A REPORT

ON

THE GEOLOGY OF AFIKPO AND ITS ENVIRONMENT IN AFIKPO LOCAL GOVERNMENT AREA, EBONYI STATE.

BY

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NOVEMBER, 2023.

DEDICATION

This report is dedicated to Almighty God, all my family and friends. Also, in a special way, I dedicate this report to my parents for always being so supportive for my goals, and also my wonderful supervisors who without their guidance, the field trip wouldn't have been successful

ACKNOWLEDGEMENT

I thank God almighty whose infinite mercy, protection, inspiration and divine providence saw me through the difficult moments, his holy name be praised forever. I also want to appreciate the dedicated efforts of the Head of Department Prof I.I. Obiadi, as well as the entire staff and members of the Department of Applied Geophysics, Nnamdi Azikiwe University for their unalloyed commitment towards the grooming of young undergraduates into qualified geophysicists.

ABSTRACT

The study area (Afikpo and its environs), lies between latitude 05053’33”N and longitude 07056’7”E. It covers Amasiri, Akpoha, Ibii and other neighboring communities of Afikpo North L.G.A of Ebonyi State. The area rests partly within the Southern Benue Trough and also the Anambra Basin and is underlain by Members of the Eze-aku and Asu river Groups. These lithological units which comprises of majorly Sandstone and Shale Units were encountered, studied and described in different outcropping units during the course of the field work. The Sandstone outcrops were encountered as ridges in the area and varies in specie from Arenaceous to Siliceous to Calcareous at different locations some having presence of dissolved or undissolved limestone clasts, dissolved body fossils, Ophiomorpha, Scolithos, Arenicollites and Thallassinoides trace fossils. The Shale units were encountered as lowlands were Agricultural activities such as farming commences and as highlands were dolerite intermediate intrusions took place. Environmental hazards in the study area were majorly gully erosions at locations of abrupt change in lithology from Sandstone to Shale. Faults, joints, folds, crossbeds and unconformity were also encountered in some stations. Lithologic logging was done for the Sandstone outcrop in station 15 and 16, Rose diagrams were drawn for Azimuths of crossbeds (trough beds) measured while the overall information obtained in the stations were used to populate the base map of the area.

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CHAPTER ONE

1.0 INTRODUCTION

Geological fieldwork is an essential component of earth science studies, enabling students to gain practical experience and firsthand knowledge of geological processes. Our recent field trip to Afikpo, Ebonyi State that took place on the 24th of October to 28th of October, 2023, was a remarkable opportunity to apply theoretical knowledge in a real-world setting and produce a geological map. Afikpo, nestled in the southeastern region of Nigeria, is known for its diverse geology, making it an ideal location for our geological exploration.

The Afikpo sedimentary basin is a very unique one; the structural and textural characteristics of the rocks are a product of the depositional energy of the environment. Research on the study of sedimentary rocks have shown that sediments, pieces and fragments of old and pre-existing rocks have created some features and rock attributes which are especially distinct and useful in the sedimentary terrain.

Geomorphologically, the terrain is composed of an alternation of highlands and lowlands. While the highlands are composed of sandstone, the lowlands are composed of siltstone and shale. Some of these lowlands are occupied by surface water bodies. The area is drained by rivers, streams and springs and generally has a dendritic drainage pattern. There are two main types of soil present; silty clayey soil and sandy clay hydromorphic soil. The study area happens to be a semi urban area where commercial activities take place basically on a low scale. Other local occupations practised by the indigenes include farming, hunting, fishing, mining, sand quarrying, etc.

Our fieldwork was conducted over a set period, and the data collected will serve as the foundation for our geological map. As we delve into the details of our journey and findings, we invite the reader to join us in exploring the geological wonders of Afikpo and the significance of our geological mapping project.

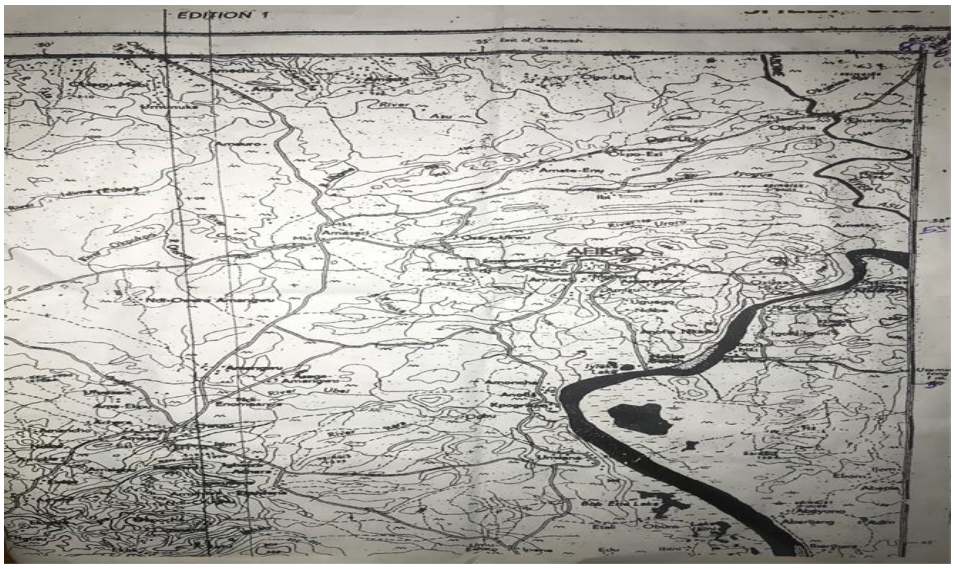


Fig.1: Base map of Afikpo

1.1 LOCATION AND ACCESSIBILITY OF THE STUDY AREA

The study area which covers around Afikpo,Ebonyi state is located between longitudes E7º 50' and E7º 60' and latitudes N5º 45' and N5º 60'. It lies within the South-Easthernpart of Nigeria and is accessible through either the Abakaliki-Afikpo expressway or through Amasiri-Akaeze road. The study area is a semi urban area where commercial activities take place basically on a low scale. Other local occupations practised by the indigenes include farming, hunting, fishing, mining, sand quarrying, etc.

