300 LEVEL FIELD WORK REPORT

ON THE FIELD MAPPING AND DESCRIPTIVE

ANALYSIS AND RELATIONSHIP OF GEOLOGIC FEATURES IN

IGARRA, AKOKO-EDO LOCAL GOVERNMENT

AREA, EDO STATE, NIGERIA.

SUBMITTED TO THE DEPARTMENT OF GEOLOGY, FACULTY OF PHYSICAL SCIENCES,

UNIVERSITY OF BENIN, BENIN CITY

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PRESENTED BY

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GROUP 2/PLOT 2

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I embarked on this fieldwork exercise with the opportunity of being surrounded by a remarkable network of individuals whose unwavering support greatly contributed to the success of this project.

First and foremost, I acknowledge God for bringing me this far. I also express my sincere gratitude to my lovely and supportive parents and siblings, whose words and deeds have been a great source of encouragement.

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Last but not least, I acknowledge the support of my group members and colleagues, including the SLT students, for their assistance and valuable contributions toward the success of the field exercise.

Thank you all.

DEDICATION

I dedicate this report to God Almighty for His guidance, protection, and grace in making this work possible.

I also dedicate this report to Mr. and Mrs. Daniel, my loving and supportive parents, who have been a constant source of encouragement and strength throughout my academic journey.

ABSTRACT

This fieldwork exercise was carried out in Igarra within the Nigerian Basement Complex terrain to provide practical training in geological mapping, rock identification, structural analysis, and field observation techniques. The exercise involved detailed study of various rock units, their mineralogical composition, textures, structures, modes of occurrence, and geological relationships.

Rock types identified during the exercise include quartzite, schist, metaconglomerate, granite, pegmatite, aplite, hornfels, sandstone, shale, mudstone, claystone, siltstone, and fault breccia. Structural features such as foliations, folds, fractures, joints, shear zones, and intrusive contacts were also observed and interpreted. Evidence of regional metamorphism, contact metamorphism, brittle deformation, and igneous intrusion associated with the Pan-African Orogeny was recognized within the study area.

The field exercise was supervised by lecturers from the Department of Geology, who guided students in structural measurements, rock description, geological interpretation, sedimentary logging, and geological mapping techniques. The exercise enhanced practical understanding of the geology, hydrogeology, engineering significance, and economic importance of rocks within the Nigerian Basement Complex.

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7. Compass clinometer
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9. Global Positioning System(GPS)

CHAPTER ONE

1.1 INTRODUCTION

Field Geology is a vital and mandatory aspect in understanding the Earth's geological processes and evolution. Without field geology, our understanding of how the Earth works and the forces that have influenced its evolution would be incomplete. Field geologists investigate rocks and rock materials in their natural environments, especially at outcrops, exposures, landscapes, and drill holes, because these features provide a clearer understanding and interpretation of the Earth's subsurface.

The proficiency of a geologist is largely measured by the ability to draw reasonable conclusions from observed geological phenomena and to predict the occurrence of geological features, structures, and processes based on field experience and observations.

1.2 GEOMORPHOLOGY

Geomorphology deals with the study of the physical features of the Earth's surface and the processes responsible for their formation and modification. The study area is characterized by rocky outcrops, uneven topography, and vegetation cover typical of basement complex terrains. Weathering and erosion processes have contributed significantly to the development of the observed landforms and surface features within the area.

1.3 AIM AND OBJECTIVES

Aim

The aim of the field exercise is to equip prospective geologists with the fundamental techniques required for effective field observation, geological mapping, and geological data recording.

Objectives

The objectives of the exercise are as follows:

- To provide a practical approach to the identification of common basement and sedimentary rock types such as granite, metaconglomerate, fault breccia, schist, sandstone, among others.
- To identify the mineralogical composition of rocks and provide tentative names for rock samples obtained from the study locations.
- To learn the use of the Global Positioning System (GPS) in determining the positions of geological features, elevation tracking, navigation, and geological map generation.
- To understand how to carry out traditional geological mapping procedures using pacing techniques for the production of geological maps.
- To observe and analyze the primary and secondary structures present in rocks.
- To learn the use of the compass clinometer in taking structural measurements such as strike direction and dip angle of foliated planes.
- To learn how to carry out sedimentary rock logging.

1.3 GEOLOGICAL FIELD MATERIALS AND INSTRUMENTS USED

Below is a list of geologic field materials and instruments I had utilized in carrying out this field work exercise;

1. **Field note:** This is used for taking notes of what are being taught in the field,documenting observations, and sketching geological features.

Figure 01: Field notebook.

2. **Self refracting measuring tape:** This was used to measure the height of strata's and also to measure the dimension of class, foliations,etc in the field.

Figure 02: Self refracting measuring tape.

3. **Field outfit:** These comprises of the attires such as long sleeve shirt,hard straw hat, gloves,safety glasses, field boots. It is specially designed for protection and it's mandatory that everyone is kitted up completely before going to the field.

Figure 03: Straw hat and field boot.

4. **Cutlass:** It was used to clear pathways of any vegetation acting as an obstruction and to expose rocks covered by weed.

Figure 04: Cutlass.

5. **Hand lens:** This is used for close examination of rocks, minerals and small features.

Figure 05: Hand lens.

6. **Mathematical set:** It was used to perform precise measurements, constructions and geometric operations. It comprises of a set square,divider,compass, protractor,ruler,etc.

Figure 06: Mathematical set.

7. **Compass clinometer:** this is used for taking altitudinal measurements of rock formations and determining their orientation. While the compass is basically used for

taking strike direction,the orientation of the geological planes and lineations with respect to the north,the clinometer is used for measuring the amount of dip and the dip direction of a geology feature with respect to the horizontal. This allows an accurate record of the geometry of the feature to be constructed.

Figure 07: Compass clinometer.

8. **Sledge and pick hammer:** This is used essentially for collection of rock samples breaking apart rocks,and examining their internal structure.

Figure 08: Sledge and pick hammer.

9. **Handheld GPS device:** This is utilized for geolocation,tracking and navigation purposes and elevation measurement. It is also used to generate geological map.

Figure 09: Handheld GPS device.

CHAPTER TWO
GEOLOGY OF IGARRA

Geological Setting and Basement Complex

Igarra lies within the Precambrian Basement Complex of Nigeria and forms part of the crystalline basement terrain affected by the Pan-African Orogeny. The rocks in the area record episodes of deformation, metamorphism, and magmatism associated with regional tectonic activities.

The Basement Complex in the area is mainly composed of metamorphic and igneous rocks, especially schists, quartzites, metaconglomerates, granitoids, and contact metamorphic rocks. Structural features such as foliations, fractures, folds, joints, and shear zones are common within the rocks due to tectonic deformation.

Major Rock Types

Metamorphic Rocks

The dominant metamorphic rocks in the area include quartz-biotite schist, schistose quartzite, quartzite, and metaconglomerate. These rocks were formed through the metamorphism of sedimentary protoliths such as sandstone, shale, and conglomerate under conditions of heat and pressure.

