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The Geology of Eshiawa in Igarra Area, Southwestern Nigeria.

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ABSTRACT

The Nigerian Basement complex has undergone polyphase metamorphism and polycyclic deformation during the Late Proterozoic and Early Phanerozoic Periods. The structures of the Pan- African belt in the southwestern Nigeria (Eshiawa area of Igarra) are the result of a succession of several events. Igarra environ provided detailed information on the structures and the following deformations were identified: (1) the original bedding surface (S0) undergoes the first episode of deformation (Di) and produced folds (Fi). This indicates an early Pan-African stage (Di) of tangential movement. (2) Mineralogical banding (Si) produced in first episode of deformation (Di) undergoes second episode of deformation (D2) to produce disharmonic folds (F2). (3) The axial plane cleavage (S2) formed as a result of second episode of deformation undergoes third episode of deformation (D3) to produce asymmetric folds (F3). D2 phase is heterogeneous simple shear in dextral transpressive context and D3 tectonic phase, also marked by dextral transpressional movements, is the phase of superposed folding with a NNW-SSE, kinematics direction. D2 and D3 are associated with medium-grade amphibolites facies metamorphic. (4) The Fourth episode of deformation (D4) is responsible for the emplacement of granitic veins, faults and joints. The first three episodes of deformations were related to ductile deformation while the latter was related to brittle deformation. The similarities of these last phases with the central Cameroon shearzone suggest that the D3 and D4 stages are controlled by transcurrents tectonics. Transpressive tectonic seem to be the main deformation style in major shear zones of Igarra.

INTRODUCTION

Eshiawa area is part of Igarra environ situated in Southwestern, Nigeria. The study area forms part of Precambrian Basement Complex of the Igarra Schist Belt (Jacobson et.al, Hurley 1966, Rahaman 1970, 1971, 1973), which lies to the rest of the West African Craton

(Fig. 1). It is located within longitudes 6°00'E - 6°15'E and latitudes 7°081N-7°15'N. The area has elevation of about 200m to 850m.

