Geology of The Area Around Bajoga Town, Part of Sheet 131 Bajoga N-E, Funakaye Local Government Area Gombe State

BY

Abubakar Baba

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AUGUST, 2010

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BY

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A THESIS SUBMITTED TO GEOLOGY DEPARTMENT, ABUBAKAR TAFAWA BALEWA UNIVERSITY BAUCHI, IN PARTIAL FULFILMENT OF THE REQUIRMENT FOR THE AWARD OF BACHELOR IN TECHNOLOGY

(APPLIED GEOLOGY)

AUGUST, 2010

DECLARATION

I hereby declare this project is a product of my research work under the supervision of Mallam Ahmad Tukur and has not been presented elsewhere for the award of any certificate. All sources have been duly distinguished and appropriately acknowledged.

Student's name; ABUBAKAR BABA

Signature; .....

Date; 3/1/2011

Supervisor's Name; Ahmadu Tukur

Signature ; .....

Date; 02/02/11

CERTIFICATION

This research project title "GEOLOGY OF THE AREA AROUND BAJOGA TOWN, PART OF SHEET 131 BAGOGA N-E FUNAKAYE LOCAL GOVERNMENT AREA, GOMBE STATE" meets the requirement for the award of Bachelor of Technology (Applied Geology) at Abubakar Tafawa Balewa University Bauchi.

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6/2/11
Date

DEDICATION

I dedicated this research work to my kind and responsible elder brother Musa Abdullahi (Baba) Kwami.

AKNOWLEDGEMENT

All praise be to Almighty Allah the Lord of the entire Universe who is the initiator of all aspect of human life. Firstly I wish to extend my profound gratitude to my Supervisor Mallam Ahmad Tukur for his constructive and technical amendments throughout the period this research work, I also wish to extend gratitude my gratitude to the programme co-coordinator Mallam A.S Maigari and the entire staff of Geology programme for their monumental effort of impacting vibrant knowledge into me during the course of my undergraduate studies. Secondly I appreciate and thank my parents who leave no stone unturned by morally and financially supporting me throughout the period of my academic studies right from nursery school up to the stage earning my first degree in Applied Geology.

Lastly I thank my colleagues , friends and all well wishers who helped me either directly or indirectly ,in cash or in kind, knowingly or unknowingly, socially, academically, or morally to the end of this academic battle.

ABSTRACT

The area mapped falls within sheet 131 BAJOGA N-E of the Geological Survey of Nigeria. It is located within the Gongola arm of the Upper Benue Trough of Nigeria, it covers thirtysix squire kilometers. The formations of the area is Gongila and is composed of three lithologic units namely; Limestone, sandstone and shale units, sandstone eighty percent, Shale covers eight percent of the study area whereas limestone covers twelve percent of the study area,they are all exposed both on the surface and along stream channels and much thicker towards parts of many sections. Geologic map was produced at the end of the mapping using the data obtained from the field, samples were obtained on the field and were analysed in the laboratory. The environment of the area is marine.

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CHAPTER ONE; GENERAL INTRODUCTION

1.0 INTRODUCTION

The area being mapped formed part of the sedimentary Terrain within the Gongola Basin of the upper Benue Trough of Nigeria. The N-S aligned Gongola Basin links Benue Trough with the Bornu (Chad) Basin forming part of the west African Rift system. It's lithostratigraphic sequences begin with thick Lower Cretaceous continental classit, the Bima sandstone which is the oldest formation and is overlain by continental to marine Yolde formation. The Pindiga Formation represents the greater part of the dominantly marine Upper Cretaceous Basin. Benue Trough is the most important of all the Cretaceous Sedimentary Basin in Nigeria. Reviews of the Origin and evolution of the linear NE-SW trending mega structure were recently provided by Benchelil (1989).

The continental Bima group comprises the oldest sediment in the upper Benue Trough which directly overlies the Basement rocks, Bima Group is divided in to Upper, Middle and Lower. Yolde Formation overlies by Pindiga, Gongila then Fika Formation. Kerri-Kerri Formation being the youngest is unconformably underlain by Gombe Sandstone.

1.1 LOCATION AND ACCESSIBILITY.

The area mapped is located within the Funakaye local Government Area of Gombe State few metres away from Bajoga town , It covers a land mass of thirty six square kilometers (36) km2 and comprises of Gongila Formation.

The area is bounded by longitude ($11^{0}26'$ 12", $11^{0}30'00$") N and latitude ($10^{0}51'00$", $10^{0}54'$ 52") E within sheet 131 Map of the Geological Survey of Nigeria. It is 80kilometres away from Gombe Town and is easily accessible by foot but may be difficult in the rainy season due to mud in most parts of the area, there are also foot paths link villages and a railine which passes across the area. There is good road network that links Gombe to Bajoga and also to Ashaka Cement factory.

1.2 OBJECTIVES.

The main objectives of the study include the following;

- To acquire skill and practical knowledge of Geological Mapping.
- To identify different Sedimentological units of the Gongila Formation.
- To produce a geologic map of the area using data obtained from the field.

1.3 TOPOGRAPHY AND DRAINAGE.

The topography of the area generally produces almost a flat terrain with a distinctive black cotton soil which is heavily cultivated in settled areas. The

drainage system exhibits a straight to meandering pattern with few tributaries and most of the stream channels are ephemeral.

1.4 CLIMATE AND VEGETATION.

Rainfall which is the most critical element of climate is concentrated in short wet season starting from May to late September whereas the dry season last for seven months and above, normally from (October to April), day time temperature is very high (except during harmattan), but as a result of rapid transpiration in the night , the wind coming from the neighboring desert land is not only dry but also dusty, visibility is greatly impaired by haze of dust particles. The vegetation cover consists of short grasses and dispersed trees commonly shrubs and scrubs mixed together.

CHAPTER TWO; LITERATURE REVIEW

2.0 GEOLOGIC SETTING

The Benue Trough is the most important of all the Cretaceous sedimentary Basin of Nigeria. Reviews of the origin and evolution of linear NE —SW trending mega structure were recently provided by Benchelil (1989). Benue Trough is divided into Upper, Middle and Lower. The Upper Benue Trough bifurcates into an S-W trending Yola Arm and N-S trending Gongola arm, Carter et al(1963) produced the foundation work on the geology of the Upper Benue Trough. Zambuk ridge is refers to the general area between the Yola Arm and Gongola Arm, a zone characterized by a number of important NE—SW trending sinistral strike slip fault. The origin of the formation and evolution of the Benue Trough is related to the opening of south Atlantic ocean were probably partly controlled by the pre-existing structures of the West African Shield Benchelil (1989).

