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Research Paper

The Geology of Aiyegunle and Its Environs in Akoko Edo, Western Niger Delta

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Abstract
Aiyegunle and its environs lies within latitude N 007 21'1 10.4'' and longitude E 006 04' 51.3'' and is part of Igarra schist belt, southwestern Nigeria. It is situated at the northern flank of Akoko-Edo local government area of Edo State, Southwest Nigeria. The study area forms part of the Mesozoic Older Granite Complex, which intruded the Pre-Cambrian Crystalline Basement. The study area is composed of porphyritic biotite granite, dolomitic marble, schist and pegmatite occurring as dyke. Petrography reveals the rock units of having quartz, plagioclase, microcline, orthoclase, biotite, hornblende, etc. as rock forming minerals. Structural features such as; joints, fractures, veins, and dykes were observed in the study area, and the rugged large individual boulders that characterized the study area. Joint patterns in the study area have a dominant SW trend.
Key words *(Schist belt, Crystalline basement, Petrography)*

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I. Introduction

The field mapping exercise took place at Aiyegunle within latitude N 007 21'1 10.4'' and longitude E 006 04' 51.3'' axis of the northern flank of Akoko-Edo, Western Niger Delta and is underlain in the north by Precambrian Basement Complex as well as cretaceous and tertiary sediments in the South. The petrographic study of the rock samples igneous and metamorphic obtained from the field was conducted. Egesi et al., (2012) holds that the northern part of the basement complex is rich in industrial and metallic minerals, which are currently being exploited at various phases of exploitation operations.

Aim and Objectives
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.

Location and Accessibility
Th mapped study area was very accessible because it has a good network of road and lots of footpaths. Aiyegunle lies between latitude **N 007 21'1 10.4''** and longitude **E 006 04' 51.3''** in the Northern part of Edo State and is the headquarters of Akoko Edo Local Government Area. It is situated at the northern flank of Akoko-Edo Western Niger Delta. 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 (Odeyemi et al, 1976).

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Bush burning and farming done in some areas also helped in making the area quite accessible. There are also other major footpaths which are indicated in the accessibility map.

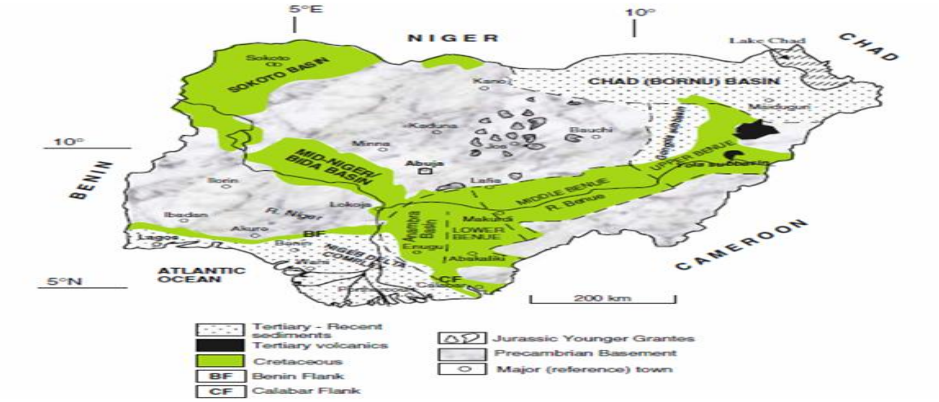


Figure 1: Geologic map of Nigeria (Obaje, 2009)

Climate and Vegetation

Generally, the climatic conditions of the environment of Aiyegunle fall in line with the warm-horrid tropical climate region, where the wet and dry seasons are noticed in the area. The dry season occurs during the time space between November and February while the rainy season come into play from April to October. Aiyegunle has a humid climate. Akoko-Edo lies in the Guinea savannah vegetation belt. In the vegetation of this area, natural vegetation is being altered and agricultural crops such as maize, yam, cocoa, etc. are grown.

Relief and Topography

The area is made up of undulating high and low reliefs. Generally, the highest point in the area is 415m, and the lowest point is 201m (Rahaman et al, 1971) . The highlands vary in sizes and shapes from ridges which can be traced for several kilometers to dome. Some of the rocks appear as low lying outcrops (mostly shicst) which are less resistance to weathering and so easily weathered and eroded to the low lying regions while the ridges and isolated hills are composed of more resistant rocks like granite.