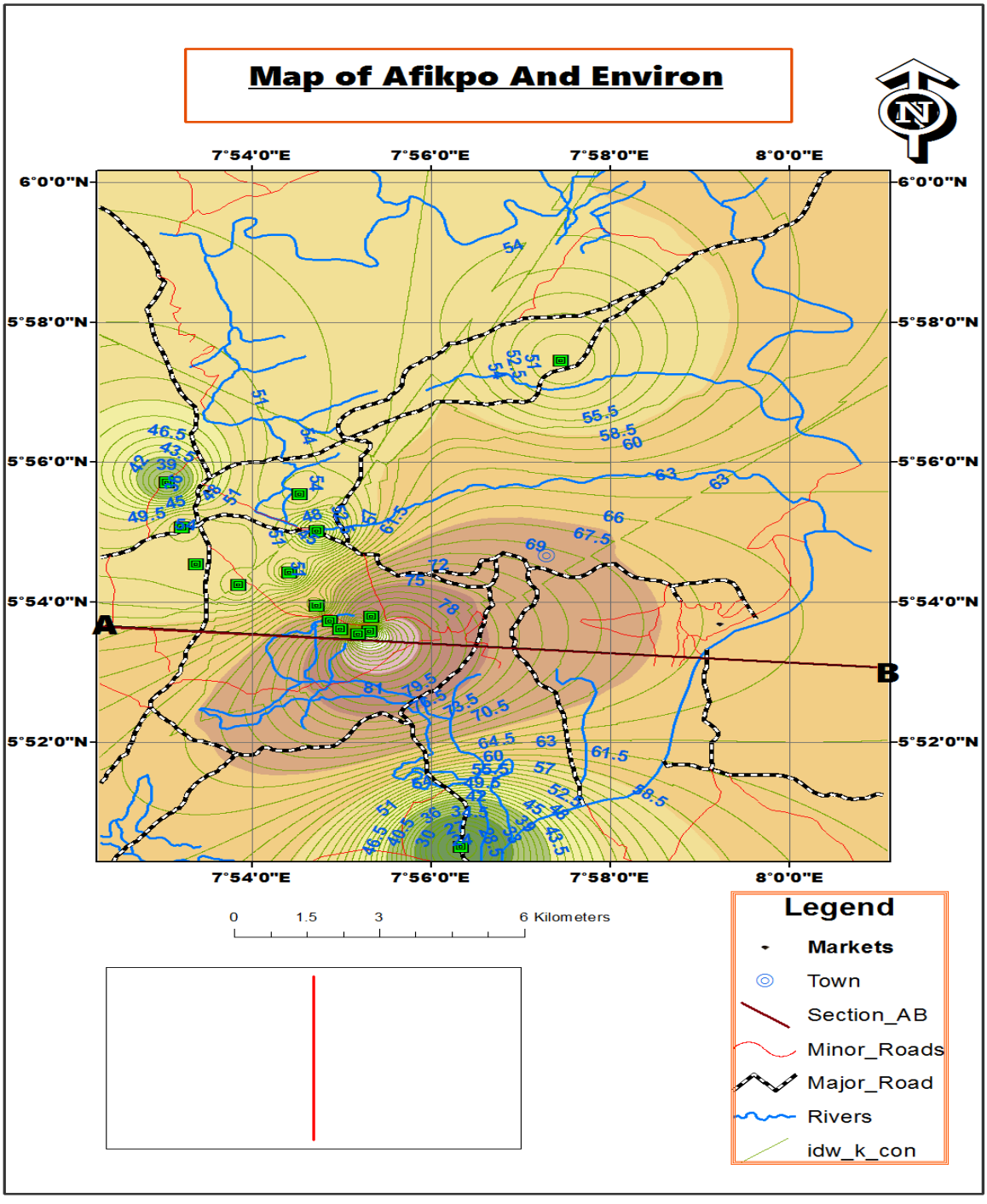


Fig.2: Map of Afikpo and its environs

1.2 GEOMORPHOLOGY AND PHYSIOLOGY

The terrains of the study area are in alternation of high and low land terrain. It is mostly succession of hills and valleys. There is cultivation on the hills while surface water bodies occupy most of the valley the hill is strip Steel with sudden drop to the valley below.

1.4 RELIEF AND DRAINAGE

The topography of the Afikpo area is undulating in its nature with the sandstone units forming the ridges and hills, while the shale units forming the lowland. The drainage of the study area is controlled by relief, topography and geology and its pattern is dendritic. The area is drained by theOkpukpo, ololo, ubaji, ogberehi, ogbuko, nsikpu and Iyiechiamachara streams which run through the heterogonous rocks joining almost at right angles to each other forming a tree like structure which later empty into the Iyieke Lake at Ndibe. This streams flow in areas of low topography