Benue Trough lies on the Nigerian Basement complex that belongs to the rejuvenated Pan-African mobile zone.

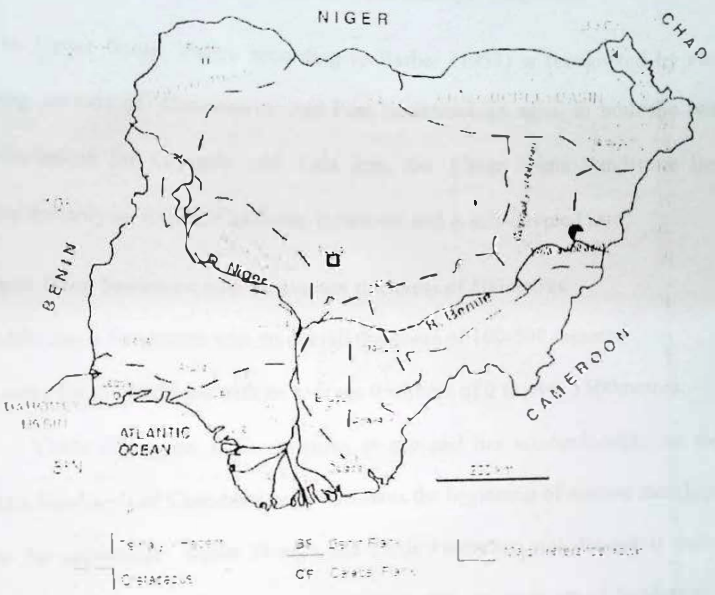


Fig 1. A Sketch of Geological Map of Nigeria showing the Lower, Middle and Upper Benue Trough of the study area (after Obaje et al 2004).

2.1 STRATIGRAPHY OF THE UPPER BENUE TROUGH

The Upper Benue Valley according to Barber (1957) is recognized by two folding periods of Cenomanian and Post Maastritchian ages, in both the two sub-basins ie the Gongola and Yola arm, the Albian Bima Sandstone lies uncomfortably on the Pre-Cambrian Basement and is sub-devided into;

•Upper Bima Sandstone with an average thickness of 500metres.

•Middle Bima Sandstone with an overall thickness of 100-500 meters.

• Lower Bima Sandstone with an average thickness of 0 to over 1500metres.

Yolde Formation is Cenomanian in age and lies uncomfortably on the Bima Sandstone of Cenomanian, it represents the beginning of marine incursion into the uppermost Benue Trough, the Yolde Formation was deposited under the transitional /coastal marine environment and is made up of Sandstone , limestone,shale and mudstonetone units. In the Yola Arm of the Basin , the Dukul , Jessu , Sekuleye Formations . Lamja Sandstone and Numanha Shale's are of the Turonian- Santonian equivalent of Gongila and Fika Formations.

The Turonian- Santonian deposits of the Yola arm is litho logically and paleoenvironmentally similar to those in the Gongola Arm except Lamja Sandstone, the type locality of the Dukul Formation is in the village of Lakun. In the Gongola Arm sub-basin, the equivalent Gongila and Pindiga Formations

plus possibly Younger Fika Shales lies uncomfortably on the Yolde Formation, these Formations represents fully marine into the Upper Benue Trough during Turonian to Santonian age.

Litho logically, these Formations are characterized by dark Carbonaceous Limestone and Shales intercalating with pale colored Limestone Sandstone and Shales . The type locality of Gongila Formation is at the quarry of Ashaka cement Factory at Ashaka village. Fika shale is composed of bluewish-green Carbonaceous limestone. Santonian was a period if deformation and folding in the whole of Benue Trough, post folding sediments is represented by the continental Gombe Sandstone of Maastrichtian age and the Kerri-Kerri Formation is of Tertiary age.

2.2 Basement Complex

The entire sedimentary unit of the Upper Benue Trough lies over the Basement complex of the Pre-Cambrian age, it is also referred to as Older Granite and composed of migmatite, manzonite, chanochite, diorite, gneiss of Late Achaean and Pan-African ages of 2.5 Ga and 600Ma respectively (Dada 1980, 1983 and 1985). However the tertiary volcanics intruded Basement complex in various localities.

2.3 Bima Sandstone

The central Bima Group comprises the oldest sediments in the Upper Benue Trough , it directly overlies the crystalline Basement rocks, although its type section at Bima hill is in the Lamurde anticline Falconer (1911), Carter et al (1963), other descriptions of Bima Sandstone were also provided by Popoff (1986, 1989) but the most detail account of it was provided by Guiraud (1990,1992) who categorized it into Upper, Middle and Younger Bima Sandstone.

2.4 Yolde Formation

The name "Yolde" was proposed by Carter et al (1963) for the transition bed recognized earlier by Falconer(1911) and Barber et al (1954) between the Bima Group and Pindiga Formation. It directly overlies Bima Sandstone and consist of thinly bedded Sandstone followed by alternating mud and Shaly Limestone (Offodile, 1992). The most complete section of Yolde Formation is found at N-W of Ruwan Kuka village nearly 1500metres exposed. The Yolde Formation is indeed a transitional sequence between the Continental Bima and the marine deposit of lower part Pindiga Formation. Lawal (1982) plus Lawal and Maulade (1986) suggested Late Albian to Late Cenomanian age for Yolde Formation on the basis of palynofossils.

2.5 Pindiga Formation

The name name "Pindiga" Formation was proposed by Carter et al (1963) for the Calcareous bed and Clays and Shale previously by Barber et al(1954), it directly overlies the Yolde Formation make up a greater part of Upper Cretaceous deposit in the Upper Benue Trough, the type section this Formation is in the Pindiga stream and it's of Turonian-Cenomanian age and is a marine sequence consisting of fossiliferous Limestone and Shale together with Sandstone intercalated with siltstone Benchelil (1985). Pindiga Formation is divided into Gongila and Fika Formation by Carter et al (1963) while Zaborski et al (1997) sub-divided it into Kanawa, Deba-fulani, Dumbulwa, Gulani and Fika Formations.

2.5.1 Kanawa Member

The name "Kanawa" was proposed by Thomson (1958) for the sequence of Shale and intercalated Limestone outcropping around Kanawa to the east of Gombe , it is therefore corresponds to only the Lower Shale-Limestone Member of Pindiga Formation. Kanawa village lies on the outcrop of Deba-fulani Member and is characterized by very few settlements, it provides an excellent stratigraphical marker horizon between the sandy units above and

below formed during Cenomanian- Early Turonian transgression which affected the entire Benue Trough and the Saharan region.