Schists in the area are characterized by foliation and abundance of mica minerals such as biotite and muscovite. Quartzites are generally hard, resistant, and ridge-forming due to their high quartz content. Schistose quartzites display weak foliation resulting from directed pressure during metamorphism.

Metaconglomerates observed within the area are mainly oligomictic and matrix-supported. They contain quartzitic and calcitic clasts together with minerals such as quartz, biotite, muscovite, and actinolite.

Igneous Rocks

Granitoids occur as intrusive igneous bodies within the area. The granites are mainly leucocratic and commonly display granular to porphyritic textures. Mineral constituents include quartz, plagioclase feldspar, K-feldspar, biotite, muscovite, and hornblende.

Pegmatite and aplite were also observed associated with the granitoid bodies. Xenoliths and fractures occur within some granite exposures, indicating emplacement and tectonic activities.

Contact Metamorphic Rocks

Hornfels occur around intrusive bodies as a result of contact metamorphism. The heat from the intruding magma altered the surrounding country rocks, producing metamorphic aureoles around the contacts.

Structural Geology

Structural features observed within the area include foliations, fractures, folds, joints, and fault-related structures. Foliation is common within schists and metaconglomerates, while fractures and joints are more common within the granitic rocks.

Fold structures and deformation observed at contacts between granitoids and metamorphic rocks indicate tectonic stresses associated with the Pan-African Orogeny. Quartz veins and fault breccias also occur within some outcrops, indicating brittle deformation.

Petrology and Mineralogy

The major minerals identified within the study area include quartz, biotite, muscovite, plagioclase feldspar, K-feldspar, hornblende, calcite, and actinolite.

Metamorphic rocks commonly exhibit granoblastic and porphyroblastic textures, while igneous rocks display granular and porphyritic textures. The abundance of quartz within quartzites contributes to their hardness and resistance to weathering.

Hydrogeology

Groundwater occurrence within the area is mainly controlled by fractures, joints, foliations, and weathered zones within the Basement Complex rocks. Fractured quartzites, schists, and granitic rocks serve as pathways for groundwater movement and storage.

Geological Significance

The geology of Igarra reflects a complex history involving sedimentation, metamorphism, deformation, magmatism, and tectonic activities. The rocks and structures within the area provide important information about the evolution of the Nigerian Basement Complex.

The quartzites, granites, schists, and other rocks within the area are also important as construction materials and may serve as sources of industrial minerals and groundwater resources.

CHAPTER THREE

3.1 DAY ONE - Saturday, 25th April, 2026
STOP ONE
Location: Near Comprehensive School, Ugbogbo
Coordinates:
N: 7°17′38.7″
E: 6°05′59.3″
Weather Condition: Sunny
Time of Arrival: 10:40 AM
Elevation:
Top: 317 m
Bottom: 316 m
Elevation Difference: 1 m
Instructors: Dr. Andre, Dr. Alex, and Dr. Odia
FIELD DESCRIPTION
DIMENSIONS:
Breadth = 6.93 m
Length = 28.5 m
Height = 1 m
MODE OF OCCURRENCE: The outcrop occurs as a low-lying exposure.
COLOUR: Dark grey
FOLIATION: The rock exhibits schistosity with a general north–south trend.
TEXTURE: Porphyroblastic texture.
MINERALOGY: The rock contains clasts rich in quartz, identified as quartzite fragments, while calcite-rich fragments are described as calcitic. The groundmass consists predominantly of biotite, muscovite, and calcite minerals. Greenish minerals observed within the rock were identified as actinolite.
PROTOLITH: The protolith of the rock is conglomerate, which has undergone metamorphism to form metaconglomerate.
Metaconglomerate is significant because it preserves original sedimentary features and can provide information about deformation history and reference orientation during tectonic activities.
Two major types of metaconglomerate were identified:

- Clast-supported metaconglomerate
- Matrix-supported metaconglomerate

TENTATIVE ROCK NAME: Oligomictic matrix-supported metaconglomerate.
Elongated clasts within the rock tend to align their long axes (x-axis) parallel to the foliation direction. In the absence of visible foliation, the orientation of the elongated clasts may be used to infer the structural orientation of the rock.
X-axis (long axis) = 30 cm.

Plate 1: Oligomictic matrix-supported metaconglomerate.

Geological Discussion

Nigeria possesses a complex geological history shaped by several tectonic and orogenic events. The Basement Complex reflects multiple episodes of deformation, metamorphism, and magmatism that have produced the diverse rock assemblages observed today. Understanding these geological features provides insight into the tectonic evolution of the region and the broader dynamics of the Earth’s crust.

The geology of Nigeria is broadly divided into:

1. Sedimentary Basins
2. Basement Complex Rocks

The Basement Complex is subdivided into:

- Migmatite–Gneiss Complex — the oldest crystalline foundation rocks
- Schist Belts — younger metasedimentary and metavolcanic rocks
- Older Granites — early intrusive granitoids
- Younger Granites — igneous intrusions associated mainly with the Pan-African Orogeny.

Orogeny

Orogeny refers to mountain-building processes caused by tectonic activities and crustal deformation. It is an extensive regional geological event that may last from thousands to millions of years and contributes significantly to the shaping of the Earth’s crust.

The three major processes involved in orogeny are:

- Deformation
- Metamorphism
- Magmatism

Major orogenic events recognized in the Nigerian Basement Complex include:

1. Liberian Orogeny (2.7–2.5 Ga)

2. Eburnean Orogeny (2.3–1.8 Ga)
3. Kibaran Orogeny (1.3–1.1 Ga)
4. Pan-African Orogeny (about 750–450 Ma).

STOP TWO
Location: Ugbogbo Community
Time of Arrival: 1:37 PM
Weather Condition: Sunny
Coordinates:
N: 7°18′9.1″
E: 6°5′55.9″
Elevation:
Top: 316 m
Bottom: 313 m
Elevation Difference: 3 m
Instructors: Dr. Alex and Dr. Odia

Structural Orientation
- Trend of foliation: NW–SE
- Direction of dip: SW

Attitudinal Measurements
- Strike: 154°
- Dip: 80° SW

FIELD DESCRIPTION
ROCK TYPE: Metamorphic rock.
COLOUR: Dark grey.
MINERALOGY: The rock is composed mainly of quartz, biotite, and minor muscovite.
TEXTURE: The rock exhibits schistosity, which is characterized by the parallel alignment of platy minerals.
GRAIN SIZE: Medium- to coarse-grained**.**
FABRIC: Granoblastic texture was observed in some mineral grains.
TENTATIVE ROCK NAME: Quartz-biotite schist (mica schist).
PROTOLITH: The probable protolith is shale or mudstone due to the abundance of platy minerals such as biotite and muscovite.
ECONOMIC IMPORTANCE: The rock may be useful as a construction material in low-stress engineering works. However, the presence of platy minerals and strong foliation planes may reduce its stability in heavy construction projects.
MODE OF OCCURRENCE: The outcrop occurs as a low-lying exposure.