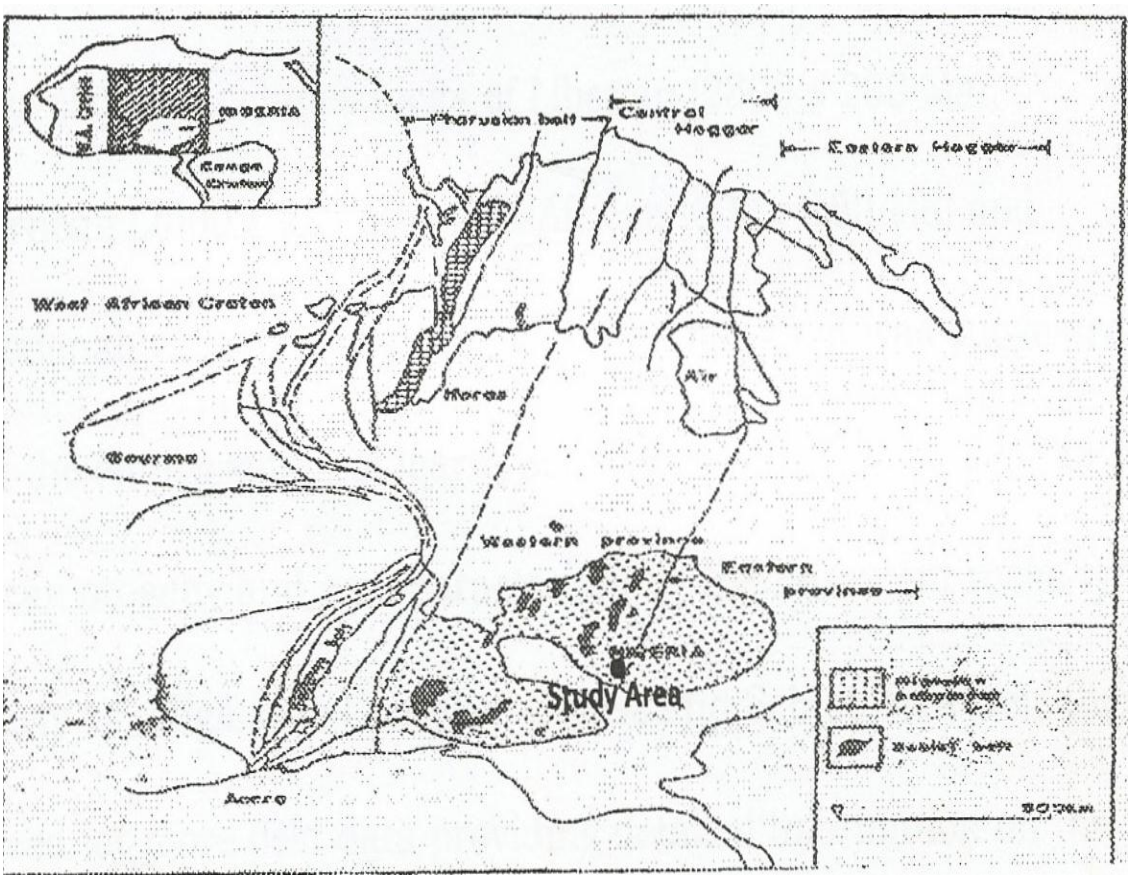

FIG. 1: GENERAL1ZD GEOLOGICAL MAP OF THE PAN-AFRICAN BELT EAST OF WEST- AFRICAN CRATON REFLECTING THE STUDY AREA (MODIFIED FROM CABY ETAL.1981)

Evidence from the eastern and northern margins of the West African Craton indicates that the Pan-African belt evolved by the plate tectonic processes, which involved the collision between the passive continental margin of West African Craton and active continental margin (Pharusian belt) of Tureg shield about 600 Ma ago (Burke and Dewey, 1972; Leblanc, 1976; 1981; Black et al; 1979; Caby et al; 1981). The collision at the plate margin is believed to have led to reactivation of the internal region of the belt. The Nigerian basement Complex lies in the reactivated part of the belt.

Radiometric ages indicate that the Nigerian basement is polycyclic and includes rocks of Liberian (2800 ± 200 Ma), Eburnean (2000 ± 200 Ma), Pan-

African (600 ± 150 Ma) and questionably, Kibaran (1100 ± 200 Ma).Though, it was suggested that the emplacement of igarra Schist Belt span within the Pan African Orogeny and are characterized by the Basement rocks types namely as, Migmatite Complex, Gneiss and Schist. However, there is need for more field data providing detailed information on the structures and the timing of deformation.

This research work therefore, seeks to give a comprehensive description of rocks types in Eshiawa area of Igarra Schist Belt.

Toward this aim, an attempt is made to interpret the tectonic activities that gave rise to the structural elements, using the orientations of the rock structures.

AIM AND OBJECTIVES

This exercise is aimed at equipping the researchers with detailed geologic mapping fact as it relate to the field, to recognize the different rocks types, their field relations on the area covered.

LOCATION AND ACCESSIBILITY

LOCATION: Igarra is the headquarter of Akoko- Edo Local Government area of Edo State. The study area covers north-western part of Igarra. It lies approximately between longitudes 6°00'E -6°15'E and latitudes 7°08'N-7°15'N.

ACCESSIBILITY: Both the Old (Unemenakhua rd) and (Aiyegunle Eshiawa rd) New roads were used as access path for the exercise. There are also major foot paths at Unemenakhua, Ugboshi-Ele, Ugboshi-Oke, Aiyegunle, and Eshiawa that were also used as access path during the mapping exercise. Those areas that were not easily accessible were reachable using cutlass.

VEGETATION: Vegetation in Nigeria ranges from thick forest types in the southernmost parts of the country to grassland type in the northernmost part. The vegetation of study area lies within tropical rainforest (Fig. 2). It is prolific and ever green, though some trees may be shedding leaves while others are growing fresh ones. In the study area, the entire forest is displayed in three storeys as follow:

- A ground storey made up of 3-6 meter high herbs and shrubs
- A dominant middle storey which consists of tree 18 to 24 metres tall, and possessing robust branches and dark green foliage
- A top storey comprising tall tree like Iroko, Obeche, Sapele and tropical cedar (Iloeje, 1975). Therefore, this study area which is underlain by basement rocks is dominantly forest.