2.5.2 Deba-Fulani Member

The name ''Deba-fulani'' was proposed by herein for the mainly sandy beds occurring in the middle part of the Pindiga Formation over most of its outcrop, it is expressed topographically as a low ridge of undulating hills, it weathers to produced a thin red lateritic soil with regolith composed of some boulders but mostly pebbled-sized fragment of dense and flaggy ironstones. Exposures of the Deba-fulani Members are rare and no complete section has been found elsewhere.

2.5.3 Dumbulwa Member

The name ''Dumbulwa'' is a new proposed name in the study for a unit which appears to be the same as upper Sandstone-Shale portion of the Gongila Formation Carter et al (1963), it reaches its greatest thickness of about 200metres in the Dumbulwa-Bage hills. The Gulani and Dumbulwa Members both overlies Kanawa Member at the base of these units is therefore not Older than Late-Early Turonian.

2.5.4 Fika Member

The Fika member comprises the Fika Shale of Carter et al(1963) and the equivalent of the Upper Shale Members recognized by this Authors in the Pindiga Formation, it produces a low featureless topography, it is outcrop can

often be recognized from the black shrinking clay soil to which it gave rise. Beds of Limestone , Ironstone, Shale and plant rich Shale have been encountered in Fika Member. No exposure of any appreciable thickness has been found in this unit and no type section has been found or can be presently be designated.

2.6 Gongila Formation

The Gongila Formation makes up the marine Upper Cretaceous deposit in the Chad Basin of Carter et al (1963). It was first described by Falconer (1911), Reburns and Jones (1934) included in there Limestone-Shale outcrop Group. The base of the Formation is defined by the first appearance of real marine sediments conformably above the less developed Yolde Formation.

The type section of the Gongila Formation is a small hillside near Gongila village Carter et al (1963). However the most better developed section of this very Formation is seen in the Limestone quarry of the Ashaka Cement Factory at Ashaka village(Obaje et al 1999).

2.7 Gombe Sandstone

Gombe Formation was proposed by Carter et al (1963) for the Gombe grits and clays previously identified by Falconer(1911), it varies from few millimeters to few centimeters in thickness, it overlies the Pindiga Formation in the stratigraphic sequence and it is a flat lying alternating thinly bedded fine to medium grained ferrogenised Sandstone, thin Coal beds occurs in localized

areas and this has been dated as Campanian-Maastritchian. The depositional environment of this Formation is Deltaic to Continental (Offodile, 1975), there is a marked angular unconformity between Gombe Sandstone and Kerri-Kerri Formation and underlained by Fika Formation.

2.8 Kerri-Kerri Formation

This is a sequence of fine-grained Sandstone and Silt, the lithostratigraphic facies changes rapidly both horizontally and vertically, this changes is noted from one Kerri-Kerri Basin to another Dike (1993), it uncomformably overlies Gombe Sandstone with an estimated thickness ranging from few metres to about 300meters (Dessanvagic, 1975) and Dike (1993), the depositional environment of this very Formation is Fluviotile to Lacustrine sequence of reddish Sandstone and Clay.

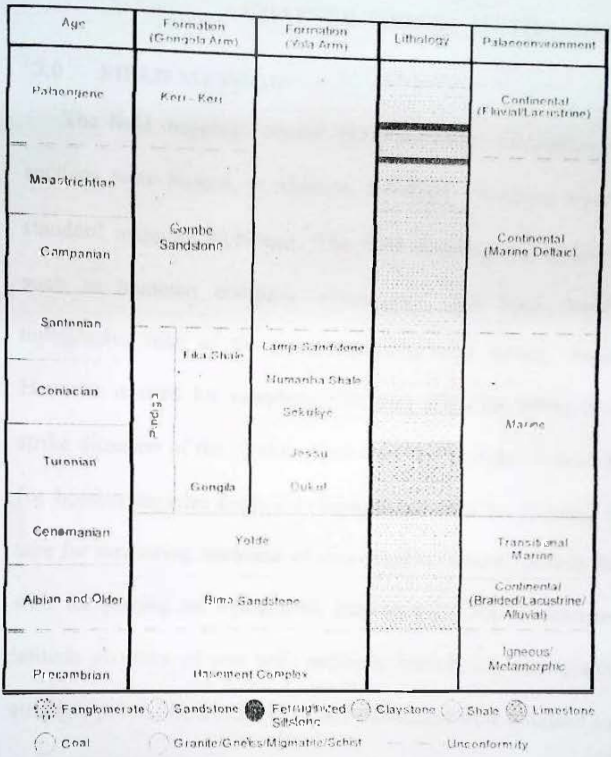


Fig. 2 Stratigraphic succession of Upper Benue Trough(after Abubakar (2001).

CHAPTER THREE; METHODOLOGY

3.0 FIELD METHOD

The field mapping covers thirty six squire kilometers, five lithostratigraphic sections were logged, in addition, lithologic boundries were delineated based on standard mapping technique. The field mapping was guided by field equipment such as hammer, compass, clinometers, field book, hand lens, sample bag, topographic map of the area, measuring tape, pencil, wooden slate and GPS, Hammer is used for sampling, Compass and clinometers for measuring dip and strike direction of the section, field book for writing all data obtained, sample bag for hosting samples collected, topographic map for locating the area, measuring tape for measuring thickness of stratigraphic sections, pencils for sketches, wooden slate for placing the topographic map on top, GPS for determining longitude and latitude position of one self, geologic boundaries, stratigraphic sections at any strategic point. The aerial extent and dimension were obtained sometimes by pacing and were converted into appropriate scales so as to ease the plotting of the map, the different rock formation boundaries were indicated on the map.

Six Sandstone samples were collected for and thin sectioned for Petrographic analysis, slide of samples were prepared in the laboratory, the slides were studied under both plane and cross polarized light using Binocular Petrographic microscope.

CHAPTER FOUR; RESULT

4.0 FIELD WORK

The field work covers an area of 36 square kilometers, three distinctive litho logic units were mapped these are; Limestone, Sandstone and Shale units, the result of the field work is presented in appendix 1.

4.0.1 Sandstone

Sandstone unit covers almost eighty percent of the total surface of the study area (appendix 1) and well exposed on the surface. Texturally, the sandstone is coarse to medium grained, the coarse fraction is trough cross bedded and medium grained is cross laminated, it is brown to dark brown in color with shale band intercalation and horizontal light-gray clay wedges in some areas. These textures were also been recognized by Dike(1993) and Berber(1997).