Population and Occupation

The geological area of Aiyegungle is sparsely populated and most of the inhabitants are farmers and other, hunters that set dangerous traps. The farmers grow crops such as yams, cassava, melon, cocoa and sugar cane. Most of the farmers were located near streams. The inhabitants have two major types of settlements nucleated and dispersed. It is more of linear nature following the trend of the road network. The building patterns are mainly huts, out dated muds houses and modern buildings made of bricks.

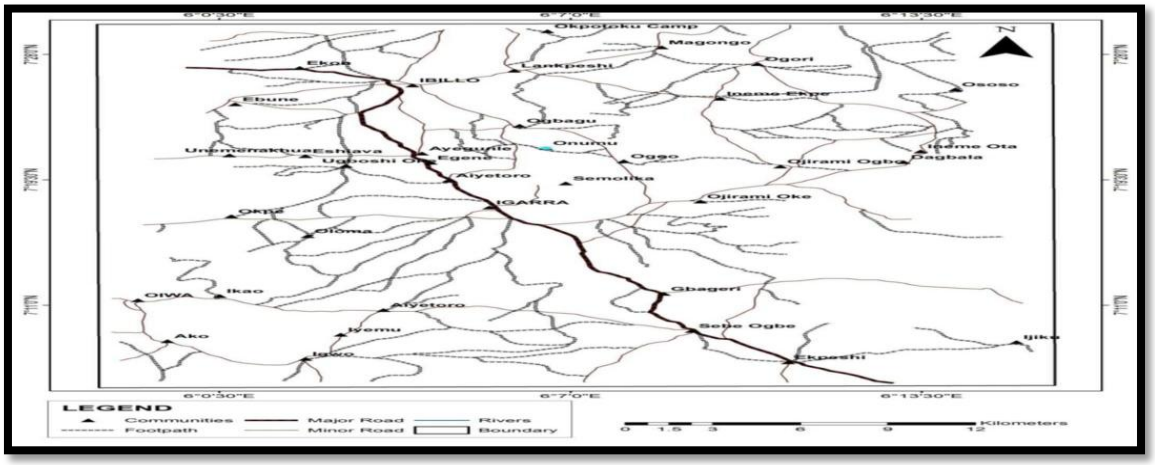


Figure 2: Topographic map of Igharra

II. Materials and Methods

Field Procedure

Before embarking on the mapping, a proper review of the study area was done. The topographic map of the area (Osi Aiyegunle) on a scale of 1:12500, was then used as a base map in the field. Traverses were taken along and

across the major outcrops during mapping. The locations of each station (longitude and latitude) were determined using the global positioning system (GPS) device and photographs were taken using camera, some sketches were made where necessary in a field notebook. Measurement of strike and dip of faults and joints and also trending direction of quartz veins on rock outcrops were taken with the aid of a compass clinometer.

III. Presentation of Results

Petrographic Study was carried out on each of the rock samples

a. Microscopic analysis was conducted under a polarizing microscope. The properties of minerals under plane and cross polarized light were studied.

Where: A=Quartz, B= Microcline/ K feldspar, C= Biotite, P= Plagioclase

The optical features of the various minerals observed are thus described below;

Biotite:can occur in distinctive plates. The observed mineral had moderate relief and a perfect cleavage in plane polarization. It reflected brown when subjected to plane polarization but pleochroic from brown to yellow. It is brownish in cross polarization with a parallel extinction.

Quartz: occurs as an anhedral, colorless crystals having a low relief in plane polarization, it is whitish in cross polarization and shows undulose extinction.

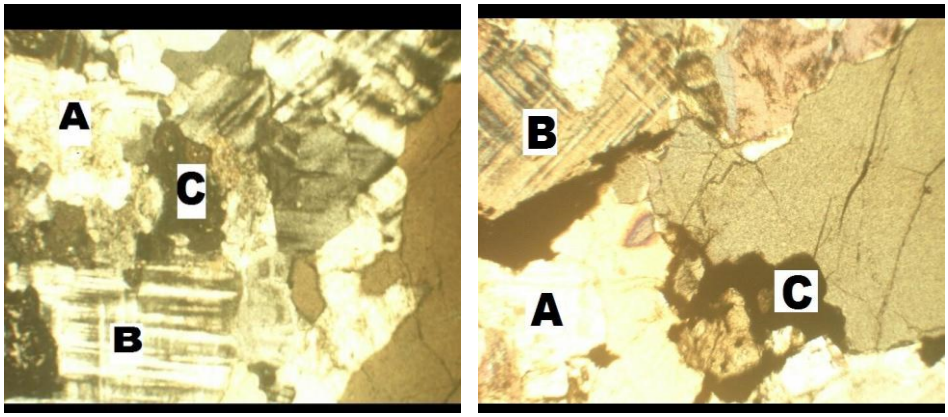
K feldspar/ Microcline: occurs as a tabular sub-hedral crystals that are cloudy in plane polarization. It is greyish in color in cross polarization and has an oblique extinction