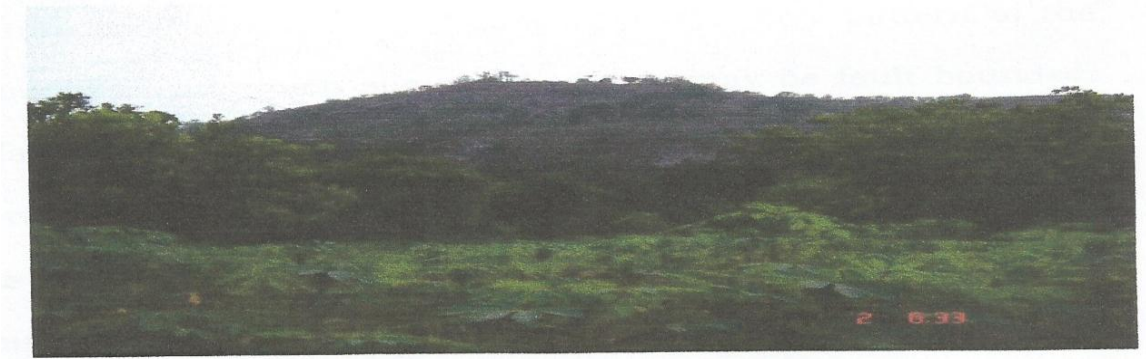

FIG. 2: SHOWING VG€TATION OF STUDY AREA

SOIL TYPES: The soil types in the study area are characterized as forest soil (Iloeje, 1975). They are essentially sandy, clayey and alluvial sands, which favour farm-cropping activities. Laterite and superficial deposits are common features in the area. Superficial deposits are sandy and clayey soils. The gravelly (mainly quartz and feldspar) sandy soil is dominant due to the basement terrain of the study area.

METHOD OF STUDY

In this study, classical field methods were used. The major tectonic structures are recognizable at a metric or centimetric scale and their orientation (strike and dip) were measured and the data statistical analyzed using steronett. The deformation history and kinematic analysis of the study area were deduced from the field study and detailed mapping of foliation and lineation were done. Sketches of the outcrops and other geologic structures were made in the field. The study was carried out in three phases, namely;

i) Field work
ii) Laboratory studies
iii) Interpretation

The field mapping exercise, which was done and lasted for six days. During the trip, we familiarized ourselves with the area using the topographic map and then carried out detailed mapping exercise of the area.

Various equipments for field work in geology were used and they include:

(a) TOPOGRAPfflC BASE MAP: This contains detail of the area at an approximate scale. In this case our base map scale was 1:40,000, this is used to locate and plot outcrops and also it is used for location of oneself on the field at any given point in time and contains sufficient contours of the different elevation depicting ridges, hills, valley, cliffs (high and low), roads, footpaths, rivers and river channels, bridges and settlements.

(b) COMPASS CLINOMETER:. **GEOLOGICAL HAMMER**: **SAMPLE BAG**:.**MAGNIFIING LENS**: (f) **MEASURING TAPE AND RULERS**: FIELD NOTEBOOK, PENS AND PENCILS:

In the laboratory, the work was mainly on thin section preparation and petrographic studies of the crystalline rocks.. The last phase of this study involved interpretation of the results and preparation of the final report in this form.

GEOLOGICAL SETTING AND PREVIOUS WORKS

The study area is part of Igarra Southwestern Nigeria (Fig. 3). The geological setting of the study area can best be understood by discussing the evolution of the Nigerian basement during the Pan African orogeny and by implication of the regional and tectonic setting of West Africa.