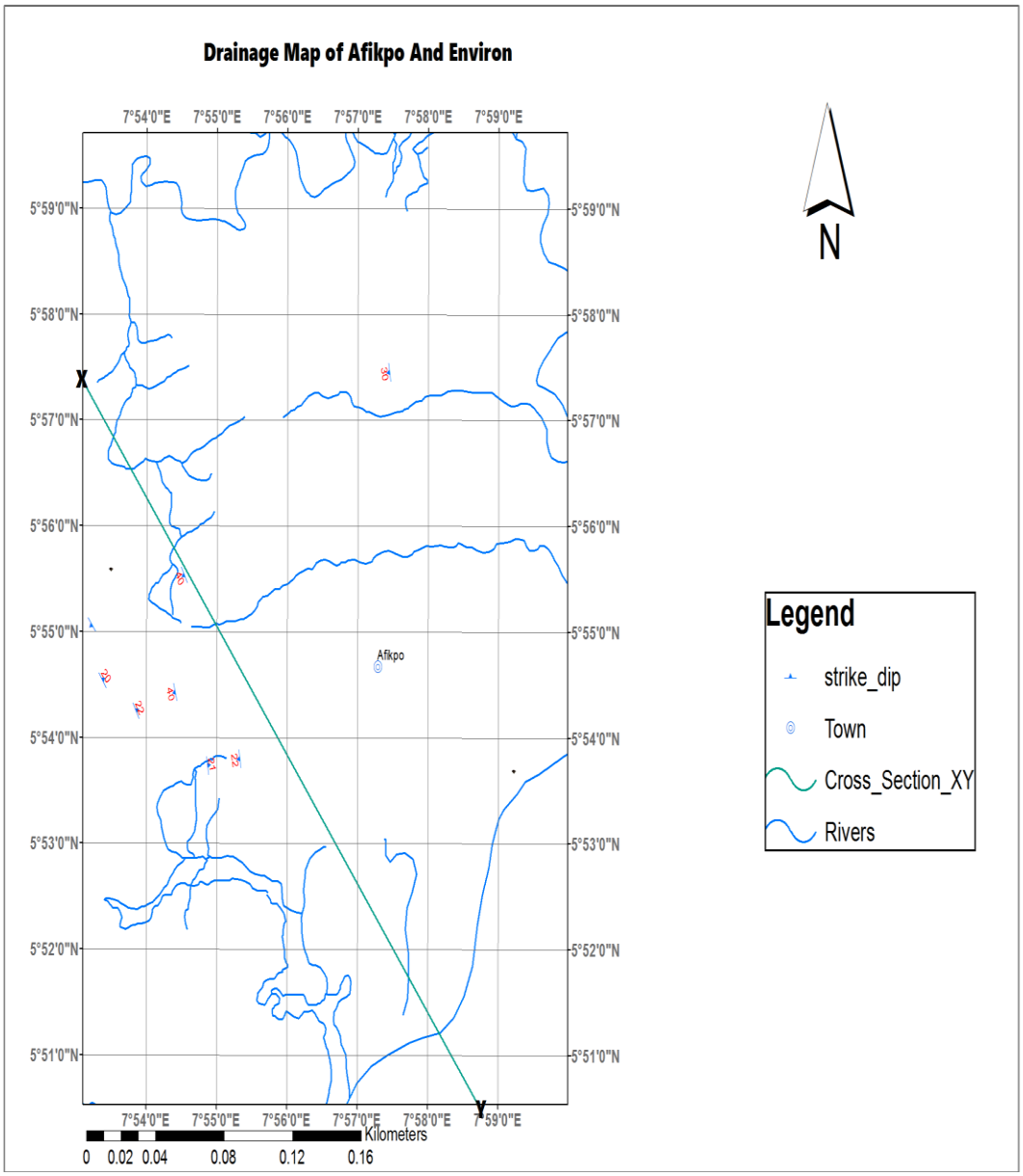


Fig.3. Drainage map of Afikpo

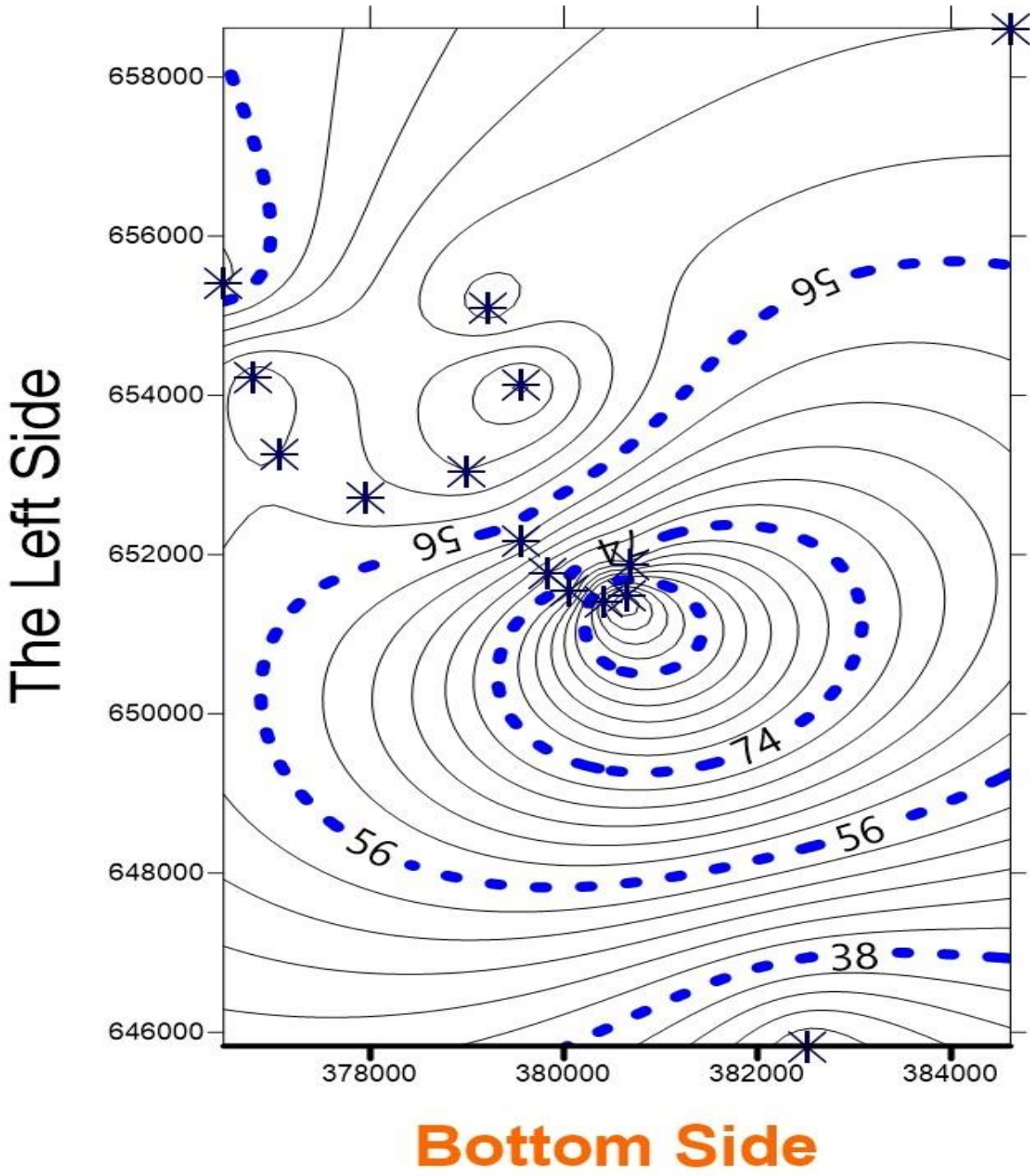


Fig.4: Contour map of Afikpo

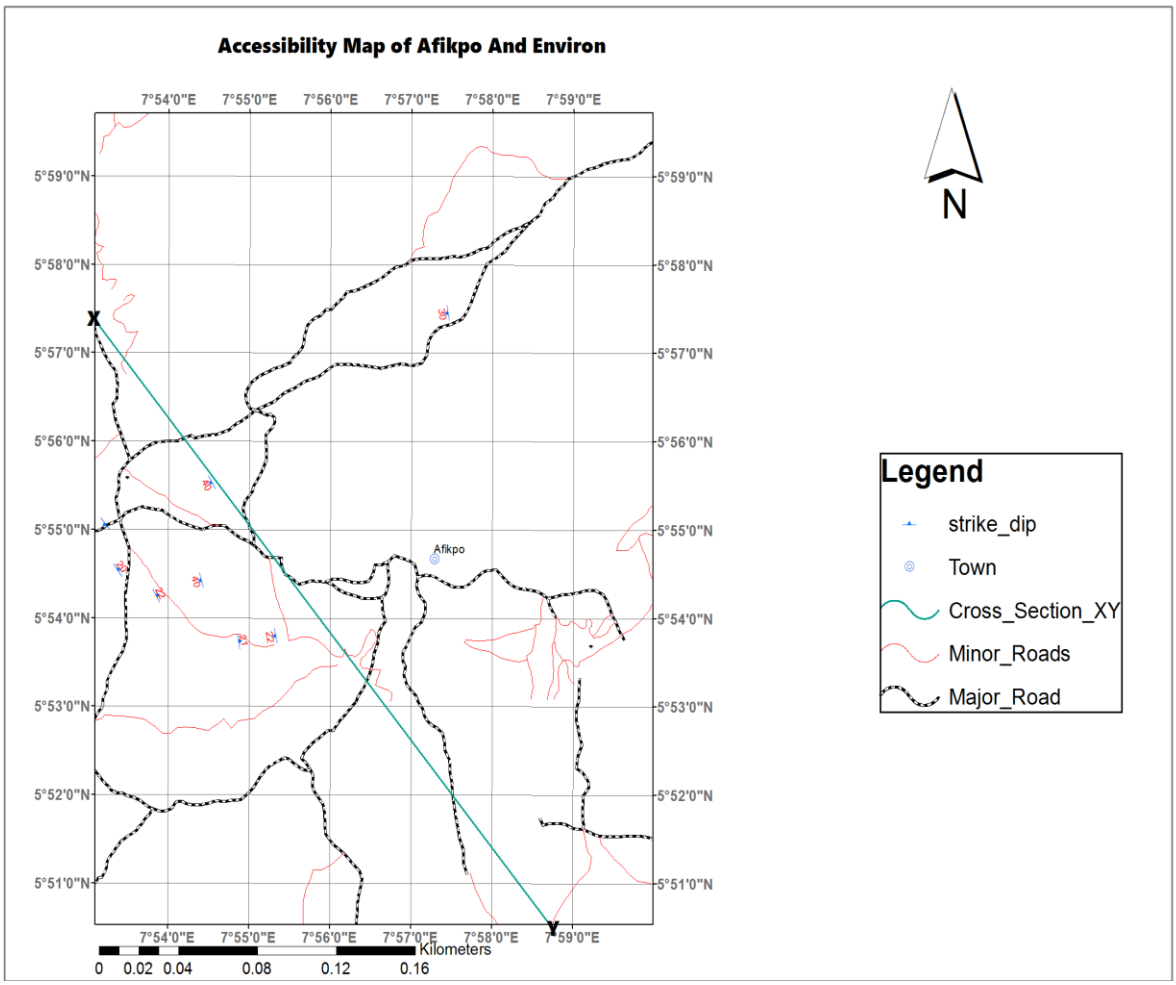


Fig.5: Accessibility map of Afikpo

1.5 CLIMATE AND VEGETATION OF THE STUDY AREA

The prevailing climate is distinctly Tropical climate which means it has high temperatures throughout the year (Iloeje; 1976). In Afikpo, the wet season is warm, oppressive, and overcast and the dry season is hot, muggy, and partly cloudy. Over the course of the year, the temperature typically varies from 66°F to 88°F and is rarely below 60°F or above 91°F