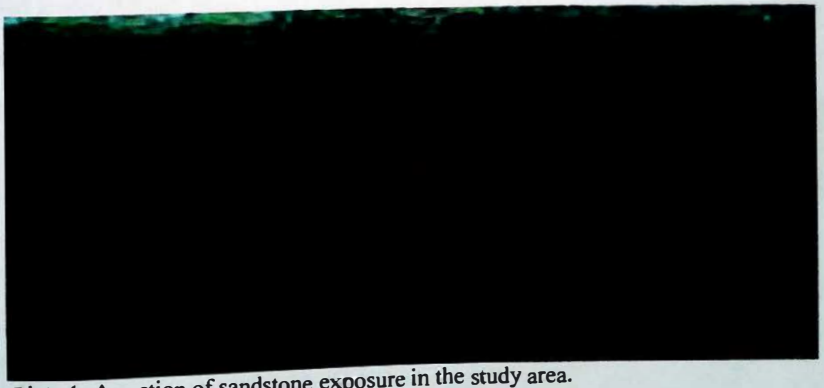


Plate 1. A section of sandstone exposure in the study area.

4.0.2 Limestone

The limestone covers twelve percent of the total surface of the study area and well exposed along stream channels and relatively exposed on the surface. The beds of limestone sections are relatively extensive ranging from 1.5-3m, most of the limestone beds are gray in color with abundant fossils such as bivalves and ammonites.

The base of Limestone bed shows sandy-shale showing an inferred boundary to the underlined bed, limestone bed is separated at the base by light gray laminated Shale. The brownish gray color of limestone can be divided on an account of outcrop character into a relatively thin basal limestone and also upper thinner Limestone Unit. The upper Limestone unit shows an intercalation of ammonite rich marl graded through lateral facie change into a couplet separated by thin Shale in the litho logic units seen. Limestone is highly fossilized with ammonites; all these were also confirmed by Barber (1957).

Plate 2 A section of limestone exposure in the study area.

4.0.3 Shale

The Shale unit covers approximately 8% of the study area, it is gray in color, it is fine grained containing few thin interbedding of siltstone occasionally, similar work was seen by Reyment(1965) and B.Jones (1934),they confirmed this by reporting Fika Formation as consisting blue-black Shale's , occasionally gypsiferous with thickness exceeding 430metres . The blue-black color of Shale nature is seen in almost all parts dominated by this very unit.

The upper part of the Shale contains Sandstone bands with varied thickness ranging from few centimeters to several meters. Shale is sometimes observed between the main limestone bed and overlying sandstone bed.

plate 3. A section of shale intercallated with limestone exposure in the study area.

4.1 FACIE ASSOCIATION AND SEQUENCE

A total of five lithostratigraphic sections have been logged at different locations of the study area. A general feature of all the sections is the presence of alternating sandstone and limestone facies.