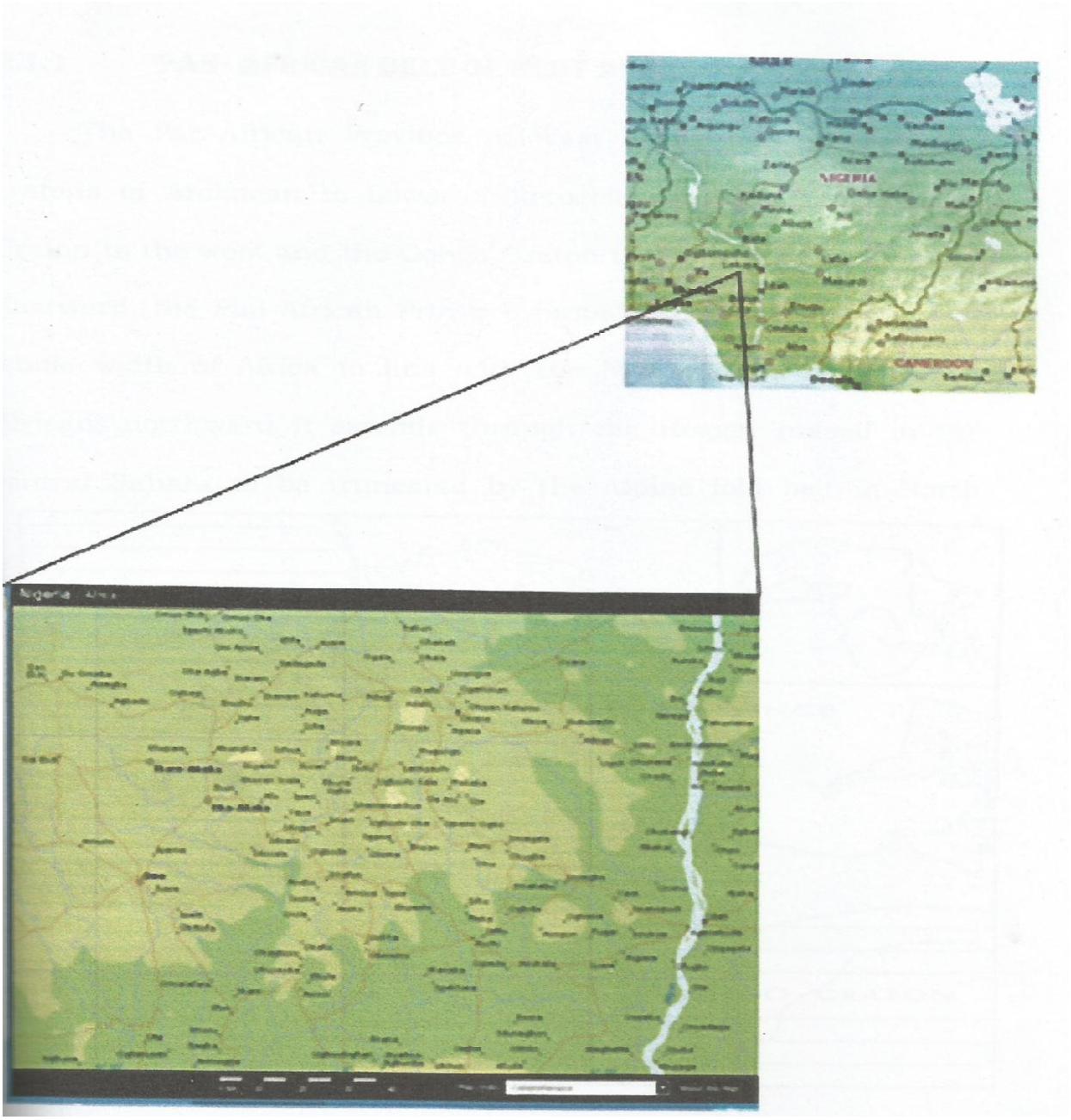

Figure 3; Showing Location Map of the Study Area

TECTONIC SETTING OF IGARRA SCHIST

The basement rocks of the Igarra schist belt represent a high grade metamorphic terrain with polyphase deformation. The metamorphic rocks are mainly migmatites, gneisses and schists with subordinate amphibolites, cataclasites and quartzites (Fig. 5). And the deformation has caused folding, refolding, faulting, foliation and shearing of the metamorphic rocks with mainly N-S to NE-SW trends in conformity with other parts of the reactivated Basement

Complex of Nigeria (Rahaman 1971, 1973, Odeyemi 1976 etc).

Intrusive into the metamorphic rocks are aplites, charmockitic rocks, granites, pegmatites, and dolerites. Post emplacement tectonic-metamorphic processes of Pan-African event have somewhat modified the primary features of some of the granites, which show weak post emplacement tectonic metamorphic foliation, especially when viewed under the microscope. Changes in mineral paregenesis of those set of granites in the later event are suggested by presence of garnet, which is diagnostic of post intrusion mineral changes.

The study area is formed of two distinct lithotew. sets, a metamorphic assemblage and a magmatic unit. The mtzphic assemblage is composed of banded amphibolites, fimt-r2ried amphibolites and gneisses. The magmatic set comprises bcegranites, hornblende, and orthogneisses which have been intruded by aplitic veins. The host rocks were deformed during four main tectonic phases.