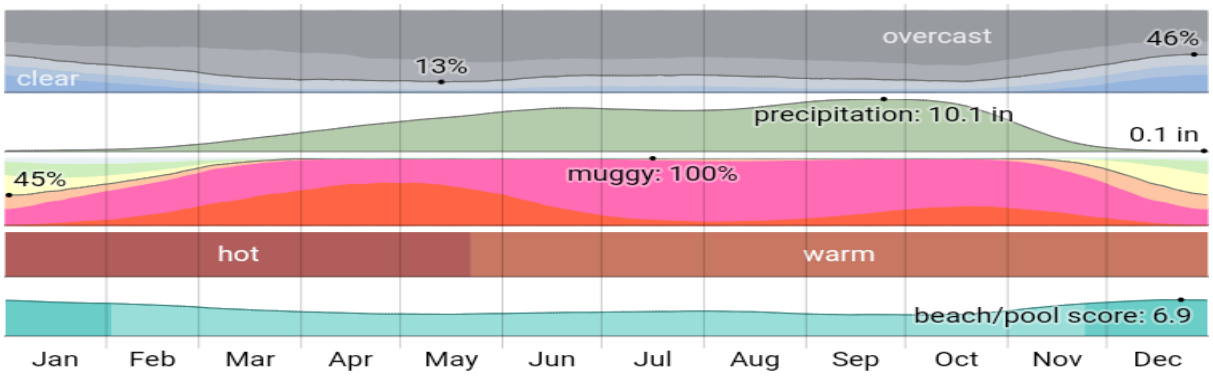


Fig.6: Afikpo weather by month

Based on the beach/pool score, the best time of the year to visit Afikpo for hot-weather activities is from late November to early February.

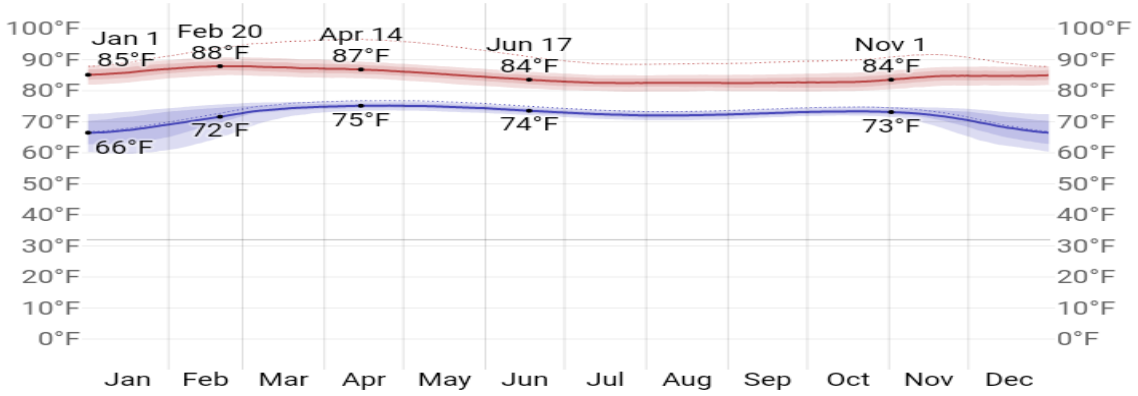
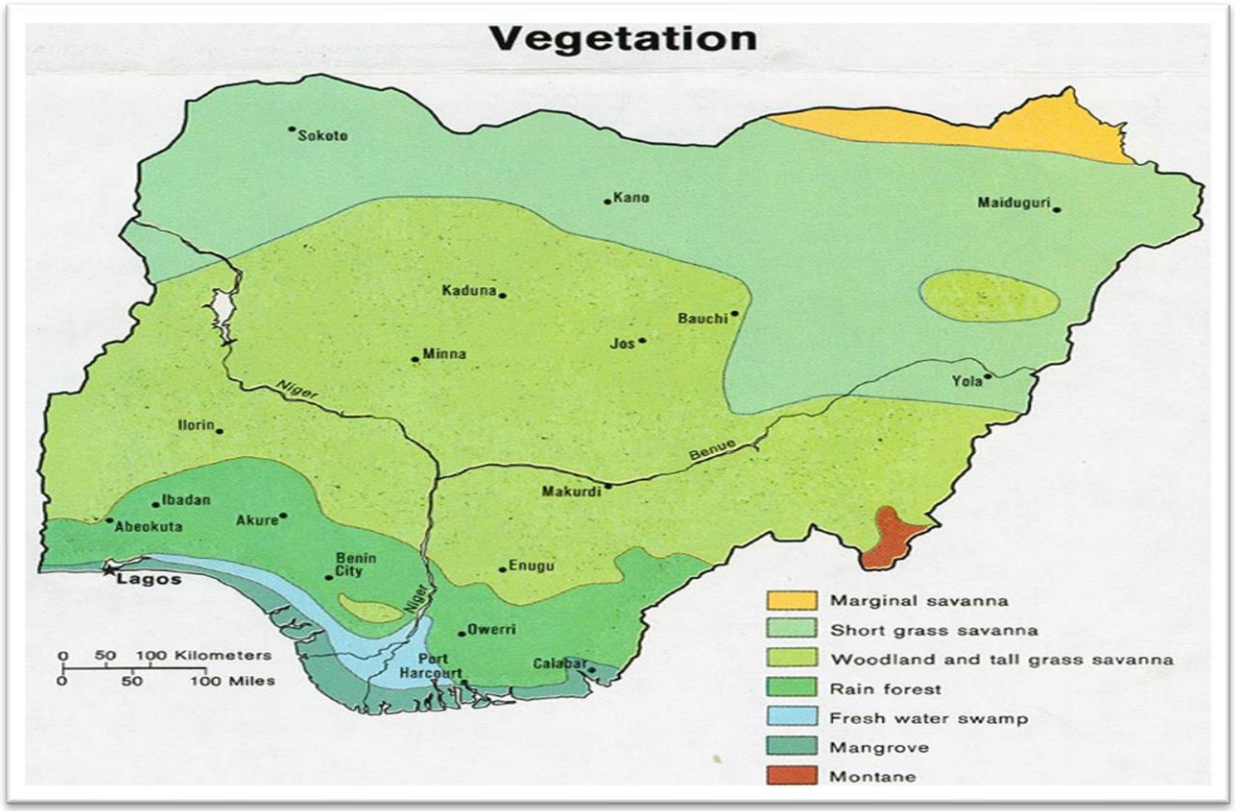


Fig.7: The daily average high (red line) and low (blue line) temperature, with 25th to 75th and 10th to 90th percentile bands. The thin dotted lines are the corresponding average perceived temperatures.

1.5.1 VEGETATION OF THE STUDY AREA

The Afikpo area belongs to the Guinea Savannah vegetation belt of Nigeria associated with thick vegetation cover, especially around the flood plain areas. The vegetation of the study area comprises mostly perennial trees, grass, climbers, shrubs and palm trees. The vegetation is influenced by human activities, annual rainfall, topography and other climatic factors.