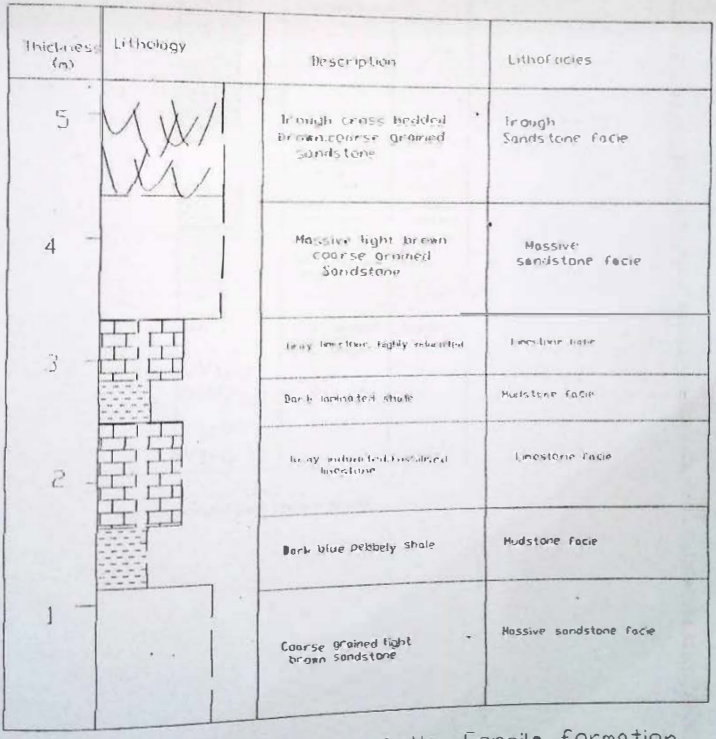


Fig.3: Facies and sequence of the Gongila formation at Unguwan Yobe

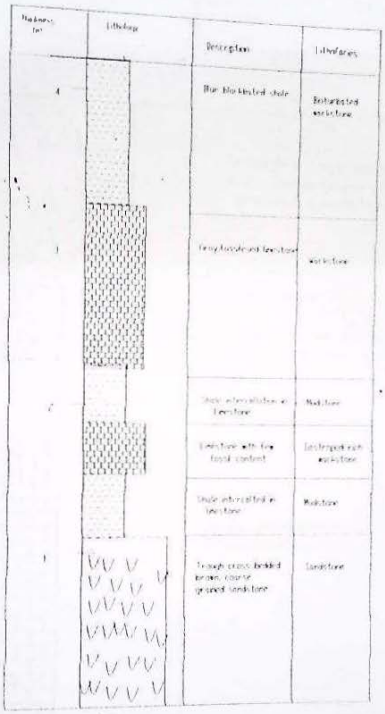


Fig. 4 Lithology and sequence stratigraphic interpretation of Ballinglen

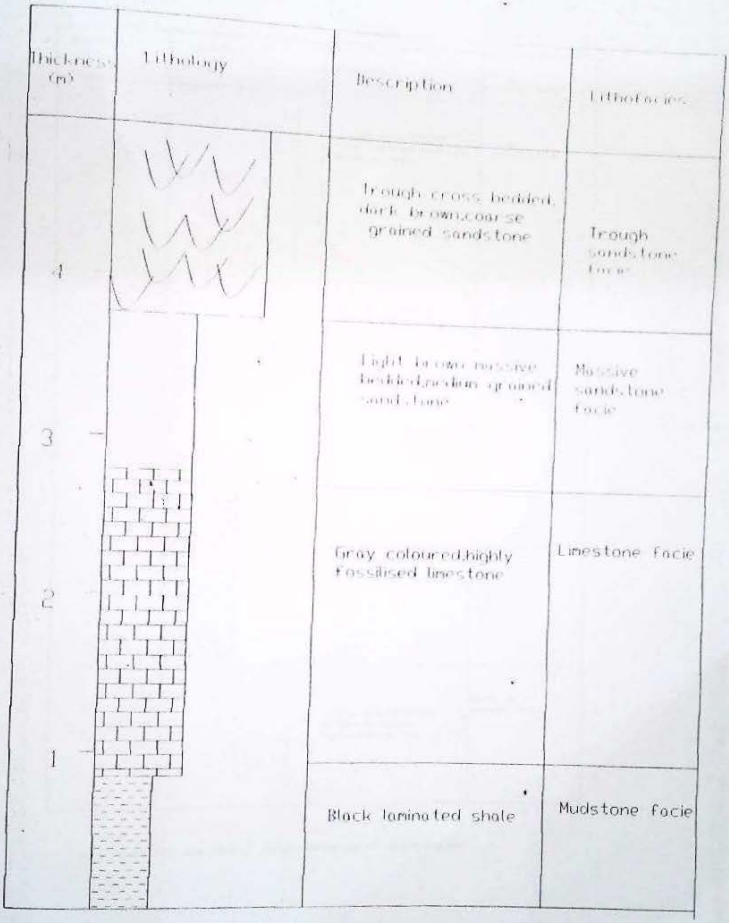


Fig.5: Facies andsequences of Gongila formation at Jaura Adama

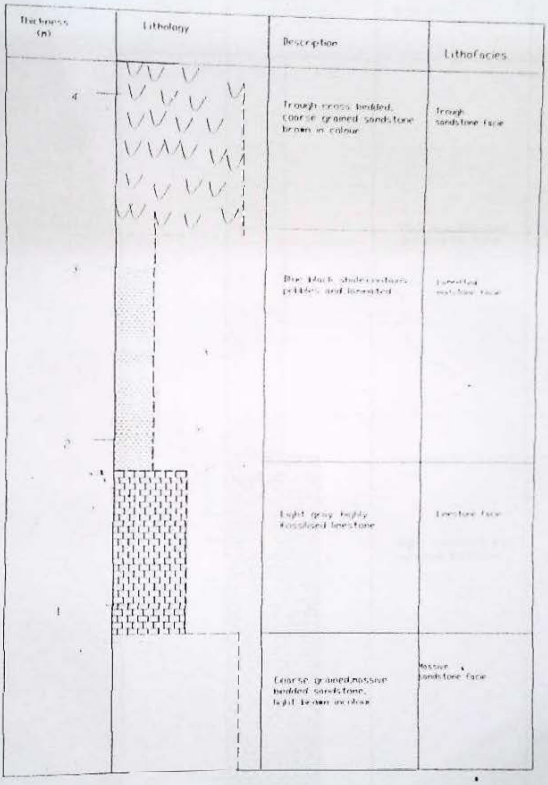


Fig 6. Facies and sequence of Gongila Formation at Jauro Boppale

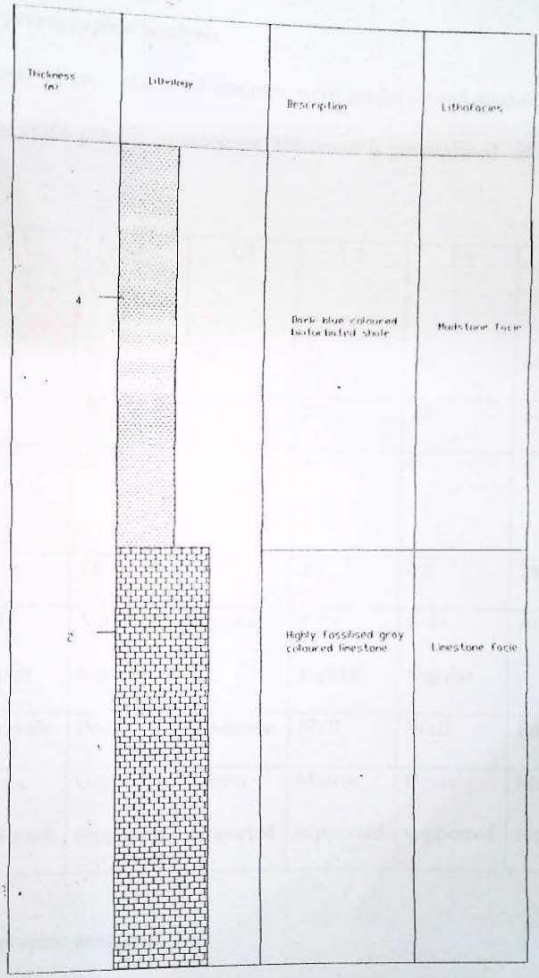


Fig7. Facies and sequence of Gongila Formation(Jaura Umaru

4.2 Result of petrographic analysis

A total of six slides of samples were prepared and studied in the laboratory using petro graphic microscope, the result is presedented in table 1 below.

Sample Name	L1	L2	L3	L4	L5	L6
Quartz (%)	60	50	59	65	70	60
Feldspar (%)	25	30	11	19	20	21
Rock fragment(%)	0	2	0	1	0	1
Matrix (%)	15	18	30	15	10	18
Roundness	Sub-angular	Very angular	Angular	Sub-angular	Sub-angular	Angular
Sorting	Moderate	Poor	Moderate	Well	Well	Poor
Grain-fabric	Matrix supported	Grain supported	Matrix supported	Matrix supported	Grain supported	Matrix supported

Table 1; Result of petrographic analysis.

The following are petrograhic sections of the slide of the samples viewed under plane both polarized and cross polarized light.