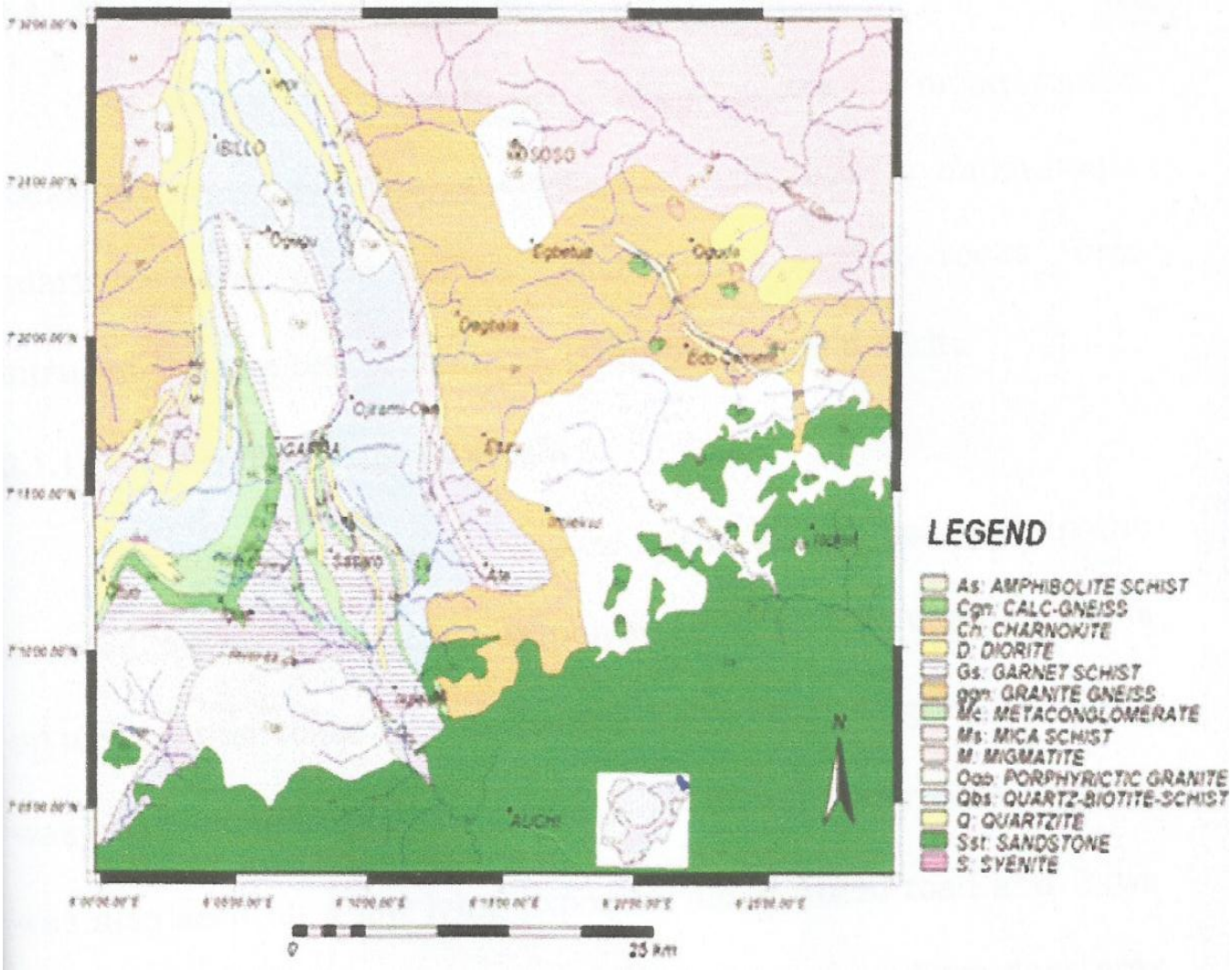

FIG 5: THE GEOLOGICAL MAP OF THE STUDY AREA (MODIFIED AFTER ODEYEMI, 1977).