Plate 2: Quartz-biotite mica schist.

STOP THREE
Location: Igarra Pluton
Time of Arrival: 2:37 PM
Weather Condition: Sunny
Coordinates:
N: 7°18′15.1″
E: 6°06′10.8″
Elevation: 316 m
Instructors: Dr. Alex and Dr. Odia

FIELD DESCRIPTION

The outcrop observed at the location is an igneous body characterized by randomly oriented mineral grains and the absence of foliation. The rock occurs as a ridge-like plutonic body. When a magmatic body cuts across pre-existing rocks, it is referred to as an intrusion.

Mode of Occurrence: Ridge/Pluton.

Mode of Emplacement: Igneous Intrusion may occur in two major forms:

1. Discordant Emplacement - The intrusive body cuts across the bedding or structural planes of the host rock. An example is a dyke.
2. Concordant Emplacement - The intrusive body lies parallel to the bedding or structural planes of the host rock. An example is a sill.

Igneous rocks formed beneath the Earth’s surface are referred to as intrusive or plutonic rocks, whereas those formed at or near the Earth’s surface are called extrusive or volcanic rocks. Examples of volcanic rocks include scoria and pumice.

COLOUR INDEX: The rock is leucocratic (light coloured), indicating the dominance of felsic minerals.

Based on colour index, igneous rocks may be classified as:

- Leucocratic: light coloured, rich in felsic minerals
- Mesocratic: intermediate composition

- Melanocratic: dark coloured, rich in mafic minerals
- Hypermelanic: extremely rich in mafic minerals

GRAIN SIZE CLASSIFICATION

- < 0.1 mm — fine grained
- 0.1–1 mm — fine- to medium-grained
- 1–5 mm — medium- to coarse-grained
- 5 mm — very coarse-grained

TEXTURE: Porphyritic texture.
STRUCTURES OBSERVED: Fractures, Quartz veins
MINERALOGY: The rock contains; Quartz, Biotite, Muscovite, K-feldspar, Hornblende
TENTATIVE ROCK NAME: Porphyritic leucocratic hornblende-biotite granite.

GEOLOGICAL INTERPRETATION

The age of the granitoids within the study area is associated with the Pan-African Orogeny, which played a major role in the formation and emplacement of granitic bodies within the Nigerian Basement Complex.

A xenolith is a fragment of pre-existing country rock enclosed within an igneous rock during magma emplacement.

Metasomatism refers to the chemical alteration of a rock through the exchange of ions between the country rock and migrating fluids or cooling magma.

Plate 3: Porphyritic leucocratic hornblende-biotite granite.

Additional Notes

The presence of folds within the surrounding schist suggests deformation associated with igneous intrusion and tectonic activity. Contact between the intrusive granite and surrounding metamorphic rocks may have contributed to localized deformation and structural modification.

Variations in dip orientation around the contact zone may indicate proximity to fold boundaries or structural disturbances related to deformation during the Pan-African tectonic event.

The contact zone between the metaconglomerate and adjacent rocks may contain complex structural features associated with deformation within the Migmatite–Gneiss Complex.

Indicators commonly used in identifying faults include:

- Quartz veins
- Displacement or distortion of foliation planes

The major factors influencing deformation include:

- Temperature
- Pressure
- Depth

In migmatitic rocks:

The metamorphic portion is referred to as the paleosome.

The igneous or newly formed granitic portion is referred to as the neosome.

Plate 3: Porphyritic leucocratic hornblende-biotite granite

STOP FOUR
Location: Igarra Pluton (Extension)
Time of Arrival: 4:10 PM
Weather Condition: Sunny
Coordinates:
N: 7°16′46″
E: 6°05′49″
Elevation: 295 m
Instructor: Dr. Odia
FIELD DESCRIPTION
ROCK TYPE: Metamorphic rock.
The metamorphic rock observed at this location is associated with contact metamorphism, which occurs when a magmatic body intrudes into pre-existing country rocks. The heat released from the intruding magma causes recrystallization of the surrounding rocks, leading to mineralogical and textural changes without complete melting.
The zone surrounding the intrusive body that has been affected by thermal metamorphism is known as the metamorphic aureole. Rocks formed within this aureole are commonly fine-grained and hard due to recrystallization. A typical example is hornfels.

GEOLOGICAL INTERPRETATION
Contact Metamorphism occurs mainly as a result of high temperature and relatively low pressure associated with igneous intrusions. The degree of metamorphism generally decreases with increasing distance away from the intrusive body.
The occurrence of hornfels within the aureole indicates intense thermal alteration of the surrounding country rock during emplacement of the intrusive magma.

Plate 4: Contact metamorphic rock(Hornfels)

3.2 DAY 2 - Saturday, 26th April, 2026

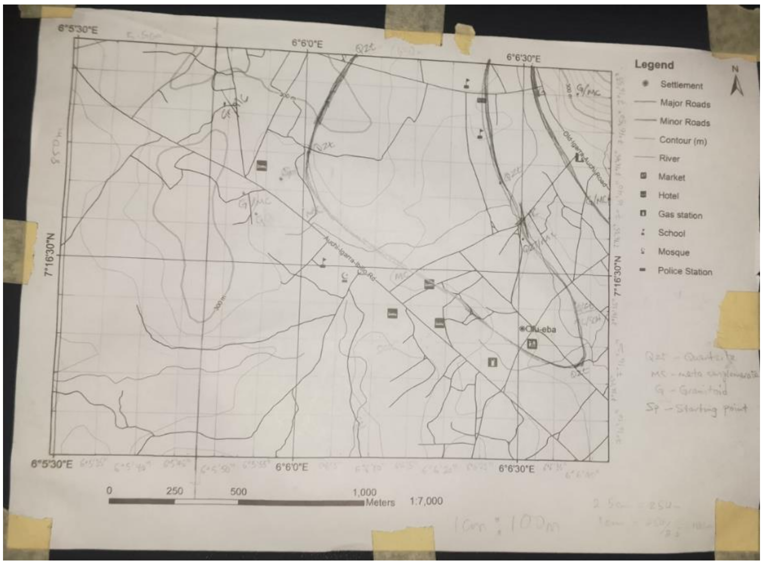

Plate 5: Map of study area

LOCATION ONE: Unity Resort Motel (Starting Point)
Time of Arrival: 10:15 AM
Weather Condition: Sunny
Coordinates:
N: 7°16′46″
E: 6°05′49”
Elevation: 293 m
Instructor: Dr. Alex

FIELD DESCRIPTION
The coordinates of the starting point were recorded using a Global Positioning System (GPS) device in order to accurately locate the position on the geological map. This served as the reference point for the mapping exercise. After establishing the location and orientation, movement commenced toward subsequent stations for continued geological mapping and field observations.