Plagioclase: occur as a prismatic colorless crystals having a low relief in plane polarization, it is a grey yellow interface in cross polarization

Porphyritic Biotite Granite

This rock is medium to coarse grained and pinkish to grey in color. The exposure is quite extensive and covers an area of approximately 0.3km. the rock is massive and occur as continuous ridges. The rock had pinkish minerals which were also fleshy with cleavage and so were suspected to be k-feldspar (microcline), with light colored minerals without cleavage but vitreous and conchiodal in fracture (quartz) were also observed, these minerals are dominant over the dark colored, flaky, vitreous ones (biotite) (Oyawoye et al 1967).

The rock exhibits porphyritic textures which have resulted from two stages of cooling. It also contains xenoliths of dark colored rocks. Some of the xenolit9hs had formed depressions in the rock due to differential weathering. It is to be noted that the xenoliths must have engulfed during emplacement of the intrusive rock.



A= Quartz, B= Microcline, C=Biotite

Plate 1) a) Porphyritic Biotite Granite Under Plane Polarized Light (Mag. 10x) b) Porphyritic biotite granite under cross polarized light (mag. 10x) (Paik, 2017).

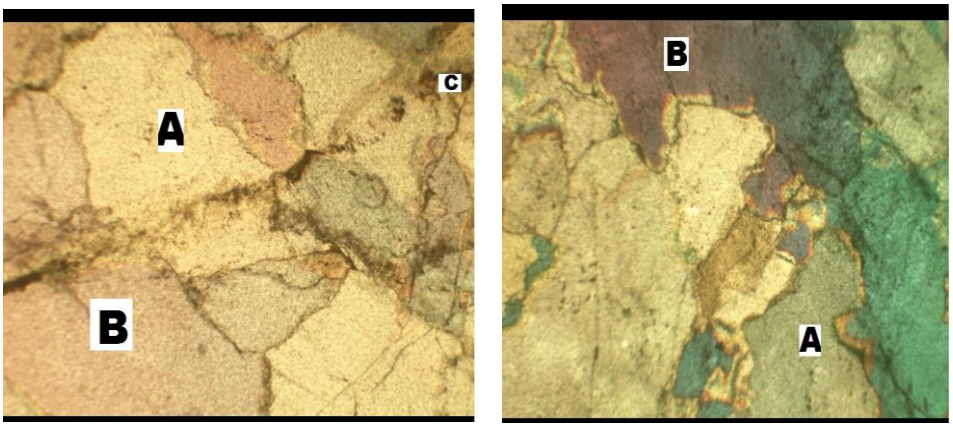
b. Pegmatites

The Pegmatites found in the plot occur both as dykes and in granite as pod like structure which are fairly small. The Pegmatites are composed of very coarse grained k-feldspar with some measuring up to 0.8cm, coarse quartz and micas both muscovite and biotite. Pegmatite dykes' grains are not coarse as those of the pegmatite bodies.

The pegmatite occurring as pod like bodies in the granites indicate that there was a stage of slow cooling during the crystallization of the granite (Blatt et al, 2005).

Observations showed that pegmatites occurring at the lower part of the ridges close to Iretutu secondary school are coarser than those occurring at the top of the granite ridge which therefore indicates divergent rate of cooling. The pegmatite dykes cut across both schist (migmatised and unmigmatised). The

pegmatite bodies and dykes are leucocratic in color and are distinguished from other bodies which they occur together with by their color.