RESULTS

FIELD DESCRIPTION OF THE ROCKS

The major rock units in the study area are the metamorphic rocks mainly migmatites, gneisses and schists with subordinate quartzites and amphibolites. These metamorphic rocks were intruded by granites, pegmatites, lamprohyre and dolerite

MIGMATITE GNEISS COMPLEX

The migmatite gneiss complex is the oldest rock type in the mapped region. They occur as polycyclic basement complex rocks on which other rocks were deposited. The migmatite gneiss complex was seen at the beds of river Osse and Ekpeshi near Sebe Ogbe. It was also seen on a low lying exposure along Auchi road and Bawa hill. The migmatite gneiss complex varies in colour from dark grey to pinkish (Fig. 6)

FIG. 6: SHOWING MIGMATITE GNEISS COMPLEX AT RIYER OSSE NEAR SEBE OGBE

SCHIST

The schist which is the country rock occupy most of the lowlands particularly in Igarra, Uneneme-nekhua, Ugboshi-Ele and some parts of Eshiawa form roof pendant. They are fine-medium grain rocks.

Mineralogically, they are quartz-biotite schist with some occurring close to the granite ridge migmatised (migmatised schist), while others are unmigmatised schist. The unmigmatised schist is foliated and consists of clear mineralogical banding involving the alternation of dark and light band minerals which define a general NW-SE trending foliation plane of the quartz-biotite schist, typically; they are melanocratic, fine grained

GRAN1TES

The granites form distinct topographic features and they are found as intrusive rocks in the metasediments exhibiting in some places sharp contacts with the country rocks which are the schists.

The granites are porphyritic. These porphyritic granites are referred to as the Igarra plutons and ranges from pinkish granites (colouration) to biotite granites and most common of the older granites rocks observed particularly in Aiyegunle and some parts of Eshiawa. The granites are elliptical in shapes with megascopic biotite crystals. Compositionally, these porphyritic granites are composed of large feldspar crystals set in groundmass of quartz and biotites.

The pinkish granites have a high amount of orthoclase feldspar which gives them pinkish colouration. The biotite granites have more of porphyritic granites which are non-foliated because of the feldspar megacryst are arranged haphazardly within the groundmass of the rock. There is noticeable increase in size and alignment of feldspar from the margin of the granites body (where it is in contact with the schist which is the country rock) to the core with a corresponding reduction in the size and alignment of the granites. The porphyritic granites are called Older Granites forming a dome shape in the study area. There is pronounced weathering of the granites mainly by exfoliation.

QUARTZITE

Quartzite is abundant in the study area and it is highly weathered in most places, hence it is seen as rubble. Quartzite was seen in places like Ugboshi— Sale, Aiyegunle and outskirts of Eshiawa. Some outcrops of quartzite are low lying and others are high. The colour varies from yellow to reddish brown. The grain size range from fine grain to coarse grain. Quartzite is foliated and the foliation is characterized by mineralogical banding and lithological banding. its mineralogy is mainly quartz, muscovite, plagioclase, feldspar and opaque mineral. The angle of dip of quartzite varies and this variation in dip results from shearing, which produced boundinage and million structures.

PEGMATITE

The pegmatite found at the northern part of Eshiawa, they occur as dyke and within the upper portion of the granite as podlike structure which are fairly small. The pegmatite are composed of very coarsed grained k-feldspar with some measuring up to 0.8cm, coarsed quartz and micas both muscovite and biotite. Pegmatite dykes grains are not coarsed as those of the pegmatite bodies.

The pegmatite occurring as podlike bodies in the granites indicate that there was a stage of slow cooling

during the crystallization of the granite. The pegmatite occurring at the lower part of the ridges are coarse than those occurring at the top of the granites ridge which therefore indicate that the mode of cooling was not uniform. The pegmatite dykes cut across both schist (migmatised and unmigmatised). The pegmatite bodies and dykes are leucocratic in colour.

METACONGLOMERATE

Metaconglomerate are fairly extensive and occupy the lower part of the study area. It was observed at Unemenekhua and I suggested to form an inferred boundary with schist. It underlies the western and eastern region of Igarra. The metaconglomerate in Igarra were formed as a result of metamorphism of basal conglomerate (Fig. 8). Its colour ranges from light to dark grey and