LOCATION TWO: Off Unity Resort
STOP ONE
Time of Arrival: 10:25 AM
Weather Condition: Sunny
Coordinates:
N: 7°16′45.1″
E: 6°06′1.7”
Elevation: 293 m
Instructor: Dr. Alex
FIELD DESCRIPTION
MODE OF OCCURRENCE: The rock occurs as a ridge.
DIMENSION: The outcrop is ridge-forming in nature.
FOLIATION: No visible foliation was observed, although micaceous minerals such as muscovite are present within the rock.
COLOUR: Light coloured
FRACTURE: Fractures were observed with an orientation of approximately 150° trending NW–SE.
STRUCTURE: The rock exhibits a massive and non-foliated structure.
TEXTURE: Granoblastic Texture
MINERALOGY: The rock is composed predominantly of quartz (about 90%) with minor mica minerals present.
TENTATIVE NAME: Pure Quartzite.

GEOLOGICAL INTERPRETATION
Quartzite is a metamorphic rock formed through the recrystallization of quartz-rich sandstone under conditions of heat and pressure. The dominance of quartz and the absence of foliation suggest a high degree of recrystallization.
Where mica minerals become abundant alongside quartz, the rock may exhibit schistose characteristics and can be referred to as schistose quartzite.
Distortion observed within rocks may indicate:

- The presence of folding, or
- Proximity to plutonic intrusion and associated deformation.


Plate 6: Pure Quartzite.

LOCATION THREE
STOP TWO
Time of Arrival: 11:05 AM
Weather Condition: Sunny
Coordinates:
N: 7°16′58.7″
E: 6°06′6.7”
Elevation: 305 m
Instructor: Dr. Alex
FIELD DESCRIPTION
MODE OF OCCURRENCE: The rock occurs as a ridge.
DIMENSION: The outcrop is ridge-forming in nature.
COLOUR: Light coloured
STRUCTURE: The rock exhibits a massive and non-foliated structure
TEXTURE: Granoblastic Texture
MINERALOGY: The rock is composed predominantly of quartz (about 90%) with minor mica minerals present.
TENTATIVE NAME: Quartzite

GEOLOGICAL INTERPRETATION
Quartzite is a hard and resistant metamorphic rock formed through the recrystallization of quartz-rich sandstone under conditions of heat and pressure.
The dominance of quartz within the rock indicates that the parent material (protolith) was likely quartz sandstone. The massive and non-foliated nature of the rock suggests that

metamorphism occurred under conditions where directed pressure was minimal or insufficient to produce foliation.

The granoblastic texture indicates recrystallization during metamorphism, resulting in interlocking quartz grains. The ridge-forming nature of the outcrop reflects the high resistance of quartzite to weathering and erosion compared to surrounding rocks.

The presence of minor mica minerals may indicate slight chemical impurities in the original sandstone or minor metamorphic alteration during recrystallization.

LOCATION FOUR

STOP THREE

Time of Arrival: 11:20 AM

Weather Condition: Sunny

Coordinates:

N: 7°16′43.0″

E: 6°06′26.4”

Elevation:

Instructor: Dr. Alex

FIELD DESCRIPTION

MODE OF OCCURRENCE: The rock occurs as a ridge.

DIMENSION: The outcrop is ridge-forming in nature.

COLOUR: Light coloured

STRUCTURE: The rock exhibits a massive and non-foliated structure

TEXTURE: Granoblastic Texture

MINERALOGY: The rock is composed predominantly of quartz (about 90%) with minor mica minerals present.

TENTATIVE NAME: Quartzite

GEOLOGICAL INTERPRETATION

Quartzite identified at this location shows strong similarities in mineralogical composition, texture, colour, and structural characteristics to the quartzite observed at the previous location. This similarity suggests that both outcrops may belong to the same continuous quartzite ridge or lithological unit within the study area.

NOTE ON ABSENCE OF PHOTOGRAPHIC PLATES FOR STOP 2 & 3

Photographic plates were not included for Stop 2 and Stop 3 of Day 2 because no prominent or well-exposed outcrop surface was observed at these locations. The quartzite occurred mainly as scattered float materials and small hand-sized fragments encountered along the traverse route. These fragments were interpreted as representative of the same quartzitic unit observed at Stop 1 until a distinctly different lithology was encountered at Stop 4.

LOCATION FIVE
STOP FOUR
Time of Arrival: 11:44 AM
Weather Condition: Sunny
Coordinates:
N: 7°16′55.0″
E: 6°06′32.6”
Elevation: 273 m
Instructor: Dr. Alex
FIELD DESCRIPTION
MODE OF OCCURRENCE: The rock occurs as a ridge.
DIMENSION: The outcrop is ridge-forming in nature.
COLOUR: Leucocratic (light coloured).
TEXTURE: Porphyritic
MINERALOGY: Quartz, Biotite, muscovite, K-feldspar, plagioclase feldspar.
TENTATIVE NAME: Porphyritic leucocratic biotite granite.

GEOLOGICAL INTERPRETATION
Granite is an intrusive igneous rock formed through the slow cooling and crystallization of magma beneath the Earth’s surface. The coarse mineral grains indicate slow cooling, while the leucocratic nature of the rock reflects the abundance of felsic minerals such as quartz and feldspars.
The porphyritic texture suggests a two-stage cooling history in which large crystals formed during slow cooling at depth before the remaining magma cooled more rapidly. The presence of biotite and muscovite indicates minor mafic and mica-rich mineral components within the rock.
The ridge-forming occurrence of the granite shows that it is resistant to weathering and erosion. The granitoid body is likely associated with magmatic activities related to the Pan-African Orogeny within the Nigerian Basement Complex**.**

Plate 7: Porphyritic leucocratic biotite granite.

LOCATION SIX
STOP FIVE
Time of Arrival: 12:30 PM
Weather Condition: Sunny
Coordinates:
N: 7°16′55.6″
E: 6°05′37.3”
Elevation: 286 m
Instructor: Dr. Alex
FIELD DESCRIPTION
MODE OF OCCURRENCE: The rock occurs as a ridge.
DIMENSION: The outcrop is ridge-forming in nature.
ORIENTATION: Random (depicts a granitoid)
COLOUR: Leucocratic (light coloured)
STRUCTURE: Fractures observed
FRACTURE: Measured at 10º
TEXTURE: Porphyritic
MINERALOGY: K-feldspar (fleshy in colour), Plagioclase feldspar, dark coloured mineral (biotite with a sheen appearance).
ROCK: Granite.
TENTATIVE NAME: Porphyritic leucocratic biotite granite.

GEOLOGICAL INTERPRETATION

Granite observed at this location is an intrusive igneous rock formed through the slow cooling and crystallization of magma beneath the Earth's surface. The random orientation of mineral grains and absence of foliation are characteristic features of granitoid rocks.

The leucocratic nature of the rock indicates the dominance of felsic minerals such as K-feldspar, plagioclase feldspar, and quartz, while the presence of biotite represents minor mafic mineral content. The porphyritic texture suggests a two-stage cooling history in which larger crystals formed before the remaining magma cooled and crystallized.

