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**Original Research Article**

# Sedimentary Petrology, Paleoclimatic and Tectonic Settings of Maastricthtian Sediments, Western Flank of Anambra Basin, Nigeria

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**ABSTRACT**

*Maastricthtian Ajali formation is an exciting site for geological field study because of the rich information preserved in the strata. However, detailed sedimentary processes, paleoclimatic and tectonics setting of the formation as it occurs in Nigeria are not well understood. This study aimed at the application of geochemical and sedimentological assay in determination of the textural parameters for provenance, paleoclimate and tectonic setting of the formation to have adequate empirical knowledge of the depositional processes and paleoenvironmental conditions of the formation. A total of 51 samples were analyzed for this purpose. The textual result shows that the formation consist of an average graphic mean of 1.41$\phi$ representing medium grain size, an average of skewness of 0.104$\phi$ indicating near symmetry, average inclusive standard deviation of 0.92$\phi$ indicating that the sediments are moderately sorted and an average kurtosis of 1.423$\phi$ which typifies leptokurtic grains. The presence of quartz arenites and siliciclastic sandstone mineral suite revealed a basement rock source. This was further confirmed by the weathering indices of $Al_2O_3/TiO_2$ of 3.25, Log $SiO_2/Al_2O_3$ of 2.18 and $SiO_2/Al_2O_3$ of 180.24. Additionally, ternary plot generated further buttress that the sediments are reworked from older sediments of igneous and metamorphic origin during a prevailing humid climate. The ternary plots for quartz feldspar lithic arkose classification scheme indicate the sandstone (quartz arenites) tectonic setting is from recycled orogeny and craton interior.*



## 1. INTRODUCTION

Maastricthtian sediments are found in different parts of the world and served as field trip site especially for geological sciences and other related disciplines (Ogg *et al.,* 2004). Maastricthtian Ajali sandstone/formation occurs in Anambra basin, one of the inland Nigeria sedimentary basins, and outcropped in different parts of the country (Onyekuru *et al*., 2019). The origin of Anambra basin is related to the evolution of the Benue trough, which is associated with the separation of the African plate from South American plate in the late mesozoic era (Tijani *et al.,* 2010). Akande and Erdtmann (1998) opined that it is logical to include the Anambra basin in the Benue trough, being a related structure that developed after the compressional stage of the formation of Abakaliki anticlinorium. The Ajali basin covers an area of 40,000 km$^2$ with approximate sediment thickness of 5000 m (Nwajide and Reijers, 1996; Uma and Onuoha, 1997; Nwajide, 2013). The correlation between the grain size parameters, heavy mineral assemblages and transport processes as well as depositional mechanism of the sediments has been established by previously in modern and ancient sedimentary environment which has thoroughly evaluated these parameters and explained their significance in relation to provenance, transportation, depositional processes and in constructing environment of deposition (Phani, 2014).

Any sandstones classified as quartz arenites with heavy mineral assemblages (zircon, rutile, tourmaline, staurolite, sillimanite, kyanite, garnet and apatite) that reveals the presence of weathering processes. A Zircon-Tourmalin-Rutile (ZTR) index of 63% typifies products of weathering of basements rocks under humid climatic setting with long transportation and or recycling history (Nton and Bankole, 2013). The relationship between sandstone composition and tectonic setting was recognized in the work of Dickinson and Suczek (1979). The quartz, feldspar and lithics (QFL) diagram, which plots quartz (Q), feldspar (F) and lithics (L) minerals is divided into three main fields representing the Continental Block, Magmatic arc and recycled orogeny. The plot established that sandstone from different depositional basins is a function of provenance type controlled by plate tectonics. According to Ogbahon and Opeloye, (2016), sandstone with 88-94% quartz, (1-8) % lithic fragment, (1-4) % cement and (0-4) % matrix is classified as quartz arenites and sub-lithic arenites respectively.

Most of the research carried out on the Ajali formation focused on south - eastern Ajali formation and ranges from studies on sedimentology, stratigraphy, petrology, paleoenvirontment and paleocurrent studies and also on permeability distribution (Chiaghanam *et al.,* 2012; Odedede and Adaikpoh, 2013; Edirin and Etu – Efeotor, 2013; Gideon *et al.*, 2014). These studies centered solely on field relationship, textural and paleocurrent characteristics. It has been reported that the chemical composition of clastic sedimentary rocks is a function of a complex interplay of 346 several variables, including the nature of source rocks, source area weathering and diagenesis (Roser and Korsch, 1986; McLennan *et al.,* 1993).

The geochemical characteristics of clastic sedimentary rocks (which include sandstones) are useful in determining the tectonic setting and its associated provenance. The study of sedimentary provenance interfaces several of the mainstream geological disciplines and it includes the location and nature of sediment source areas, the pathways by which sediment is transferred from source to basin of deposition, and the factors that influence the composition of sedimentary rocks (e.g., relief, climate, tectonic setting). Information on transport history, paleoenvironment of deposition and energy of transport medium can be deduced from mineralogical studies and the incorporation of this into data from inorganic geochemistry will ultimately result in a concise depiction of sediment provenance amongst other information.

