area can be subdivided into three major groups;

a. Migmatite and biotite hornblende gneiss

b. Low grade metasediments (schists, calc-gneiss, marble, metaconglomerates and quartzites)

c. Syn-to late-tectonic porphyrite biotite-hornblende granodiorites, adamelites, charnokites gabbros, unmetamorphosed dolerite, pegmatite, aplite and syenite dykes-representing minor rock types.

The contact between the migmatites and the metasediments are fault-bounded in most cases. The metasedimentary succession in the Igarra Formation consists of:

a. Quartz biotite schist

b. Mica schist

- c. Marble and Calc-silicates
- d. Metaconglomerates

The presence of both calcareous rocks and conglomerates is peculiar to the Igarra schist belt which set it apart from other schist belts in Nigeria. These rock types together with quartzites, occur as bands in the dominant biotite schists. The gneisses at the margin of the metasediments may be a highly metamorphosed basal part of the sequence.

### Methods

(a) Field technique Reconnaissance and detailed field studies were carried out at the site. Field relationship between rock unit and selected exposures were given close attention. Study of rocks in hand specimen in the quarry pit provided a good basis for tentative identification of the rock samples using their mineral constituent, texture, and structures. General structure pattern and tectonic behavior was also studied in the quarry pit. Samples were collected at different locations at the quarry pit for thin section and petrographic analysis.

(b) Laboratory technique Laboratory work involves the preparation of thin section (horizontal and vertical section) from the rock samples gotten from the field. Thin section was examined with the help of photomicrograph to ascertain mineral compositions of the different rock samples. Thin sections are important because they provide undisturbed sectional samples of the rock that are not only effective for rapid identification of the common minerals present but are also particularly adapted for the study of their spatial relations and also grain size, texture and structure.

### **RESULTS AND DISCUSSION**

The result of the petrographic study of the 15 rock samples obtained from Ibillo, Lankpeshi and Magongo areas of the Northern fringe of Igarra are presented in table 1 and plates 1-4.

Sample No.	Sample Group/Location	Lithology, Rock description
1	GRP 2, Loc 4	Augen Gneiss
2	GRP 1, Loc 6	Banded Gneiss
3	GRP 1, Loc 15	Quartzite
4	GRP 2, Loc 3	Pigmatite-Gneiss contact
5	GRP 1, Loc 3	Gneiss
6	GRP 1, Loc 12	Banded Gneiss
7	GRP 2, Loc 7	Quartzite
8	GRP 2, Loc 1	Quartzite
9	GRP 1. Loc 3	Metaconglomerate

Table 1: Petrographic study of rocks sample obtained from Ibillo, Lankpeshi and Magongo areas of the Northern fringe of Igarra

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### (1) PLATE 1: AUGEN GNEISS

Augen, meaning "eyes", is a coarse-grained gneiss, interpreted as resulting from metamorphism of granite, which contains characteristic elliptic or lenticular shear bound feldspar porphyroclasts, normally microcline, within the layering of the quartz, biotite and magnetite bands [2,11]. The size of the augen eyelet is about 1cm. The rock contains aggregates of feldspar and quartz often a centimeter across each other, which are eye shaped. Some gneisses show local development of large clots, and these clots are referred to as augen [12,14]. Thus, such gneisses that contain them are referred to as augen-gneisses [6,10]. It also contain muscovite, biotite and hornblende.

### HAND SPECIMEN



### PHOTO-MICROGRAPH







(a) Handspecimen

# (2) PLATE 2: BANDED GNEISS

This is a coarse-grained irregularly banded crystalline rock with poorly defined schistosity. Banded gneiss often contains alternating bands of light quartzo-feldspathic minerals and dark ferromagnesian minerals (mica, amphibole and pyroxene) [2]. The thickness of the bands is variable. Gneiss displays compositional banding where the minerals are arranged into bands of more mafic minerals and more felsic minerals. This is developed under high temperature and pressure conditions. The grain size is about 2-3mm.

### Plate 2 (1-3)



(a) Handspecimen





(b) Photomicrograph

(b) Photomicrograph

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#### (3) PLATE 3: QUARTZITE

It essentially composed of tightly interlocking grains, with granoblastic textures of quartz and a little feldspar [4]. It appears quite similar to sandstone, and the best way to tell the difference is to break both the rocks, while sandstone shatters into many grains, quartzite breaks across the grains. Quartzite forms in two different ways. In the first way, under the high pressures and temperatures of deep burial, sandstone or chert recrystallizes resulting in a metamorphic rock. A quartzite in which all traces of the original grains and sedimentary structures are erased may also be called metaquartzite. A quartzite that preserves some sedimentary features is best described as a metasandstone or metachert [7]. The second way involves sandstone at low pressures and temperatures, where circulating fluids fill the spaces between sand grains with silica cement. This kind of quartzite, also called orthoquartzite, is considered a sedimentary rock, not a metamorphic rock, because the original mineral grains are still there and bedding planes and other sedimentary structures are still evident [8]. The grain size is about 1.5cm.

Plate 3 (1-3)





(a) Handspecimen

#### (b) Photomicrograph

### PLATE 4: PEGMATITE-GNEISS CONTACT

The rock below is a contact between igneous and metamorphic contact (gneiss and pegmatite). The Pegmatitic texture shows very large crystals, with some of them more than 1 m in length and 10cm in diameter. Pegmatite intruded the host rock, which is gneiss . A pegmatite is a very crystalline, intrusive igneous rock composed of interlocking crystals usually larger than 2.5 cm in size; such rocks are referred to as pegmatitic [11]. Most pegmatites are composed of quartz, feldspar and mica; in essence a granite. Rarer intermediate composition and mafic pegmatites containing amphibole, Ca-plagioclase feldspar, pyroxene and other minerals are known, found in recrystallised zones and apophyses associated with large layered intrusions [3,15]. Crystal size is the most striking feature of pegmatites, with crystals usually over 5 cm in size. Feldspar within a pegmatite may display exaggerated and perfect twinning, exsolution lamellae, and when affected by hydrous crystallization, macroscale graphic texture is known, with feldspar and quartz intergrown [13].

### Plate 4 (1-3)



(a) Handspecimen



(b) Photomicrograph

### DISCUSSION AND CONCLUSION

The contact between the migmatites and metasediments are fault-bounded in most cases. The metasedimentary succession in the Igarra formation consist of; Quartz-biotite-schist, mica-schist, marbles and calc-silicates and metaconglomerates [16]. These shows that the area is within metamorphic terrain. The present of both calcareous rocks and conglomerates is peculiar to the Igarra schist belt which set it apart from other schist belts in Nigeria. These rock types together with quartzites occur as bands in the dominant biotite schist [5,8,9]. The gneisses at the margin of the metasediments may be a highly metamorphosed basal part of the sequece.

Metamorphic rocks of Igarra North-West are distributed in the Basement Complex. They are mostly metasediments, gneisses and migmatites. They are products of multiple periods of regional metamorphism that affected the ancient sedimentary series that covered study area. This metamorphism produced schists, quartzites and calcsilicates. Further metamorphism produced migmatites, gneisses and granites. Gneisses and Migmatites are polymetamorphic rock complexes. The gneisses can be classified into biotite gneiss and banded gneiss. The biotite gneisses show strong foliation. The banded gneisses show alternation of light and dark bands.

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