Fractures observed within the rock may have developed due to tectonic stresses or cooling processes after emplacement. The repeated occurrence of granitic intrusions within the area suggests widespread magmatic activity associated with the Pan-African Orogeny. The apparent intrusion of granite into metaconglomerate indicates that the granite is younger than the surrounding metamorphic rocks. Closely spaced contour lines on the map indicate areas of steep slope within the terrain.

Plate 8: Porphyritic leucocratic biotite granite.

LOCATION SEVEN

STOP SIX

Time of Arrival: 1:09 PM

Weather Condition: Sunny

Coordinates:

N: 7°16′41″

E: 6°06′44.1”

Elevation: 278 m
Instructor: Dr. Alex
FIELD DESCRIPTION
MODE OF OCCURRENCE: The outcrop occurs as a low-lying exposure.
DIMENSIONS: The outcrop extends for less than 100 m.
COLOUR: Pegmatite and aplite observed within the outcrop are leucocratic (light coloured), whereas the metaconglomerate is dark coloured.
STRUCTURE: Severe folding was observed at the contact between the granitoid body and the metaconglomerate.
TEXTURE: Pegmatite exhibits a very coarse-grained texture. Aplite exhibits a fine-grained texture.
MINERALOGY: The dominant minerals observed include; Quartz, Feldspar, Biotite.
TENTATIVE ROCK NAME: Granitoid.

ADDITIONAL OBSERVATIONS
The pegmatite observed contains:

- large K-feldspar crystals,
- large quartz grains,
- and very little biotite.

These characteristics are typical of pegmatite, which is a coarse-grained intrusive igneous rock formed during the final stages of magma crystallization.
The aplite observed contains:

- fine-grained quartz,
- fine-grained feldspar,
- and very little biotite.

Aplite is a fine-grained intrusive igneous rock commonly associated with granitic bodies. It is not the extrusive equivalent of pegmatite, but rather a fine-grained intrusive phase of granitic magma.
A contact was also observed between the granitoid and surrounding metamorphic rocks. The pegmatitic body could not be represented on the geological map because its extent was less than 100 m relative to the map scale used during the exercise.
Feldspathic materials refer mainly to rocks rich in feldspar and quartz minerals.

GEOLOGICAL INTERPRETATION
Pegmatite and aplite associated with the granitoid body indicate late-stage magmatic activity during the cooling and crystallization of granitic magma. The coexistence of coarse-grained pegmatite and fine-grained aplite suggests variations in cooling conditions and magma composition during emplacement.
The severe folding observed at the contact between the granitoid and metaconglomerate indicates strong tectonic deformation within the area. This deformation may have occurred during the emplacement of the granitoid body and associated tectonic activities related to the Pan-African Orogeny.
The contact relationship between the granitoid and metamorphic rocks suggests that the granitoid intruded into pre-existing metamorphic rocks, making the granitoid relatively

younger than the surrounding metaconglomerate. The occurrence of pegmatite and aplite further supports an intrusive magmatic origin for the granitoid complex.

Plate 9: Granitoid. (Image 1 showing the pegmatite & Image 2 showing severe folding at contact between the Granitoid and the Metaconglomerate).

LOCATION EIGHT
STOP SEVEN
Time of Arrival: 1:42 PM
Weather Condition: Sunny
Coordinates:
N: 7°16′37.7″
E: 6°06′30.8”
Elevation: 270 m
Instructor: Dr. Alex
FIELD DESCRIPTION
MODE OF OCCURRENCE: The outcrop occurs as a low-lying exposure**.**
DIMENSION: The outcrop extends for less than 1 m.
COLOUR: Dark coloured.
STRUCTURE: The rock exhibits a foliated structure.
FOLIATION:

- Strike: 160°
- Dip: 65° SW

TEXTURE: Granoblastic Texture.
MINERALOGY: The dominant minerals observed include: Biotite, Quartz, Muscovite.
TENTATIVE NAME: Matrix-supported metaconglomerate.

GEOLOGICAL INTERPRETATION
Metaconglomerate is a metamorphic rock formed from the metamorphism of conglomerate under conditions of heat and pressure. The foliated nature of the rock suggests that it was

subjected to directed pressure during regional metamorphism, resulting in the alignment of platy minerals such as biotite and muscovite.

The granoblastic texture indicates recrystallization of mineral grains during metamorphism. The matrix-supported nature of the metaconglomerate implies that the clasts are surrounded by a finer-grained matrix, which may reflect the original sedimentary characteristics of the parent conglomerate before metamorphism.

The observed foliation orientation (160°/65° SW) reflects tectonic deformation within the area and may be related to regional metamorphic events associated with the Pan-African Orogeny in the Nigerian Basement Complex.

Plate 10: Matrix-supported metaconglomerate.

LOCATION NINE

STOP EIGHT

Time of Arrival: 2:08 AM

Weather Condition: Sunny

Coordinates:

N: 7°16′34.7″

E: 6°06′30.8”

Elevation: 293 m

Instructor: Dr. Alex

FIELD DESCRIPTION

MODE OF OCCURRENCE: The rock occurs as a ridge.

DIMENSION: The outcrop is ridge-forming in nature.

FOLIATION: No visible foliation was observed, although micaceous minerals such as muscovite are present within the rock.

COLOUR: The rock is weathered but originally leucocratic (light coloured).

Foliation.

FRACTURE: Measured at 70º.

STRUCTURE: Fractures are present within the outcrop.
TEXTURE: Granoblastic texture.
MINERALOGY: The dominant minerals observed include: Mica (Muscovite), Quartz.
TENTATIVE NAME: Quartzite.

GEOLOGICAL INTERPRETATION

Quartzite is a resistant metamorphic rock formed through the recrystallization of quartz-rich sandstone under conditions of heat and pressure. The dominance of quartz and the granoblastic texture indicate extensive recrystallization during metamorphism.

The absence of visible foliation suggests that the rock was not subjected to strong directed pressure during metamorphism, despite the presence of minor mica minerals. The leucocratic nature of the rock reflects the abundance of quartz and other light-coloured minerals.

The ridge-forming occurrence of the quartzite indicates high resistance to weathering and erosion compared to surrounding rocks. The fractures observed within the outcrop may have formed as a result of tectonic stresses or weathering processes after the rock had formed.

Plate 11: Quartzite.

LOCATION TEN
STOP NINE
Time of Arrival: 2:27 PM
Weather Condition: Sunny
Coordinates:
N: 7°16′30″
E: 6°06′14”
Elevation: 283 m
Instructor: Dr. Alex

FIELD DESCRIPTION
MODE OF OCCURRENCE: The outcrop occurs as a low-lying exposure.
DIMENSION: The outcrop ranges from approximately 1–3 m in extent.
COLOUR: Dark coloured.
STRUCTURE: The rock exhibits a foliated structure.
TEXTURE: Granoblastic.
MINERALOGY: The dominant minerals observed include: Quartz, biotite, mica minerals.
TENTATIVE NAME: Matrix-supported metaconglomerate.