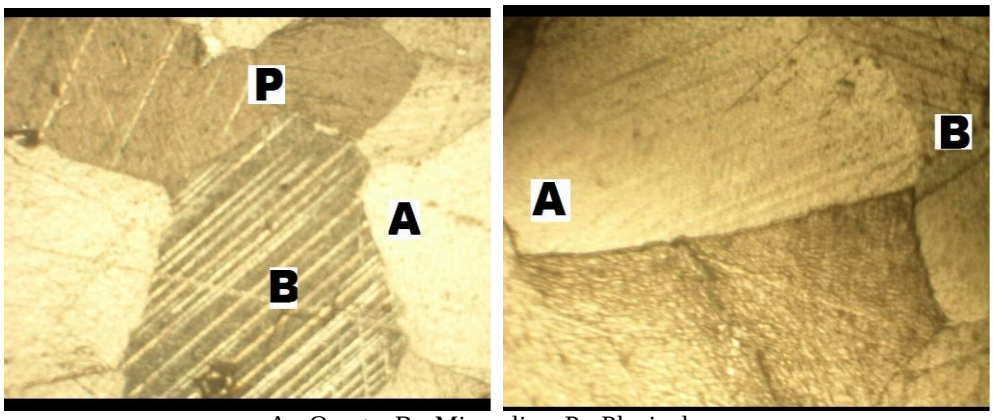


A= Quartz, B= K- feldspar, C=Biotite

Plate 2: a) Pegmatite under Plane Polarized Light (Mag. 10x) b) Pegmatite Under Cross Polarized Light (Mag. 10x).

c. Dolomitic Marble

Recrystallized dolomitic limestone or dolostone producing interlocking grains of dolomite. ($CaMg(CO3)_2$). It is virtually green in color, and a translucent mineral consisting of a carbonate of calcium and magnesium, which may also contain iron, it has a conchodial fracture, pearly luster and is poorly soluble in dilute Hcl, (Egbuniwe et al, 1978).

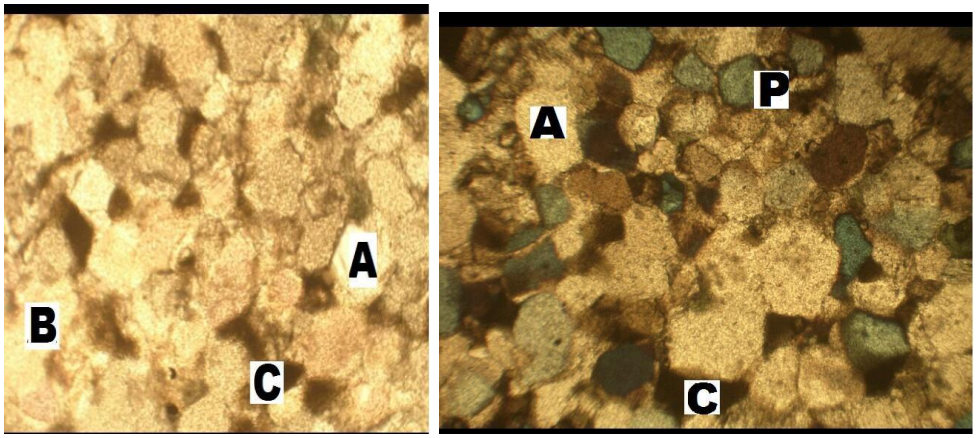


A= Quartz, B= Microcline, P= Plagioclase

Plate 3: a) Marble Under Cross Polarized Light (Mag. 10x) b) Marble Under Plane Polarized Light (Mag. 10x)

d. Schist:

The schists were found both on the lowland and the ridges, they form both conical and round top hills. They were identified to be fine to medium grain rocks. The schists are quartz– biotite schists with some occurring close to the granite ridge migmatised (migmatised schists). These schists are foliated and consist of clear mineralogical banding involving the alternation of dark and light band minerals which define a general NW – SE trending foliation planes of the quart – biotite schists (Annor et al,2005). Typically, melanocratic, fine grained with dark and grey bands. The thickness of the individual bands varies between few millimeters. The darker bands contain more biotite than the lighter ones. The lighter bands contained quartz giving rise to granulitic texture while the biotite is responsible for the foliation. The migmatised schists consist of granitic bands, gneissic bands, quartz and muscovite (Ajibade et al,1988). Their general trend is 330° - 355° in the azimuth while their dip varies between 68° and 80°. Their contact with the granites is sharp with some migmatised.



A= Quartz, B= Microcline, C=Biotite

Plate 4: a) Schist Under Plane Polarized Light (Mag. 10x) b) Schist Under Cross Polarized Light (Mag. 10x).