1.6 OBJECTIVE AND SCOPE OF STUDY

The primary objective of our field trip was to produce a comprehensive geological map of the Afikpo area. This geological map will serve as a visual representation of the region's geological features, formations, and structures, aiding in the understanding of its geological history. It also provided students with hand-on experience in the field of geology, enabling us to apply the theoretical knowledge gained in the classroom to practical situations. This practical experience is invaluable in building a strong foundation for future geological studies and careers.

CHAPTER TWO

2.0 MATERIALS AND METHODS

2.1 GEOLOGICAL MAPPING PROCESS.

The geological mapping process undertaken in the Afikpo region was a meticulous ans systematic endeavor aimed at capturing the intricate details of the local geology. The methodology employed involved a series of well-defined steps to ensure accuracy and comprehensiveness in our geological mapping efforts. These steps include:

2.1.1 Preliminary Research and Planning

Before embarking on the fieldwork, a thorough review of existing geological literature was conducted to establish a foundation understanding of regional geology. These preliminary researches inform the selection of key geological features and area of interest within the Afikpo region. Planning involved determining the optimal routes for traversing the study area, ensuring comprehensive coverage.

2.1.2 Field Reconnaissance

The field study commenced with a reconnaissance phase, during which the research team systematically explored the study area to identify prominent geological features and potential sampling sites. This initial survey provided a broad overview, aiding the subsequent detailed mapping process.

2.1.3 Data Collection and Mapping

Geological mapping involved detailed data collection through direct observation and measurements. Various geological features, including rock outcrops, soil types, and topographical characteristics, were documented. The team utilized geological compasses, GPS devices, and measuring tools to record precise locations and orientations.

2.1.4 Rock Sampling

Strategic rock sampling was conducted to obtain representative specimens from different geological formations. These samples were carefully documented, tagged, and later subjected to laboratory analysis for detailed mineralogical and petrological investigations.

2.1.5 Structural Analysis

Detailed structural analysis involved the examination of geological structures such as folds, faults, and fractures. Structural measurements were taken to understand the orientation, dip, and relationships between different rock layers. This information contributed to unraveling the tectonic history and deformation processes in Afikpo.

The summary of the procedures which we used in the field in the course of the study is as follows:

- ❖ Obtaining the Coordinates of stations in the field.
- ❖ Taking note of the various outcrops/cross sections.
- ❖ Logging every outcrop to obtain details like grain size, clast shape, colour, framework structures, sedimentary structures, texture, etc which helps in naming of the rocks, as well as the paleoenvironment of deposition of the rocks.
- ❖ Measurement of the attitudes (dip direction, strike direction and dip amount) of various geological structures.
- ❖ Taking note of the trends (bearing) of the various structures.
- ❖ Collection of fresh samples at every location for further analysis in the laboratory.
- ❖ Measurement of thickness of the beds
- ❖ Taking of photographs of various structures alongside magnification objects.

2.2 MATERIALS

Materials used for the fieldwork includes:

- GPS (Global Positioning System) involved in taking the appropriate coordinates of the various locations.
- Silver compass and clinometer used for measuring attitudes of beds e.g. dip, strike, dip direction etc.
- Basemap for checking the location of outcrops.
- Camera for taking photograph of the outcrops encountered.
- Geological hammer for breaking rock samples
- Sample bags used in collecting samples.
- Markers used in labelling samples.
- Tape for measurement of distance
- Field notebook and writing materials for taking records.
- Hand lens for viewing grain size (roundness)
- Protective wears. For protection against harmful things like thorns, snakes etc.

- Hydrochloric acid: for checking for presence of calcite in rocks like sandstone.

2.3 PRECAUTIONS

Some precautions were taken in the field in order to reduce error and also to ensure safety. They include:

- Use of protective clothing for e.g. long sleeves, raffia hats, trousers and field boots to ensure body protection
- Ensuring that the attitudes of structures (dip and strike) are taken on smooth bedding planes.
- Strictly staying on the road sides of major roads as some of the outcrops studied were along the road.
- Staying off the ridges at the quarry site to avoid been hit by fallen fragments of rock or by the vehicle conveying the rocks.

2.4 LITERATURE REVIEW

Afikpo as an area of study has been visited by many geologists and researchers in the past, based on these facts many detailed maps and literature has be done and some of them have been revisited during the course of the field work.

The stratigraphy of the area consists of Ezeaku formation and Asu River group being the oldest dated sedimentary rock unit. The study area Afikpo and its environs falls within the Lower Benue trough which has been reviewed and studied by many authors on the basis of its tectonic history, facies association and successions like Kogbe (1996-1987),R.C Murat (1970) and Reyment (1965),C.S Nwajide (1976), Norbert Ejike Ajaegwu, Anthony Uwaoma Okoro, Izuchukwu Ignatius Obiadi, Emmanuel Kenechukwu Anakwuba, Leonard Nnaemeka Onuba (2015) and more.

According to Rayment (1965), the Turonian sediments in Lower Benue trough is marked by hard grey and black calcareous shale, limestone and siltstone make up the Ezeaku formation.

The Ezeaku shale grades laterally into Amasiri sandstones which has a type locality in Amasiri near Afikpo. Ezeaku formation has a thickness of about 1200m and it is overlain by Awgu shale which is 900m thick, a bluish grey in colour.

Murat (1972) was of the view that Ezeaku shale shows deposit of marine condition in a tectonically controlled basin (Abakaliki trough), he believed that sandstone deposits mark a period of transgression.

The Ezeaku formation was deposited in the Turonian transgressive phase but in a shallow marine environment. The lithologies include shale, sandstones and calcareous sandstone. Fossils present are orphiomorpia, skolithos, plant fragments and so on. The sedimentation in Afikpo syncline is as a result of erosional activities in the Aptian-Albian, Turonian and Coniacian deposits.

The Benue Trough has a lateral extent of about 250km in the south and consists of the Anambra basin, the Abakaliki Anticlinorium and the Afikpo syncline. The accumulation of thick sediment in the Benue Trough from Albian to Turonian times led to the development of instability at the base of faulted crustal blocks.

2.5 FIELD STUDY EVIDENCE

2.5.1 Field Observation

. The field observations conducted during the geological study in Afikpo were instrumental in capturing the rich tapestry of geological features present in the region. Notably, diverse rock types were identified, ranging from sedimentary to igneous and metamorphic formations. Distinctive lithological characteristics, including color, texture, and mineral composition, were meticulously documented for each observed rock unit.

Structural elements played a significant role in shaping the landscape, and detailed observations revealed the presence of various geological structures. Prominent fault lines, folds, and fractures were identified, contributing to a nuanced understanding of the tectonic processes that have influenced the geological evolution of Afikpo. In addition to rock types and structures, the team documented the topography of the study area. Variations in elevation, slope angles, and the overall geomorphology provided valuable context for interpreting geological formations in relation to landscape features.

Photographic documentation supplemented textual descriptions, capturing the essence of the geological landscape. These photographs served not only as a visual record but also as aids in subsequent analyses and presentations.

2.5.2 Sample Collection

Rock sampling was a meticulous process, guided by the intention to capture the representative diversity of Afikpo's geological composition. Samples were systematically collected from key locations, considering variations in lithology, structural features, and topography.

The collected samples exhibited a wide range of characteristics, reflecting the geological complexity of Afikpo. Sedimentary rocks unveiled clues about past environments, while igneous formations hinted at volcanic activities. Metamorphic rocks added layers to the narrative of geological transformations over time.