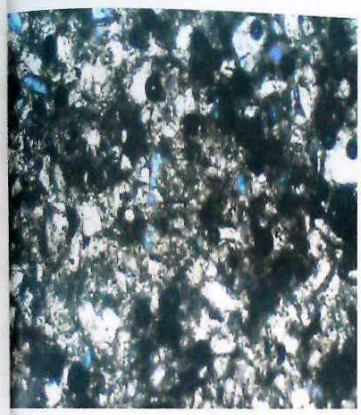


plate L1 cross polarized

plate L1 plane polarized

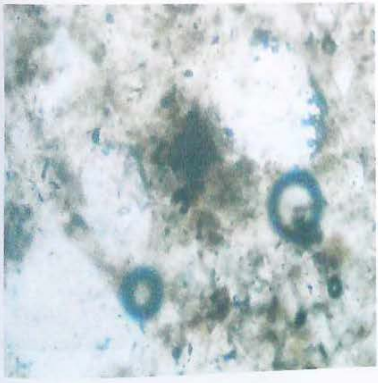


plate L2 cross polarized

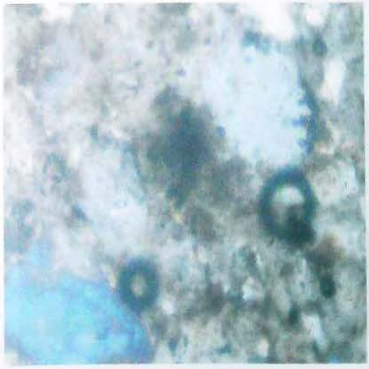


plate L2 plane polarized

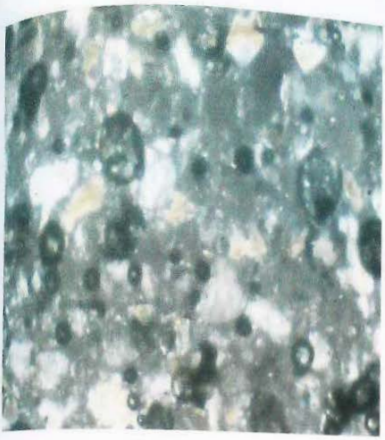


plate L3 cross polarized

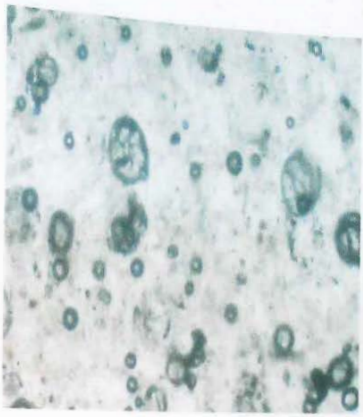


plate L3 plane polarized

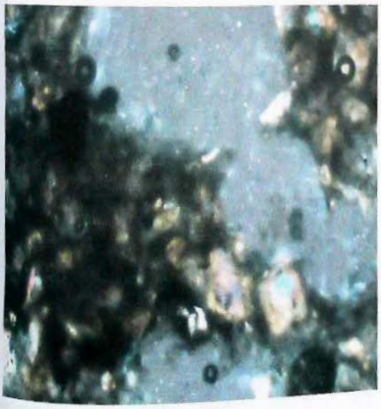


plate L4 cross polarized

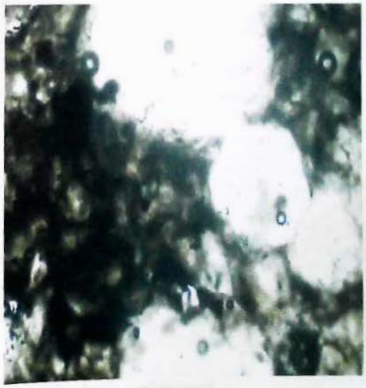


plate L4 plane polarized

plate L5 cross polarized

plate L5 plane polarized

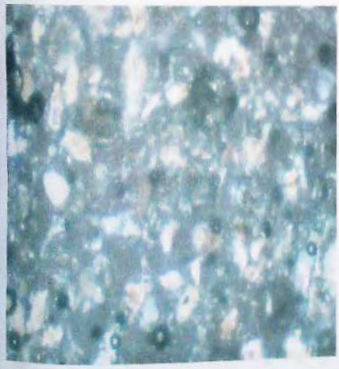


plate L6 cross polarized

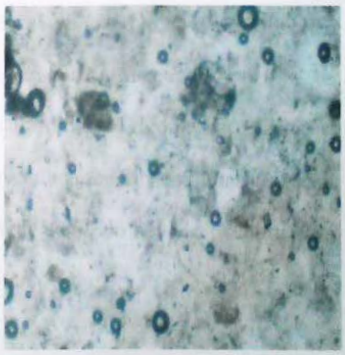


plate L6 plane polarized

CHAPTER FIVE : DISCUSSION OF RESULTS

The analysis of the result obtained is discussed in the following ways.

5.0 PETROGRAPHIC ANALYSIS

5.0.1 Limestone Petrography

Limestone has been observed to be light-dark gray in color and highly fossilized with aboundant micro and macro fossils such as ammonites, pelecypods, brachiopods and echinoids and ostracodes. It is thickly developed than Shale. some of the samples were found to be grain supported while others are matrix supported. Limestone has been observed to be affected by diagenetic process of recrystallization and dissolution which has seen in both grain supported and the matrix supported samles, it has also seen to be compacted enough but in some parts it is seen to be loosely compacted probably because of the action of weathering.

5.0.2 Sandstone Petrography

Sandstone has been observed to be brown to dark-brown in color seemed to be ferrogenised, it is moderately compacted with an average of(60-65)% quartz,(20-25)% feldspar,(10-15)% matrix and 1% rock fragments. As various diagenetic effects have significantly alter the original grain matrix

ratio in Sandstone, a further appreciation of the diagenetic process helps one to look through the post depositonal features to better judge the composition, depositional environment and the provenance of the original sand.

5.0.3 Shale Petrography

It shows a blue-black color , the feassility is clearly seen, it bioturbated and contains a lot of bubbles. Shale contains a lot of pebbles.

Based on the result of the slides of the six samples observed, the data was plotted on the DOTT (1964) triangular classification of sedimentary rocks and the following result was obtained.

Sample Name	L1	L2	L3	L4	L5	L6
Quartz (%)	60	50	59	65	70	60
Feldspar (%)	25	30	11	19	20	21
Rock fragment(%)	0	2	0	1	0	1
Matrix (%)	15	18	30	15	10	18
Roundness	Sub-angular	Very angular	Angular	Sub-angular	Sub-angular	Angular
Sorting	Moderate	Poor	Moderate	Well	Well	Poor
Grain-fabric	Matrix supported	Grain supported	Matrix supported	Matrix supported	Grain supported	Matrix supported

Table 1. Result of petrographic analysis.