Structural Geology

Table 1: Strike and Dip readings taken at Study Area

STRIKE	DIP
N181°S	N56°W
N177°S	N54°W
N180°S	N50°W
N183°S	N45°W
N182°S	N34°W
N178°S	N58°W
N184°S	N56°W
N182°S	N58°W
N188°S	N48°W
N200°S	N60°W
N188°S	N60°W
N174°S	N60°W
N192°S	N42°W
N190°S	N54°W
N212°S	N46°W
N196°S	N64°W
N182°S	N52°W
N168°S	N56°W
N184°S	N54°W
N186°S	N55°W

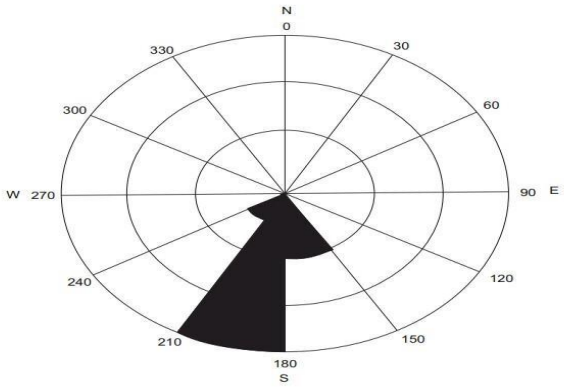


Figure 2: A Rosette Diagram Showing the Dominant Trend of Joint Pattern

DIRECTION	NUMBER OF MEASUREMENTS
150-180	4
180-210	15
210-240	1

NUMBER OF MEASUREMENTS = 20
NUMBER OF DATA PLOTTED = 20
DOMINANT TREND = SW

IV. Discussion

Structures

During the mapping exercise, many structures were observed on the plot. The study of structures on rock exposures, aided in deciphering the geologic history of the area. The age relationship of the different rock types observed were determined and the type of metamorphism that gave rise to the different rock types is also known. The structural elements observed include; folds, foliation, joints/fractures, veins, dykes.

Folds

Normal and disharmonic fold were mostly observed which were micro and had decrease in intensity and frequency as the distance away from the granitic bodies identified increased. These geologic events suggest that the fold are genetically related to the granite or may have been modified by the emplacement of the granites (Annor et al, 1998) .

Plate 5: Quartz Biotite Schist Showing Folds

Foliation

Foliation represents parallel orientation of platy minerals. This is the primary feature in some rock inherited from the time of their formation. Foliation when exhibited in schists are called "schistocity". Schistose rocks were observed and its schistocity were well defined on the migmatised and unmigmatized schist (Turner et al, 1983). The strike and dip of the foliation planes in the schists in the study area had a general trend of NW-SE direction.

Plate 6: Quartz Biotite Schist Showing Schistosity (A Hihger Form of Foliation)

Joints and Fractures

They occur as cracks on rock outcrops without any relative displacement of blocks, as some of the joints/fractures seen ran parallel to the foliation plane of the schists, while others cut across it. Some of the joints have been refilled with secondary minerals or by recrystallization of the original minerals (Fitches et al, 1985). Fractures observed in the intrusive igneous rock can be attributed to exposure of granitic plutons to surface temperature and release of over burden pressure.

Plate 7: Joint on a Porphyritic Biotite Granite

Plate 8: A Fractured Schist

Veins

Veins of quartz, granitic materials and pegmatites were observed to run along weak foliation planes on the schistose rocks. Some of the veins cut across the foliation directions. Some are highly fractured and folded. Most of them occur as fillings in the joints and fractures. The width of veins was measured to range from 2.5mm to 20cm with lengths exceeding 4 meters.

Plate 9: A Quartz Vein On a Quartz Biotite Schist

Dykes

Dykes are tabular or sheet-like bodies which are discordant to the country rock in which they occur (Pearce, 1984). The dykes were believed to be emplaced during the last phase of the Pan African Orogeny. In the study area, pegmatite dykes were distributed and observed on the basement rocks. The thickness varied from 3cm to about 1.5m. The structural trends of the dykes in the area were identified to be NW-SE and N-S directions.

Plate 10: A Pegmatite Dyke

V. Conclusion

The following conclusions were hereby made; The study area is composed of; porphyritic biotite granite, dolomitic marble, schist and pegmatite which occurs as a dyke. The rocks of the study area tend to depict certain characteristics that reflect the impact of geologic events such as plate tectonism, chemical and mechanical weathering with volcanic eruptions. These geologic actions gave rise to the structural geology of the area shaping the rock formations. Their impact also gave influence to the mineralogy and elemental makeup of the area which made it rich in materials and mineral resources of fairly economic potentials and raw materials for construction purposes. These rocks belong to the basement complex rocks of South Western Nigeria. The structural trends observed in the study area are influenced by the structures in the basements rocks.

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