2.5.3 Preliminary Analysis

A preliminary analysis of the field data revealed intriguing patterns and relationships within the geological landscape of Afikpo. Initial observations suggested geological sequences, with certain rock layers appearing to be stratigraphically linked. Structural analysis hinted at the dynamic forces that have shaped the region, providing a glimpse into the geological history of Afikpo.

The distribution of rock types across the survey grids hinted at geological variations within the study area. Certain lithological units seemed to correlate with specific topographic features, sparking curiosity about the interplay between geological processes and landscape formation.

CHAPTER THREE

3.0 DETAILED DESCRIPTION OF FIELD WORK

On the first day of the field work, we were reminded how to make accurate use of the compass in measurement of bearing and attitudes of beds (as already treated in GLS132). A base map of the area was given to us and we were asked to locate the position we were on the map. The class was divided into six groups but the learning was done together.

The process generally involves the following;

- Obtaining the Coordinates (Longitude and Latitude) at each station, as well as its elevation using the GPS.
- Taking the bearing of the forward station using a compass.
- Any notable landmark around the stations can be recorded as a remark.

These processes were carried out in each station. The readings are tabulated as seen in Table 1 below and was inserted in the base map.

3.1 STATION REPORTS

STATION 1: Amasiri Quary site

Coordinates

Longitude: $007^0$54’41”E

Latitude; $005^0$56’48” N

Elevation: 80m

Altitude of Bed

Strike direction: S126^0E

Dip Direction: 210^0 SW

Dip Amount: 9^0

Sedimentary structure: Angular bedding

GENERAL DESCRIPTION

It is highly indurated sandstone due t the presence of calcite

Its bedding is inclined

It is well sorted

There is a little effervescence due to the presence of very little percentage of calcite

It has lamination

There is presence of joint

1st joint direction: 150^0 & 230^0 , 2nd joint direction: 150^0 & 338^0

STATION 2: St Gabriel Catholic Parish Amasiri

Coordinates

Longitude: $007^0$53’10”E

Latitude; $005^0$55’6” N

Elevation: 50m

Altitude of Bed

Strikes: 122^0

Dip Direction: 61^0

Dip Amount: 8^0

GENERAL DESCRIPTION

The outcrop is highly consolidated limestone

It is also highly ferrogenized

The outcrop is homogenous

It is highly indurated

It has rip-up clasts that are created from the reaction between rainfall and the carbon that is present in the limestone.

It has an overall thickness of 10ft

It is light grey to dark grey in colour

STATION 3: ROAD CUT ABOUT 700M FROM AMASIRI FLYOVER

Cordinate:

Latitude: 5º 53´ 47´´N

Longitude: 7º 53´ 5´´E

Elevation: 50m

Altitude of bed:

Dip of the fault: 52º

Strike: 220º

Dip direction: 70º

Fault direction: S234ºW

GENERAL DESCRIPTION

A fault zone. Shattered boulders are evidences of fault (shattered zone). It is indurated and the sandstone has been crystalized after faulting.

Evidences of faulting:

- Shattered rocks
- Reticulations
- Sleeking sites

The horizontal displacement of the hanging wall and footwall is called the Heave while the vertical displacement is called the Throw. When the heave and the throw changes from the top of the fault to the base, it is called a growth fault.

The fault plane flattens towards the base of the fault, it is called a listric fault

STATION 4: Amasiri Primary school (200m from D-Base hotel)

Coordinates

Longitude: $007^0$53’22.57”E

Latitude; $005^0$54’37.09” N

Elevation: 44.92m

Altitude of Bed

Strike direction: S310^0E

Dip Direction: 46^0 SW

Dip Amount: 33^0

GENERAL DESCRIPTION

The lithology is sandstone

It is highly indurated (very hard) due to diagenesis activity

Presence of bioturbation. It combination of cryptic and distinct burrows

Effervescence occur when acid is poured on the rock

It is dark grey on the surface but when broken into, the colour is light grey

There is fault and joints caused by tectonic activities e.g. Earthquake

It is an erosional exposure of sand that has undergone diagenesis to be compacted

We find skolithos facies because the area is made up of relatively high energy due to the sandstone.

The ophiomorphia are the distict ichno fossils that are evidence of storm.

Altitude of joints

Strike of the 1st joint: 150^0, 330^0

Strike of the 2nd joint: 158^0, 338^0

Dip amount: 40^0

Dip direction: 158^0

Strike direction: 238^0

STATION 5: Roadcut ridge along 1km Amasiri Junction on Amasiri Afikpo road

Coordinates

Longitude: $007^0$53’46.82”E

Latitude; $005^0$54’15.66” N

Elevation: 45.8m

Altitude of Bed

Strike direction: S126^0E

Dip Direction: 210^0 SW

Dip Amount: 9^0

SECTION 2 (Extension)

Coordinates

Longitude: $007^0$54’39”E

Latitude; $005^0$36’47” N

Elevation: 80m

Altitude of Bed

Strike direction: S254^{0}E

Dip Direction: 154^0 SW

Dip Amount: 13^0

GENERAL DESCRIPTION

It is highly consolidated sandstone

It is heterogeneous sandstone with intercalations of shale

Presence of water seepage from the boundary between sand and shale

STATION 6: Road cut ridge along 1km to Amasiri/Abakaliki junction

Coordinates

Longitude: 007^{0}53’46.82”E

Latitude; 005^{0}54’15.63” N

Elevation: 45.81m

Altitude of Bed

Strike direction: S332^{0}E

Dip Direction: 242^0 SW

Dip Amount: 32^0

GENERAL DESCRIPTION

It is highly consolidated

It is poorly sorted

The overall thickness is 4.45ft

It is moderately coarse

It is highly friable

The sedimentary structures present are reticulations, burrows and bioturbations

The outcrop has about 3 strata

1st bed

The bed is about 1.1ft

It is well sorted

It has fine grains

2nd bed

The bed is about 2.35ft thick

It is well sorted

It is moderately coarse

STATION 6, OUTCROP 2: Road cut on Ozara ukwu ridge 1km from Amasiri junction along Abakaliki road

Coordinates

Longitude: $007^0$53’58.93”E

Latitude; $005^0$54’18.50” N

Elevation: 47.11m

Altitude of Bed

Strike direction: S260^0E

Dip Direction: 170^0 SW

Dip Amount: 16^0

GENERAL DESCRIPTION

There’s presence of lamination

Presence of crossbed

STATION 7: IBII JUNCTION QUARRY SITE.

Cordinates:

Latitude: 5º 65′ 34′′N

Longitude: 7º 54′ 29′′E

Elevation: 50m

Altitude of bed:

Dip amount: 42º

Dip direction: 160º

Strike: 238º

GENERAL DESCRIPTION

Formation: Shale formation.

There is presence of shale fragments. It is interbedded sandstone and shale. They are alternating and flipping. Shale are formed by clay minerals, quartz, and kaolinite.

The sediments are marine sediments.

Colour: Bluish grey

STATION 8: ABANDONED QUARRY SITE, 200M FROM AMASIRI JUNCTION ON AFIKPO ROAD

Cordinates:

Latitude: 5º 53′ 59′′ N

Longitude: 7º 54′ 39′′ E

Elevation: 85m

Altitude of bed:

Strike: 152º

Dip amount: 40º

Dip direction: 68º

Lithology: Base igneous rock

GENERAL DESCRIPTION

There is presence of sill because it is parallel to the strike direction of the bed. The igneous rock travels through fracture and follows magma into the sediments. They crystallize and form intrusive rock. The outcrop is mainly dolomite or diorite and it has a coarse grain.