GEOLOGICAL INTERPRETATION
Metaconglomerate is formed through the metamorphism of conglomeratic sedimentary rocks under conditions of heat and pressure. The foliated structure observed within the rock indicates that it was subjected to directed tectonic stress during regional metamorphism, leading to the alignment of platy minerals such as biotite and mica.
The granoblastic texture reflects recrystallization of mineral grains during metamorphism. The matrix-supported nature of the rock suggests that the larger clasts are embedded within a finer-grained matrix, which represents the original sedimentary framework prior to metamorphism.
The occurrence of foliated metaconglomerate within the area indicates significant tectonic deformation, likely associated with regional metamorphic events linked to the Pan-African Orogeny in the Nigerian Basement Complex.

Plate 12: Matrix-supported Metaconglomerate.

LOCATION ELEVEN
STOP TEN
Time of Arrival: 2:50 PM
Weather Condition: Sunny
Coordinates:
N: 7°16′37.3″
E: 6°06′0”
Elevation: 289 m
Instructor: Dr. Alex
FIELD DESCRIPTION
MODE OF OCCURRENCE: The outcrop occurs as a low-lying exposure**.**
DIMENSION: The outcrop extends for less than 2 m.
COLOUR: Dark coloured.
STRUCTURE: The rock exhibits weak foliation.
TEXTURE: Granoblastic texture.
MINERALOGY: The dominant minerals observed include: Quartz and mica minerals.
TENTATIVE NAME: Matrix-supported metaconglomerate.

GEOLOGICAL INTERPRETATION

Metaconglomerate observed at this location was formed through the metamorphism of conglomeratic sedimentary rocks under conditions of heat and pressure. The weak foliation displayed by the rock suggests that it experienced relatively low to moderate directed tectonic stress during metamorphism.

The granoblastic texture indicates recrystallization of mineral grains during metamorphism, while the abundance of quartz and mica minerals reflects the mineralogical composition of the parent sedimentary material and subsequent metamorphic alteration.

The matrix-supported nature of the rock indicates that the clasts are enclosed within a finer-grained matrix. The occurrence of weakly foliated metaconglomerate within the area suggests progressive regional metamorphism and tectonic deformation associated with the Pan-African Orogeny in the Nigerian Basement Complex.

Plate 13: Matrix-supported Metaconglomerate.

LOCATION TWELVE
STOP ELEVEN
Time of Arrival: 3:06 PM
Weather Condition: Sunny
Coordinates:
N: 7°16′39.3″
E: 6°06′53.0”
Elevation: 308 m
Instructor: Dr. Alex
FIELD DESCRIPTION
MODE OF OCCURRENCE: The rock occurs as a ridge-forming exposure.
DIMENSION: The outcrop is ridge-forming in nature.
COLOUR: Granite is eucocratic (light coloured), whereas the hornfels is dark coloured.
ORIENTATION: Mineral grains within both rocks are randomly oriented.
STRUCTURE: Evidence of contact metamorphism was observed at the contact between the granite and hornfels.
TEXTURE: The granite exhibits a granular texture.
MINERALOGY: The dominant minerals observed include: granite muscovite, biotite, quartz, plagioclase feldspar. For Hornfels: Muscovite and biotite.
TENTATIVE NAME: Leucocratic granular plagioclase feldspar biotite granite.

GEOLOGICAL INTERPRETATION

Hornfels observed at this location were formed through contact metamorphism resulting from the intrusion of granitic magma into surrounding country rocks. The heat released by the intrusive granite caused thermal alteration and recrystallization of the adjacent rocks, leading to the formation of hornfels.

The random orientation of mineral grains in both rocks indicates the absence of strong directed pressure during formation. The granular texture and mineral composition of the granite suggest slow cooling and crystallization of felsic magma beneath the Earth’s surface.

The contact relationship between the granite and hornfels indicates that the granite intrusion is younger than the surrounding metamorphic rocks. The ridge-forming occurrence of the granite reflects its resistance to weathering and erosion within the study area.

Plate 14: Leucocratic granular plagioclase feldspar biotite granite.

3.3 DAY 3 - Saturday, 27th April, 2026
LOCATION ONE
STOP ONE
Time of Arrival: 9:45 AM
Weather Condition: Sunny
Coordinates:
N: 7°16′21.6″
E: 6°06′11.6”
Elevation: 294 m
Instructor: Dr. Andrea
FIELD DESCRIPTION
ROCK TYPE: Metamorphic rock
MODE OF OCCURRENCE: The outcrop occurs as a low-lying to ridge-forming exposure.
DIMENSION: The outcrop extends as a ridge-forming exposure.
COLOUR: The outcrop is highly weathered, making it difficult to determine the original rock colour.
STRUCTURE: The rock exhibits foliation.
TEXTURE: Fine grained texture.
MINERALOGY: The rock is predominantly composed of mica and clay minerals.
TENTATIVE NAME: Weathered Schist.

GEOLOGICAL INTERPRETATION

Schist is a foliated metamorphic rock formed under conditions of regional metamorphism. The observed foliation indicates alignment of platy minerals, particularly mica minerals, due to directed pressure during metamorphism.

The high degree of weathering observed at the outcrop has altered many of the original minerals into clay minerals, making identification of the original rock colour and mineral composition difficult. This intense weathering suggests prolonged exposure to surface weathering processes such as chemical alteration and decomposition.

Although the rock has undergone extensive weathering, it has not transformed back into a sedimentary rock. Rather, the metamorphic rock has been weathered to produce sediments and secondary clay minerals at the Earth’s surface.

Plate 15: Weathered Schist.

LOCATION TWO
STOP TWO
Time of Arrival: 10:20AM
Weather Condition: Sunny
Coordinates:
N: 7°16′9.6″
E: 6°06′8.4”
Elevation:
Top: 291 m
Bottom:281
Elevation Difference: 10 m
Instructor: Dr. Andrea
FIELD DESCRIPTION
ROCK TYPE: Metconglomerate.
MODE OF OCCURRENCE: The outcrop occurs as a hummocky exposure.
DIMENSION: The outcrop extends for approximately 10 m.
COLOUR: The colour could not be clearly determined due to weathering and mineral variation within the rock.
TEXTURE: Porphyroblastic texture characterized by large mineral crystals embedded within a finer-grained matrix.
MINERALOGY: The dominant minerals and clasts observed include: Calcitic class, Quartzitic class, actinolite, mica (biotite).
TENTATIVE NAME: Oligomitic matrix supported metaconglomerate.

ADDITIONAL OBSERVATIONS
The rock was difficult to break, suggesting a high quartz content and therefore high hardness. Effervescence was observed during acid testing, indicating the presence of calcitic material within some clasts.

Greenish minerals observed in association with the calcitic clasts were identified as actinolite. Two major clast types were recognized:

- Quartzitic clasts, which contribute to the hardness of the rock
- Calcitic clasts, which reacted with dilute acid

Based on clast composition, the rock was classified as oligomictic because only a limited number of clast types were observed.

GEOLOGICAL INTERPRETATION

Metaconglomerate formed through the metamorphism of an original conglomeratic sedimentary rock under conditions of heat and pressure. The presence of quartzitic and calcitic clasts suggests that the parent conglomerate contained fragments derived from different source rocks before metamorphism.