The current study is aimed at using integrated scientific assay in assessing the sedimentary processes, paleoclimatic condition and tectonic settings of the Maastricthtian Ajali formation, western flank of Anambra Basin, Nigeria to have firsthand knowledge of the petrogenesis, petrophysical properties of the evolution and depositional processes.

## 2. MATERIALS AND METHODS

### 2.1. Location of the Study Area

The study was carried out at different localities in Edo North, Nigeria were the Formation outcropped as road cuts. The localities include Fugar, Ayogwuiri, Auchi, and Uzebba (Figure 1).

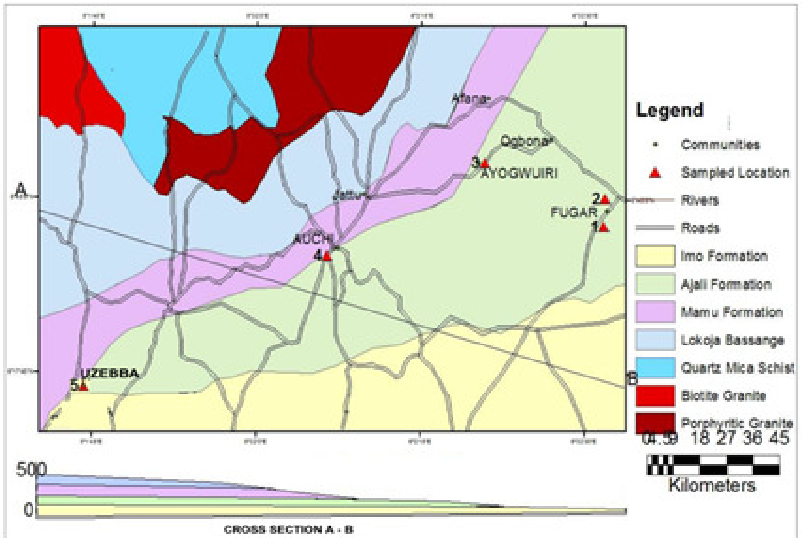



Figure 1: Geological cross section of study area

## 2.2. Methodology

Samples were collected with the aid of a sledge and pick hammer at an interval of 0.6 m in five (5) different locations as shown in Figure 1. A total of 51 samples were collected as follows: Fugar (17) and Fugar II (12), Ayogwuiri (10), Auchi (7) and Uzebba (5).

## 2.3. Grain Size Analysis

The sieve method was adopted for the grain size analysis. The weight of each sieve as well as the bottom pan was measured and recorded. Pans were thoroughly cleaned by using sieve brush and assembled in descending order of sieve numbers. The sieve stack was removed and weighed; this represents the weight of the bottom pan and the retained soil was recorded. Fifty grams (50 g) of each of the 51 samples collected were weight and place on the mechanical sieve shaker for 2 minutes. The grains retained in each pan were recorded. The weight and cumulative weight percentages as well as grain size parameters were computed.

## 2.4. Thin Section Sample Preparation

Five grams (5 g) of each prepared samples were impregnated with epoxy A and B mixture. The prepared samples were left to cure for at least 24 hours and later trimmed to fit on a glass slide. The trimmed surface was lapped on the glass plate using water and silicon carbide 600 grits to have a very smooth surface for bonding with the glass side. The other surface of the glass slide was also lapped and made smooth for bonding with the sample. Cut-off saw was used to trim the prepared 50-micron glass slide to 30 microns and transferred to the lapping plate ready for petrographic study. The prepared slides were then labelled, and examined with the aid of transmitted light under the flat stage of the petrographic microscope using point count method according to Ingersoll *et al.* (1984) and Osae *et al.* (2006) Photomicrographs were taken and features of the mineral grains were observed based on the optical properties of the minerals.

## 2.5. Determination of Heavy Mineral

For heavy mineral assessment, a total of twenty five (25) samples, five from each location were prepared for the experiment. Five grams (5 g) of each prepared sample were weighed in a separating funnel and filled to three-quarter (3/4) with bromofoam solution. The mixture was stirred vigorously in a fume cupboard. Heavy minerals present in the sample sank to the bottom of the funnel where it was collected and washed with acetone to remove the bromoform solution. The minerals obtained in the experiment were mounted on a clean glass slide using DPX mountant which allows heavy minerals to adhere to glass slide for petrographic assessment (Rosenblum and Leo, 2000).

## 2.6. X-Ray Fluorescence (XRF) Analysis

Fifteen (15) samples, three from each location were analyzed using XRF fusion analysis for major oxides. One gram (1 g) of prepared samples was weighed in porcelain and placed in oven at about 110 °C for 1 hour to determine $H_2O^+$. The sample was further subjected to a temperature of 1000 °C in an oven for about an hour to determine loss of Ignition (LOI). LOI is used in XRF to test for major oxide by strongly heating the sample to a specific temperature to allow volatile substances escape or oxygen added until the mass ceases to change. One (1 g) of claisse flux was added and fused in M4 Claisse fluxer for 23 minutes. Furthermore, 0.2 g of sodium trioxocarbonate IV ($Na_2CO_3$) was added to the mix. The resulting mix was pre-oxidized at 700 °C before fusion, according to the laid down procedure of Temitope and Oyedotun, (2018).