STATION 9: Amasiri sandstone

Coordinates

Longitude: $007^{0}54'52"$E

Latitude; $005^{0}53'47"$ N

Elevation: 60m

GENERAL DESCRIPTION

It is a road cut outcrop of about 25ft thickness

It has a colour of yellowish brown

Minerals present are the kaolinite, quartz and feldspar

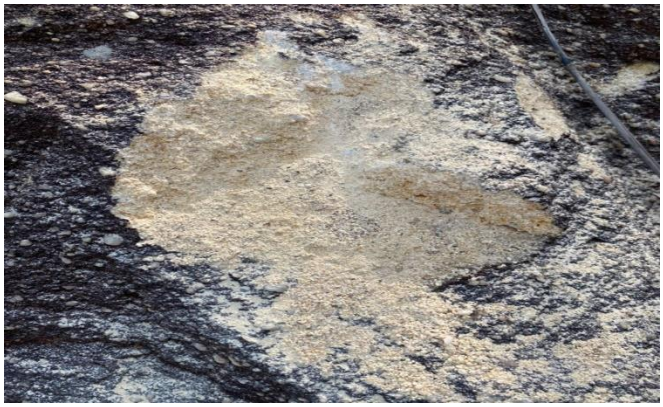
It has a coarsening upward sequence

It is poorly sorted

The grain shape is sub-rounded to angular

Going upward, there is presence of pebbles

The beddings are not well displaced so we cannot log



DAY3, STATION 9, OUTCROP 2; Extension of station 11

Coordinates

Latitude: $005^{0}53^{'}44^{"}$ N

Longitude: $007^{0}54'52"$E

Elevation: 69.38m

Altitude of Bed

Dip amount: 180

Dip direction: 240°

Strike direction: 150

GENERAL DESCRIPTION

It is caused as a result of regression after transgression occurs and it's called ravament surfaces and it is characterized by shoreline pebbles and it is called AFIKPO sandstone

The area is made up of amasiri sandstone which is the oldest bed and on topis AFIKPO sandstone which is the younger bcd.

Outercrop1

The outcrop is a gorge filled with fine particles, it is a faut zone

Dip amount: 9^{0}

Outerop2

It is a fault zone, there is an opening in it called gorge filled with fines

Dip amount: 44^{0}

Hence it is a normal fault if the fault is less than 30, it is a reverse fault

Dip direction: 266^{0}

Strike direction: 226^{0}

Outcrop 3(Afikpo sandstone)

We are now entering the Anambra basin with the basal area as the afikpo sandstone. The unconformity separating the benue trough and the Anambra basin has a gap of about 6 million years.

We have weathered sandstone and they are fine grained particles

Coordinates

Latitude: $005^0 53' 38''$ N

Longitude: $007^0 54' 59''$E

Elevation 90m

Altitude of beds

Dip amount: 8^0

Dip direction: 198^0

Strike direction: 280^0

1st bed

Thickness: 93.5em

Four Fine sandstones and pebbles

2nd bed

Thickness: 15cm

Claystones with pebbles

It has a brown color

3rd bed

Thickness: 15cm

Very coarse grain and pebbling sandstone

It has brown colour

4th bed

Thickness: 6cm

Its grain size is fine to medium gran

It has a brown colour

5th bed

Thickness: 7cm

It has a reddish brown colour

It is very coarse grain and pebbling. It is ferrogenous

6th bed

Thickness: 8cm

It is claystone

They are coarse grained with presence of feldspar

Presence of cross bedding. It is lenticular

EXTENSION OF MC GREGOR HILL

Coordinates

Latitude: $005^{0}53^{'}38^{"}$ N

Longitude: $007^{0}55^{'}6^{"}$E

Elevation: 90m

GENERAL DESCRIPTION

They are coarse grained sandstone

It is a channeled sediment

It is pebbly with planar cross beds. It is tidal point bar

It has about 6 strata

1st bed

Thickness: 5cm

Its grain size is medium to fine grained

It has a whitish colour

It grain shape is sub-rounded

It is well sorted

It sedimentary structures are planar cross beds

Strike of the bed is 286^{0}

2nd bed

Thickness: 20cm

It has a planar cross bed as sedimentary structure

The azimuth of the cross bed is 336^{0}

It is poorly sorted

The grain shape is angular

3rd bed

Thickness: 15cm

The azimuth of the cross bed is 286°

The grain shape is sub-rounded

Grain is poorly sorted

The grain size is fine to very coarse grained

4th bed

Thickness: 32cm

Azimuth of the cross beds is 270^0

The grains are poorly sorted

It has fine to very coarse grain

5th bed

Thickness: 26cm

It has cross beds

It is pebbly, with fine to coarse grained

6th bed

Thickness: 72cm

It is also pebbly and has grain size of fine to coarse

STATION 10: Back of Ebonyi hotel (ripple area)

Coordinates

Latitude: $005^0 53' 34'' N$

Longitude: $007^0 55' 9'' E$

Elevation: 100m

GENERAL DESCRIPTION

Current ripples are those deposited by rivers

Ripples can be asymmetric or symmetric

Asymmetric ripples are those ripples that migrate until the flow stops then the ripple is preserved

Ripples have crest and trough

The depositional side is called LEE

Symmetric ripples are generally produced in places of bi-directional current

Asymmetric ripples are produced in river or tidal channels in continental environments

If the distance between two crests and troughs are equal, they can be named symmetrical ripples

If the distance between two crests and troughs are not equal, it is said to asymmetrical ripples

STATION 11: AFIKPO SANDSTON RIDGE AT OZIZA

Cordinates:

Latitude: 5º 57′ 27.22′′N

Longitude: 7º 57′ 41.55′′E

Elevation: 122m

Altitude of bed:

Dip direction: 310º

GENERAL DESCRIPTION:

A syncline and there is no evidence of tectonic activity.

Grain size: Fine to medium.

Colour: Brown

STATION 12: NDIBE BEACH/RIVER (FLUVIAL ENVIRONMENT).

Cordinates:

Latitude: 5º 50′ 38′′N

Longitude: 7º 56′ 53′′E

Elevation: 50m

Altitude of bed:

Dip direction: 310º

Dip amount: 2º

Strike amount: 37

GENERAL DESCRIPTION:

The point bar is the sandy part of the river i.e. where sand accumulates. The sediments are eroded through the river to the point bar. The river is the boundary of cross river flowing from the hinterland at the calabar estuary to the ocean.