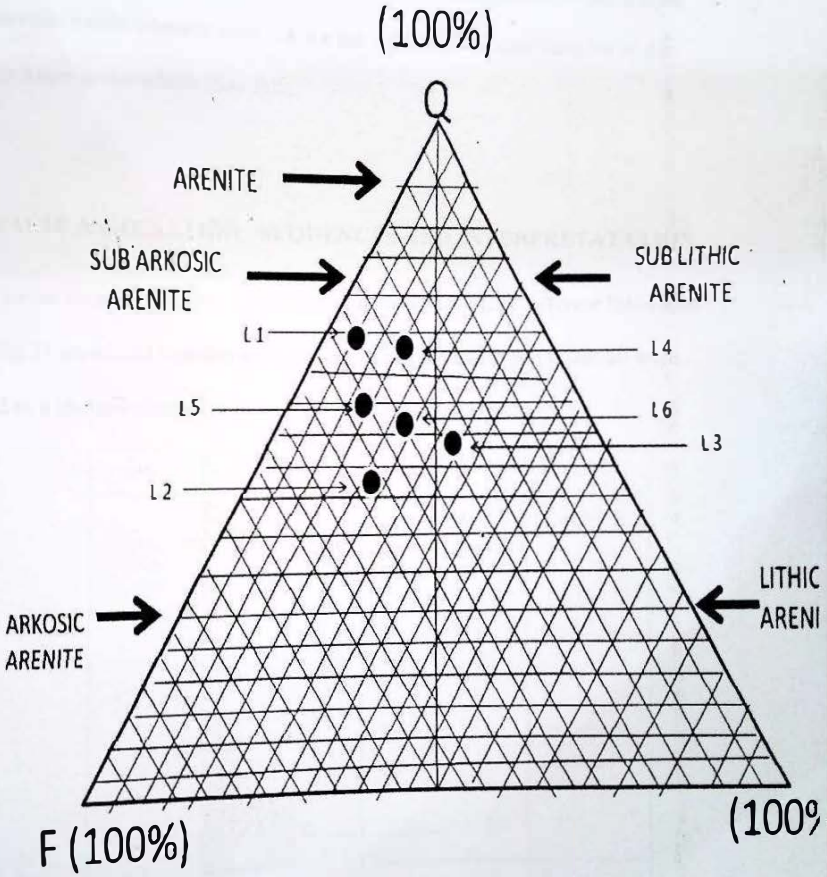
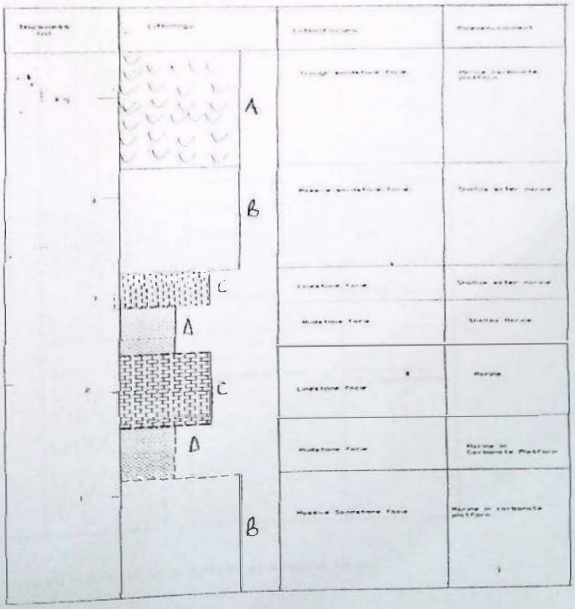


Fig.8 Graph showing the triangular classification of sedimentary rocks of the six slides of the samples based on Dott (1964).

Looking at the graph above, slide L1,L2,L4,L5 and L6 are all sub arkosic arenite sands whereas slide L3 is a sub lithic arenite sand because of the column under which they falls.

5.1 FACIE ASSOCIATION, SEQUENCES AND INTERPRETATATION

The section at Unguwan Yobe is over 5m thick comprising four different lithofacies ABCD (fig.3) associated together and two sequences as ABCD and CDB, all were deposited in a shallow marine in carbonate platform environment.



The section at Bullagaidam stream is over four metres thick comprising three different lithofacies ABC associated together (fig.4) and three sequences as AB,AB and AC ,all were deposited in a marine in carbonate platform environment.

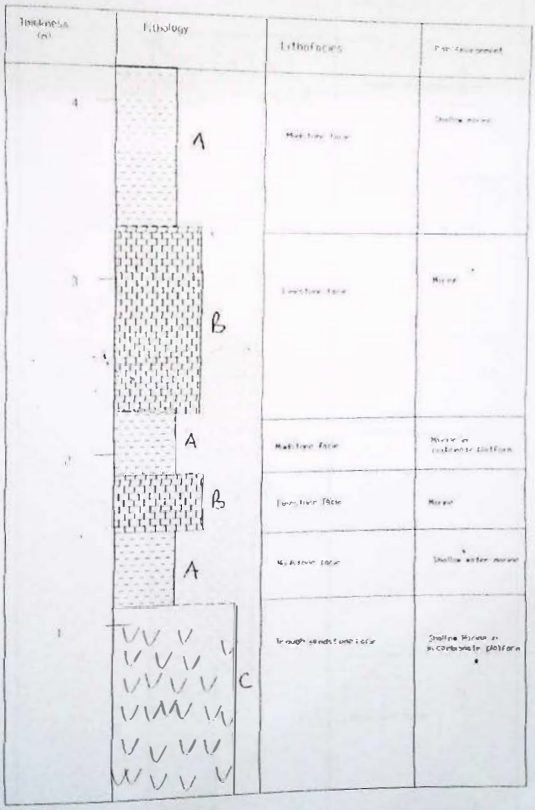


Fig. 4 Facies and sequence of Gangila formation at Bullagaidam stream

The section at Jauro Adama is about 5m thick comprising four lithofacies ABCD associated together (fig.5) with only one sequence as ABCD deposited in a marine in carbonate platform environment.