The porphyroblastic texture and occurrence of actinolite indicate recrystallization during metamorphism, while the matrix-supported nature of the rock suggests that clasts are enclosed within a finer-grained matrix. The hardness of the rock reflects the dominance of quartz-rich material.

The hummocky occurrence and mineralogical variations indicate localized deformation and metamorphic alteration, likely associated with tectonic events affecting the Nigerian Basement Complex, particularly during the Pan-African Orogeny.

Plate 16: Oligomitic matrix supported metaconglomerate.

LOCATION THREE: OFU-EBA MARKET

STOP THREE

Time of Arrival: 11:15AM

Weather Condition: Sunny

Coordinates:

N: 7°16′18.3″

E: 6°06′38.3”

Elevation: 269m

Instructor: Dr. Andrea

FIELD DESCRIPTION

ROCK TYPE: Weathered Quartzite.

MODE OF OCCURRENCE: The rock occurs as a ridge-forming outcrop**.**

DIMENSION: The outcrop extends as a ridge-forming exposure.

STRUCTURE: Weak foliation was observed with a foliation trend in the NW-SE direction.

COLOUR: The original colour of the rock could not be clearly determined due to weathering.

TEXTURE: Granoblastic texture characterized by interlocking mineral grains of nearly equal size.

MINERALOGY: The rock is composed predominantly of: Quartz (approximately 60%), mica minerals (approximately 40%).

TENTATIVE NAME: Schistosite Quartzite.

GEOLOGICAL INTERPRETATION

Quartzite observed at this location is a metamorphic rock formed through the recrystallization of quartz-rich sandstone under conditions of heat and pressure. The dominance of quartz and the granoblastic texture indicate extensive recrystallization during metamorphism.

The presence of abundant mica minerals and weak foliation suggests that the rock experienced direct pressure during metamorphism, resulting in partial alignment of platy minerals. Due to these schistose characteristics, the rock is more appropriately described as schistose quartzite.

The ridge-forming occurrence of the quartzite reflects its resistance to weathering and erosion. The weak foliation trend observed in the NW-SE direction may indicate tectonic deformation associated with regional metamorphic events within the Nigerian Basement Complex, particularly during the Pan-African Orogeny.

Plate 17: Schistosite Quartzite.

LOCATION FOUR
STOP FOUR
Time of Arrival: 12:09 PM
Weather Condition: Sunny
Coordinates:
N: 7°16′26.5″
E: 6°06′37.4”
Elevation: 274 m
Instructor: Dr. Andrea
FIELD DESCRIPTION
ROCK TYPES OBSERVED: Quartzite and metaconglomerate were observed at this location. Some portions of the outcrop exhibit weak foliation suggestive of schistose characteristics.
MODE OF OCCURRENCE: The rocks occur as low-lying exposures, with quartzite appearing as layered bands associated with metaconglomerate.
DIMENSION: Quartzite occurs as a ridge-forming exposure. The metaconglomerate exposure extends for less than 1 m.
COLOUR: Weathered
STRUCTURE: Foliation was observed within parts of the outcrop.
TEXTURE: The texture could not be clearly identified due to intense weathering.
TENTATIVE NAME: Quartzite and Metaconglomerate.

GEOLOGICAL INTERPRETATION
Quartzite and Metaconglomerate occurring together within the outcrop suggest a metamorphosed sedimentary sequence within the study area. The quartzite likely originated from quartz-rich sandstone, while the metaconglomerate was derived from conglomerate sedimentary rocks before metamorphism.
The weak foliation observed indicates that the rocks experienced direct pressure during regional metamorphism, although intense weathering has obscured some structural and textural features. The association of quartzite and metaconglomerate may indicate varying sedimentary environments and depositional conditions prior to metamorphism.
The ridge-forming nature of the quartzite reflects its greater resistance to weathering and erosion compared to the surrounding rocks. The observed deformation and foliation may be related to tectonic activities associated with the Pan-African Orogeny within the Nigerian Basement Complex.

Plate 18: Quartzite and Metaconglomerate occuring together in this outcrop suggests a metamorphosed sedimentary sequence.

LOCATION FIVE
STOP FIVE
Time of Arrival: 12:32 PM
Weather Condition: Sunny
Coordinates:
N: 7°16′46″
E: 6°05′49”
Elevation: 295 m
Instructor: Dr. Andrea
FIELD DESCRIPTION
ROCK TYPE: Metamorphic and Igneous rocks were observed at this location.
MODE OF OCCURRENCE: The rocks occur as ridge-forming outcrops.
DIMENSION: The outcrop extends as a ridge-forming exposure.
ORIENTATION: Mineral grains within the igneous rock are randomly oriented.
STRUCTURE: Evidence of contact metamorphism was observed at the contact between the igneous and metamorphic rocks.
ADDITIONAL NOTES
Examples of non-foliated metamorphic rocks include:

- Quartzite
- Marble
- Hornfels

Hornfels form mainly under conditions of high temperature and relatively low pressure during contact metamorphism.

GEOLOGICAL INTERPRETATION

Contact Metamorphism occurred at this location as a result of the intrusion of igneous rocks into pre-existing metamorphic rocks such as metaconglomerate. The heat released from the intrusive body altered the surrounding country rock, producing a metamorphic aureole around the contact zone.

Hornfels form within this aureole due to high temperatures and relatively low pressure during thermal metamorphism. The hornfels produced has a mineralogical and textural composition different from both the intrusive igneous rock and the original metaconglomerate parent rock.

The random orientation of mineral grains within the igneous rock supports its intrusive origin, while the ridge-forming nature of the outcrop reflects the resistance of both the granitoid and hornfels to weathering and erosion. The contact relationship observed indicates that the igneous intrusion is younger than the surrounding metamorphic **rocks.**

Plate 19: Metamorphic rock.

LOCATION SIX

STOP SIX

Time of Arrival: 12:41 PM

Weather Condition: Sunny

Coordinates:

N: 7°16′38.4″

E: 6°05′53.8”

Elevation: 300 m

Instructor: Dr. Andrea

FIELD DESCRIPTION

ROCK TYPE: Granite.

MODE OF OCCURRENCE: The rocks occur as ridge-forming outcrop.

DIMENSION: The outcrop extends as a ridge-forming exposure.

ORIENTATION: The mineral grains are randomly oriented. The rock also exhibits signs of weathering, including exfoliation of the outer rock layers.
COLOUR: Leucocratic (light coloured).
STRUCTURE: Fracture and Joints were observed. Xenoliths were also present.
TEXTURE: Granular texture.
MINERALOGY: The dominant minerals observed include: Plagioclase feldspar, biotite, Quartz**.**
TENTATIVE NAME: Leucocratic granular plagioclase feldspar granite.

GEOLOGICAL INTERPRETATION

Granite observed at this location is an intrusive igneous rock formed through the slow cooling and crystallization of magma beneath the Earth's surface. The granular texture and random orientation of mineral grains indicate slow cooling under plutonic conditions.