STATION 13: 200m from Ndibe River

Latitude: $005^{0}50^{'}41^{"}$ N

Longitude: $007^{0}56^{'}48^{"}$E

Elevation: 20m

GENERAL DESCRIPTION

The rocktype is sandstone

It is poorly sorted

Its composition is quartz and feldspar

The cement is clay

Its grain size is fine to very coarsening pebbles

Here, it is also a distributive chanel or tidal or fluvial channel

The outcrop is 200m from the river

DAY 3, STATION 14: Beside maria island resort

Coordinates

Latitude: $005^{0}50^{'}50^{"}$ N

Longitude: $007^{0}55^{'}56^{"}$E

Elevation: 21.20m

Altitude of Bed

Dip amount: 4^0

Dip direction: 280^0

Strike direction: 190^0

DAY 3, STATION 15; Endrock ventures block industry

Coordinates

Latitude: $005^0 51' 59'' N$

Longitude: $007^0 56' 30'' E$

Elevation: 21.20m

Altitude of beds

Dip amount: 5^0

Dip direction: 132^0

Strike direction: 212^0

GENERAL DESCRIPTION

The outcrop is a sandstone with a foundation where the flows from

The sandstone is cross bedded and laminated

It is fine grained to medium

It has bioturtbated and has burrows (skolithos)

It has whitish colour

CHAPTER FOUR

HYDROGEOLOGY, ENGINEERING, ENVIRONMENTAL, STRUCTURAL AND ECONOMIC GEOLOGY OF THE AREA

4.0 HYDROGEOLOGY OF THE AREA

The hydrogeology of the study area is influenced by the presence of sandstones which serves as an aquiferous unit and also by the presence of fractured shale in the locality. Surface water flow and seepage from streams, lakes,beaches, and rivers are among the major processes by which ground water is recharged naturally. Also these surface waters serve other purposes to the indigenes such as fishing, means of transportation, etc. The aquiferous sandstone due to its high porosity and permeability allows for ground water movement. The ground water in the area is utilized in the following ways:

i. For agricultural purposes.

ii. For drinking purposes.

iii. For industrial purposes.

iv. For domestic uses.

These aquiferous sandstones where interbedded with other rocks like shale results to the eruption of springs.

4.1 ENGINEERING GEOLOGY OF THE AREA

Engineering geology can be referred to as a major aspect of geology concerned with the physical and mechanical properties of natural rock, structural fabrics and defects such as fault, folds, foliations and joints which can affect the stability of rocks and consequently human engineering structures such as dams, road cuts, open and underground mines, buildings, etc. The area is naturally endowed with geologic materials which directly affect the engineering geology of the area. For example, dolerite intrusion was observed at station 23 within the Amasiri sandstone. This dolerite can be used for construction but cannot be used for engineering purposes in Afikpo region due to the fact that dolerite rocks are made of high temperature minerals such that they have weak cooling rate during road construction. The dolerite rather is crushed and used for cement production. Sandstone which dominates in this area can be used for construction of houses,roads,etc.Amasiri and Ezeaku sandstone are more useful in terms of engineering because they are more indurated and hardened whereas the Afikpo sandstone unit is more plastic than the other two units.

4.2 ENVIRONMENTAL GEOLOGY AND GEO-HAZARDS

It is observed that the sediments in the study area were simultaneously deposited by a set of transgressive and regressive events. There are presence of different rock types like sandstone, mud, silt, shale, pyroclastic rocks and igneous intrusions. Afikpo lies in the Cross River plain and the area lies in the formation known as Ezeaku shale formation of the Turonian age. The result of sedimentation and folding on Afikpo gave rise to two major structural features thus the Abakaliki anticlinorium and the Afikpo synclinorium. The transgression and regression occurred in the Cenomanian period.

The major geo-hazards found in the study area of Afikpo are mainly of three (3) types and they are; ground water erosion, contamination and pollution. All these are of hazardous effect to health and could predispose one to health complications. Other hazards harmful to health are droughts and desertification.

Erosion might arise in such area because of the burning of bushes probably for cultivation and even uncontrolled deforestation could also make the land easily influenced to erosion thereby causing leaching. Some of these hazards can be in terms of erosion and pollution. In terms of erosion, planting of cover crop and also making ridges across slope could minimize the danger to human health especially when farming is about to take place. Careful application of these methods will reduce hazards especially the controllable ones to the barest minimum and the lives of the people will be better.

4.3 STRUCTURAL GEOLOGY OF THE AREA

The study area has many structural features which are both primary and secondary structures in origin. The primary structures observed include ripple marks, cross beddings, laminations, trails and burrows which are evidence of animals or organisms that were in existence in the past, while some secondary structures present in the area include fractures (joint and faults) and igneous intrusion. The dolerite and exfoliation dome which occurred as a result of spherical weathering was observed.

4.3.1 Primary Structures

These structures includes: cross bedding, bedding planes, ripple marks, etc

- Cross bedding: These are also called cross stratification developed where the sand has dropped over the edge for gravity sand bar, migrating sediments usually cause cross bedding in sandstone, and are common in Amasiri sandstone.

- Ripple marks: these are wave-like sedimentary structures made by water or water movement mostly observed in the sand units. It has both crest and trough. The type found in Afikpo is the oscillatory type which gives much information about the energy of the environment of deposition.

- Biogenic Structures: These are structures made by living organisms. These may be footprints or traces of feeding habit. Typical examples are the traces of orphiomorphia and skolithos which were observed in the area

4.3.2 Secondary Structures

They are geologic structures that are formed after the host rock is formed. The secondary structures encountered in the study area are: joints, faults, igneous activities and angular unconformity.

- Joints: They are structures that are formed when there is no appreciable displacement in a fractured terrain. There are lots of these structures within the area especially in the Ezeaku sandstone outcrop at station 10.

- Faults: These are structures that are characterized by appreciable displacement within a fractured terrain. The fault plane observed in the study area has palm trees clustered along it which is due to the stream flowing along the strike direction of the fault plane. Standing at one block of the fault, it was observed that the other block was displaced to the right which makes it a dextral strike-slip fault.

4.4 ECONOMIC GEOLOGY OF THE AREA

Economic geology is the branch of geology concerned with the earth materials that can be used for economic and/or industrial.

Some of these economic materials observed in the study area are thus;

i. **Sandstone:** It is excavated in most part of the study area and consists of quartz fragments with high iron concentration. They are used in house building, roads and bridge constructions. It can also be used to stabilize slopes especially the angular slopes flat boulders.

ii. **Clay and Shale:** Clay are locally quarried and used for pottery and plastering of houses because they have good binding properties. The shale are used for structural wares such as bricks, terracotta, refractory production and even tiles and also are modified and used for roofing.

iii. **Ironstone/pebbles:** Ironstones are also quarried in the study area. They are made up of quartz and limonite. Iron oxide is the cementing material. They used for making alloys and construction works.

iv. **Dolerites:** Is a fine to medium grained mafic igneous mineralogically and chemically equivalent to basalt, commonly forming minor intrusions. The rock is quarried and crushed into aggregate for construction purpose.

CHAPTER FIVE

SUMMARY AND CONCLUSION

5.0 SUMMARY

The study area is situated at Afikpo North Local Government Area of Ebonyi State. The area is composed of sediments of the upper cretaceous and the various formations encountered include; Afikpo sandstone, Ezeaku shale and Amasiri sandstone. Ezeaku shale and Amasiri sandstone are parts of the Ezeaku group which outcrops as a major stratigraphic unit of the southern Benue trough. Geomorphologically, the area is made up of highlands and lowlands, as a result of which the drainage pattern is Dendritic. It possesses many geological features both primary structures such as cross beds, bedding planes and biogenic structures, secondary structures such as faults and joints and dolerite (igneous) intrusions which can be very useful in terms of economic geology.

5.1 CONCLUSION

In conclusion, the geological field study in Afikpo represents a significant step in unraveling the geological complexities of the region. The systematic mapping process, coupled with detailed field observations and rock sampling, has laid a foundation for a more profound understanding of Afikpo's geological history.

This report not only contributes to the local geological knowledge but also provides a basis for future research endeavors in the region. The preliminary findings underscore the need for continued investigations to refine our understanding of Afikpo's geological evolution. As we conclude this chapter, we look forward to delving deeper into the laboratory analyses and interpretations that will follow in subsequent sections, enriching our comprehension of Afikpo's geological story.