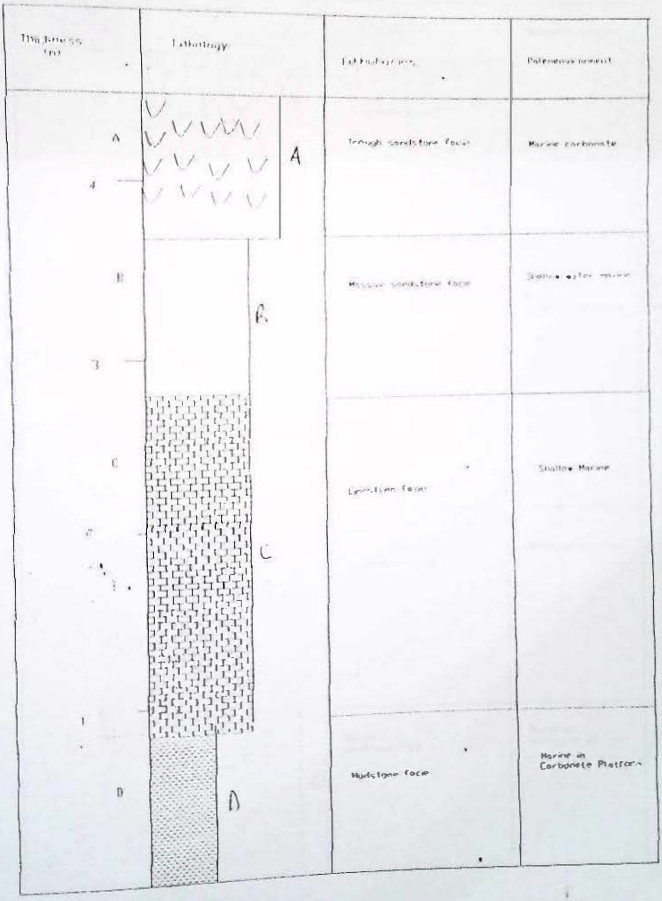


Fig. 5 Facies and sequence of Gongola formation at Jauro Adama

This section at jauro Bappale is over 4m thick comprising four lithofacies associated together (fig.6) and only one sequence as ABCD deposited in marine carbonate platform environment.

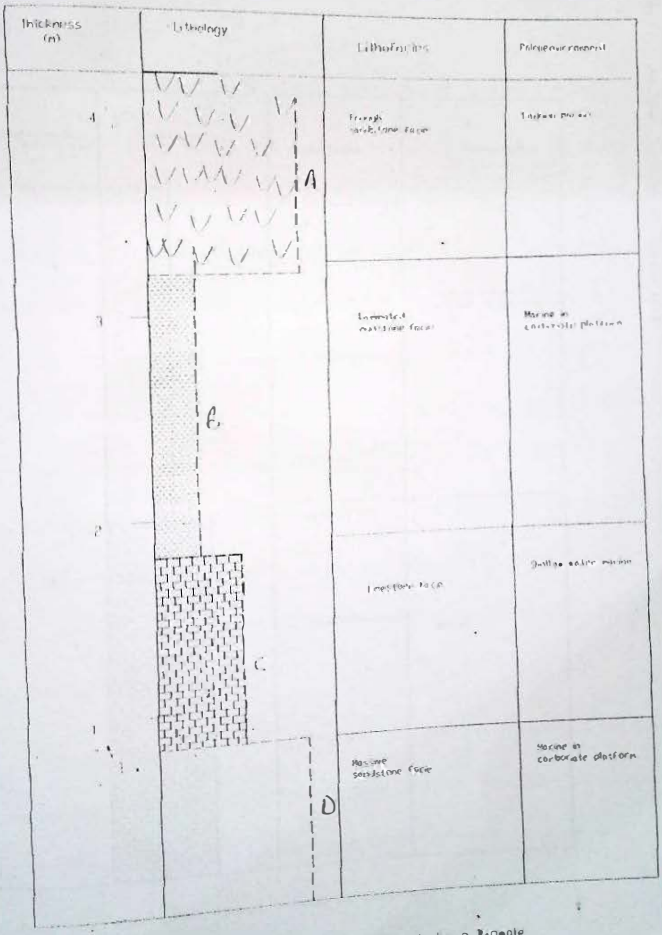


Fig. 6: Facies and sequence of Gongila formation at Jauro Bappale

The section at Jauro Umaru is also over 5m thick comprising two lithofacies associated together (fig.7) with only one sequence as AB deposited in a shallow marine in carbonate platform environment.

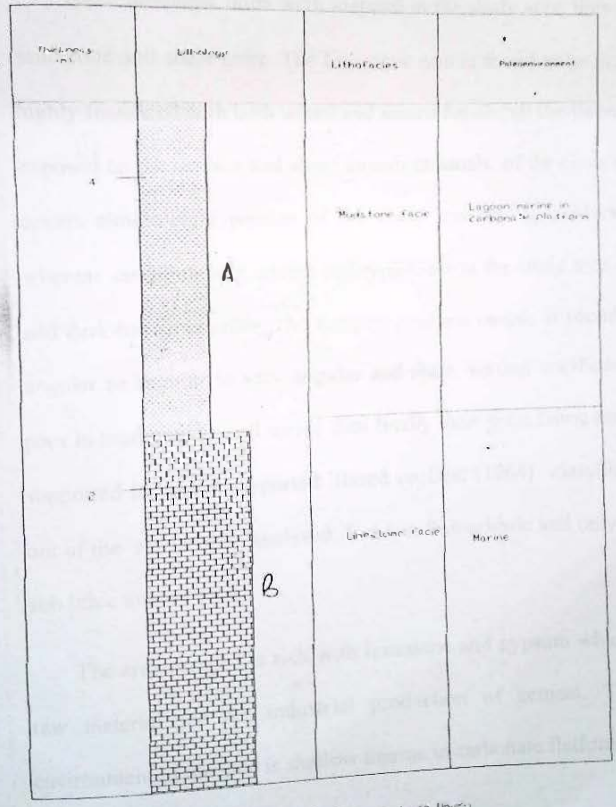


Fig. 7: Facies and sequence of Jiyanga formation at Jauro Umaru

CHAPTER SIX: CONCLUSION AND RECOMMENDATION

6.0 CONCLUSION

Three lithologic units were mapped in the study area, they are; limestone, sandstone and shale units. The limestone unit is found to be gray in color and highly fossilized with both micro and macro fossils, all the three formations are exposed on the surface and along stream channels of the study area, shale unit covers almost eight percent of the study area and it is black-gray in color whereas sandstone unit covers eighty percent of the study area and it is brown and dark-brown in color. The samples analysis ranges in roundness from sub-angular to angular to very angular and their sorting coefficient ranges from poor to moderate to well sorted then finally their grain fabric ranges from grain supported to matrix supported. Based on Dott (1964) classification of rocks, out of the six samples analysed, five are Sub-arkosic and only one falls under sub lithic arenite sand.

The area mapped is rich with limestone and gypsum which are the major raw material for the industrial production of cement. The depositional environment of the area is shallow marine in carbonate flatform.

6.1 RECOMMENDATIONS

It is recommended that Government should put more effort in enhancing and motivating Geologic research in the area to further discover the occurrence of some economic mineral deposits in order to burst the National economy.

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Appendix I

GEOLOGICAL MAP OF PART OF SHEET 131 BAJOGA N.E..