The leucocratic nature of the granite reflects the abundance of felsic minerals such as quartz and feldspars, while biotite represents the minor mafic mineral component. The occurrence of xenoliths within the granite suggests that fragments of pre-existing country rocks were incorporated into the magma during emplacement.

Fractures and joints observed within the outcrop may have developed due to tectonic stresses, cooling processes, or weathering after emplacement. The exfoliation observed on the rock surface indicates mechanical weathering resulting from repeated expansion and contraction of the outer rock layers. The ridge-forming occurrence of the granite reflects its resistance to weathering and erosion within the study area.

Plate 20: Leucocratic granular plagioclase feldspar granite.

CHAPTER FOUR

4.1 HYDROGEOLOGY

Hydrogeology is the branch of geology concerned with the occurrence, movement, and storage of groundwater within rocks and soil. Groundwater occurrence in the study area is controlled mainly by porosity, permeability, fractures, joints, foliations, and weathered zones within the rocks.

The sedimentary rocks observed within the geological terrain, especially the well-sorted sandstones, possess high porosity and permeability, making them good aquifers and reservoir rocks. Their coarse grain size and good sorting enhance groundwater storage and movement. In contrast, shale, mudstone, and claystone possess low permeability and therefore act as aquitards or aquicludes that restrict groundwater movement.

Within the Basement Complex terrain, rocks such as schists, quartzites, granites, and metaconglomerates generally possess low primary porosity. However, groundwater occurs within secondary structures such as fractures, joints, foliations, and weathered zones. Fault breccias and fractured quartzites may also serve as localized groundwater pathways.

Structural features observed within the area strongly influence groundwater movement and storage. Fractures, joints, and foliations enhance permeability and channel groundwater flow, while intrusive activities and contact metamorphism may alter groundwater chemistry through rock–water interaction.

4.2 ECONOMIC GEOLOGY

Economic geology deals with geological materials that possess economic value and can be exploited for industrial, construction, or energy purposes. The study area contains economically important sedimentary, metamorphic, and igneous rocks.

Quartzites, granites, schists, hornfels, and metaconglomerates observed within the Basement Complex are valuable as construction materials, road aggregates, and dimension stones due to their hardness and durability. Granitic rocks may also host mineralization associated with intrusive and metasomatic processes.

Sandstones observed within the sedimentary terrain possess high porosity and permeability, making them important reservoir rocks for groundwater accumulation and possible hydrocarbon storage. Coal-bearing units associated with shale, mudstone, claystone, and siltstone indicate the presence of economically important energy resources.

Structural features such as fractures, shear zones, faults, and intrusive contacts are economically significant because they may serve as pathways for mineralizing fluids and influence the concentration of mineral deposits. Contact metamorphic zones associated with igneous intrusions may also contain economically important minerals.

4.3 ENGINEERING GEOLOGY

Engineering geology involves the application of geological knowledge to engineering works such as road construction, building foundations, dams, tunnels, and slope stability assessment. The engineering properties of rocks depend on factors such as mineral composition, texture, structures, weathering, hardness, porosity, and permeability.

Quartzites observed within the area are hard, resistant, and durable due to their high quartz content. These characteristics make them suitable for construction aggregates, road stones, and foundation materials. Granites are also mechanically strong and widely used as building stones, dimension stones, and construction materials.

Schists and foliated metamorphic rocks possess planes of weakness due to foliation and schistosity. These structures may reduce their engineering strength and make them unsuitable for heavy load-bearing structures, although they may still be used in low-stress construction works.

Shales, mudstones, and claystones generally possess low strength, high compressibility, and poor drainage properties. These rocks are not suitable for major foundations without stabilization. Fractures, joints, folds, and fault zones observed in the field may also influence slope stability, seepage, and the mechanical behavior of rocks during engineering construction.

4.4 ENVIRONMENTAL GEOLOGY

Environmental geology is concerned with the interaction between geological materials, geological processes, and the environment. It focuses on how rocks, structures, weathering, erosion, and human activities affect the natural environment and human safety.

Weathering processes observed within the study area contribute to soil formation and landscape development. Resistant rocks such as quartzites and granites form ridges, while weaker rocks weather more easily into low-lying areas. Fractures, joints, and fault zones may influence erosion, drainage patterns, and groundwater contamination pathways.

Mining and quarrying of granites, quartzites, and other construction materials may lead to environmental problems such as land degradation, deforestation, dust pollution, noise pollution, and slope instability if not properly managed.

The occurrence of fractures and weathered zones within the Basement Complex also affects groundwater vulnerability to contamination. Proper geological understanding is therefore essential for environmental management, land-use planning, groundwater protection, and sustainable resource exploitation.

4.5 STRUCTURAL GEOLOGY

Structural geology deals with the study of rock deformation and the structural features produced by tectonic forces. Structural features observed within the study area include foliations, fractures, joints, folds, fault breccias, shear zones, and intrusive contacts.

Metamorphic rocks such as schists and metaconglomerates display foliations and schistosity resulting from directed pressure during regional metamorphism. Quartzites and schists commonly exhibit foliation trends associated with tectonic deformation during the Pan-African Orogeny.

Fold structures observed within the area indicate compressional forces and varying deformation intensities. Both brittle and ductile deformation features were recognized. Brittle deformation produced fractures, joints, and fault breccias, while ductile deformation resulted in folds and mineral alignment.

Igneous intrusions observed within the Basement Complex show cross-cutting relationships with surrounding metamorphic rocks. Contact metamorphism around these intrusions produced hornfels and metamorphic aureoles. Xenoliths within granitic rocks indicate incorporation of country rock fragments during magma emplacement.

These structural features provide evidence of the tectonic history, deformation patterns, metamorphism, and magmatic activities that affected the Nigerian Basement Complex.

SUMMARY

The fieldwork exercise carried out in Igarra provided practical exposure to geological mapping, rock identification, structural measurements, and geological interpretation within the Nigerian Basement Complex terrain. The exercise commenced with orientation, location mapping using GPS, and familiarization with field instruments and geological procedures.

Throughout the exercise, several rock types were studied, including quartzite, schist, metaconglomerate, granite, pegmatite, aplite, hornfels, sandstone, shale, mudstone, claystone, siltstone, and fault breccia. Their mineralogical composition, textures, structures, modes of occurrence, and field relationships were carefully observed and described. Structural features such as foliations, fractures, joints, folds, shear zones, and intrusive contacts were also identified and measured.

The exercise further involved sedimentary logging, interpretation of depositional environments, identification of metamorphic and igneous processes, and recognition of contact metamorphism and deformation associated with the Pan-African Orogeny. Hydrogeological, engineering, environmental, and economic significance of the rock units were also evaluated.

Overall, the fieldwork improved practical understanding of geological processes, field mapping techniques, structural analysis, and the geological evolution of the Nigerian Basement Complex, thereby strengthening the students' field competence and geological interpretation skills.

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