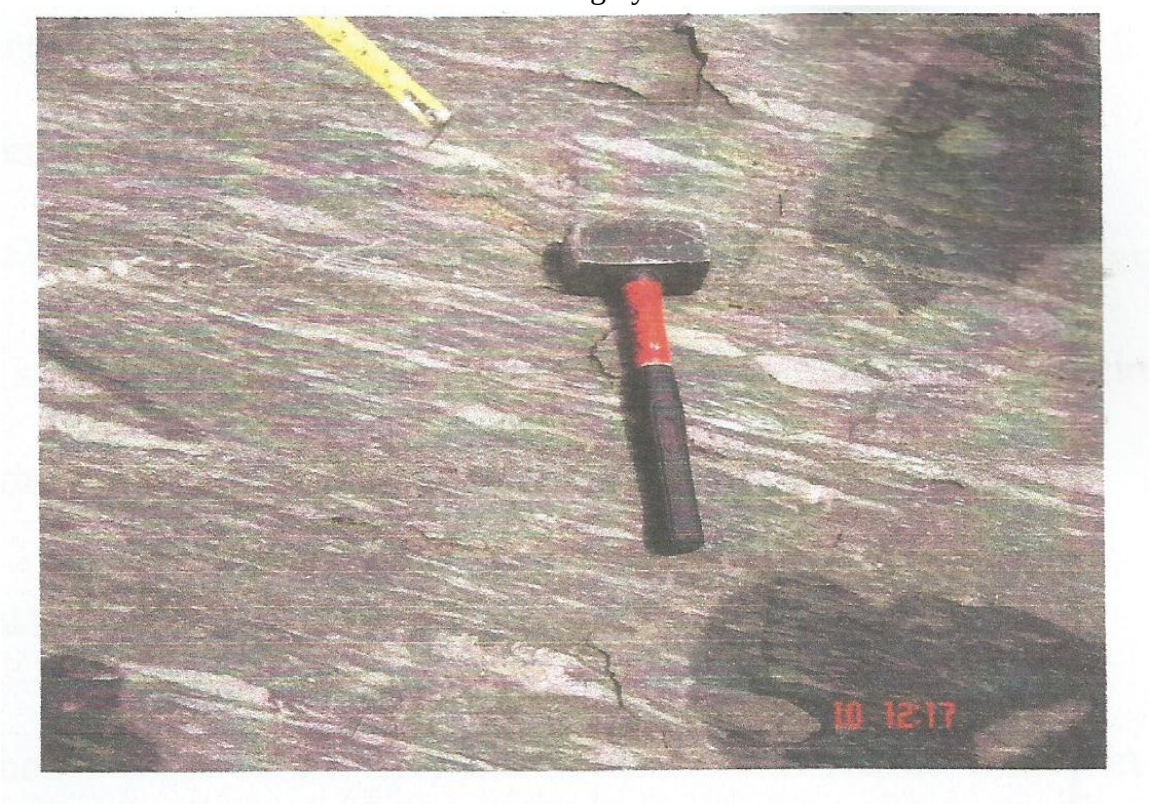

FIGURE 8: SHOWING METACONCLOMERATES AT UNEMENEKHUA

The texture of metaconglomerate is described in two parts:

> **THE MATRIX**: It is made up of pebbles of varying size. The pebbles vary in sizes from 0.3 to 9cm in width and 0.5 to 29cm in length. The degree of sorting and average grain size varies from outcrop to outcrop. The varying shapes of the pebbles range from angular-ovoid-elongateeffiptical to sub rounded are indicative of the transformational and deformational history of the pebbles. The Angular pebbles suggest a short distance of travel while the sub-rounded one shows a longer distance of travel from the parent source. The elongate pebbles have been subjected to some degree of stretching to form a linear fabric generally trending N-S.

> **THE CLAST**: Most of the metaconglomerates in the regional mapped are matrix supported. Metaconglomerate is foliated and the foliation is defined by mineralogical and lithological banding.

AMPHIBOLITE

Amphibolite is a small irregular lense and xenolith found in the biotite-gneiss observed at Ugboshi-Ele (Fig. 9). It is dark-grey in colour and its orientation of the inclusion is discordant to the biotite-gneiss. It is mainly composed of fine-grained texture.

FIG.9: SHOWING AMPHIBOLITIES AT UGBOSHI-ELE

In this research work, the results of geological map and kinematic analyses show that the complex geometry of Eshiawa area, the basement rocks of the Igarra schist belt represent a high grade metamorphic terrain with polyphase deformation. The metamorphic rocks are mainly migmatites, gneisses and schists with subordinate amphibolites, cataclasites and quartzite. And the deformation has caused folding, refolding, faulting, foliation and shearing of the metamorphic rocks with mainly N-S to NE-SW trends in conformity with other parts of the reactivated Basement Complex of Nigeria .

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