## 3. RESULTS AND DISCUSSION

This section presents in a systematic order the textural characteristics, petrographic studies analyses and major oxide percentages of the sediments of Ajali formation and their implication for ancient paleoclimatic and paleotectonic setting well discussed. Table 1 shows the textural characteristics of Ajali sandstone across the study areas, showing their maximum, minimum and average values.

Table 1: Grain size parameters in the study areas

| Area | Range | Mean (ϕ) | Sorting (ϕ) | Skewness (ϕ) | Kurtosis (ϕ) |
|---|---|---|---|---|---|
| FG | Max | 1.70 | 1.50 | 0.46 | 3.28 |
| | Min | 0.30 | 0.30 | 0.06 | 0.80 |
| | Average | 1.00 | 0.90 | 0.26 | 2.04 |
| FGB | Max | 2.00 | 0.80 | 0.19 | 1.50 |
| | Min | 0.70 | 0.50 | -0.08 | 0.81 |
| | Average | 1.35 | 0.65 | 0.06 | 1.16 |
| AY | Max | 1.50 | 1.20 | 0.25 | 1.23 |
| | Min | 0.40 | 0.80 | -0.07 | 0.93 |
| | Average | 0.95 | 1.00 | 0.09 | 1.08 |
| UZ | Max | 2.30 | 1.50 | 0.14 | 1.64 |
| | Min | 1.70 | 0.30 | -0.06 | 1.03 |
| | Average | 2.00 | 0.90 | 0.04 | 1.335 |
| AU | Max | 2.30 | 1.10 | 0.22 | 1.27 |
| | Min | 1.20 | 0.70 | 0.07 | 0.94 |
| | Average | 1.75 | 0.90 | 0.07 | 1.11 |

FG=Fugar, FGB=Fugar II, AY=Ayoguiri, UZ=Uzebba and AU=Auchi

From Table 2, Fugar and Uzebba sandstone have average graphic mean of 1.0ϕ and 2.0ϕ respectively. In Ayogwuiri (AY), Auchi and Fugar II (FGB), the mean values recorded were 0.95ϕ, 1.75ϕ and 1.35ϕ. The percentage distribution of the grain sizes in each location show that the Formation is made up of medium grain sizes ranging from 16.10 % at Uzebba to 96.83% at Ayogwuiri (Table 1). The inclusive standard deviation (sorting) at Fugar, Fugar II, Uzebba, and Auchi were on the average 0.9ϕ except in Ayogwuiri where it was measured 1.0ϕ indicating moderately sort grains. The average skewness across the study locations are 0.263ϕ, 0.055ϕ, 0.09ϕ, 0.04ϕ and 0.0725ϕ, for Fugar 1, Fugar 2, Ayogwuiri, auchi and Uzebba respectively thus making the sediments in the study areas near symmetrical. The graphic kurtosis at Ayogwuiri and Auchi sandstone are both mesokurtic with an average value of 1.082ϕ and 1.105ϕ respectively. Others include Uzebba, Fugar and Fugar II which were best described as leptokurtic with average value of 1.34ϕ, 2.041ϕ and 1.55ϕ.

Table 2: Summary of grain size parameters in percentage

| Parameter | FG (%) | FGB (%) | AY (%) | UZ (%) | AU (%) |
|---|---|---|---|---|---|
| | | | Mean | | |
| CS | 22.99 | 9.47 | 3.175 | 0 | 0 |
| MS | 77.02 | 78.69 | 96.83 | 16.10 | 78.94 |
| FS | 0 | 11.84 | 0 | 88.90 | 21.06 |
| | | | Sorting | | |
| WS | 6.41 | 0 | 0 | 0 | 0 |
| MWS | 13.93 | 78.93 | 0 | 40.66 | 11.17 |
| MS | 68.36 | 21.07 | 36.22 | 50.38 | 71.68 |
| PS | 11.31 | 0 | 63.78 | 0 | 17.16 |
| VWS | 0 | 0 | 0 | 8.96 | 0 |
| | | | Skewness | | |
| SFS | 13.10 | 0 | 16.98 | 0 | 47.37 |
| FS | 39.30 | 0 | 0 | 0 | |
| NS | 7.89 | 25.69 | 0 | 13.73 | 25.87 |
| CS | 37.10 | 52.68 | 30.39 | 17.65 | 0 |
| SCS | 2.49 | 21.61 | 52.62 | 68.63 | 26.75 |
| | | | Kurtosis | | |
| PK | 7.43 | 5.83 | 0 | 0 | 0 |
| MK | 39.24 | 48.30 | 76.47 | 15.26 | 51.04 |
| LK | 22.50 | 45.87 | 23.54 | 60.45 | 48.96 |
| VLK | 15.78 | 0 | 0 | 24.29 | 0 |
| ELK | 15.04 | 0 | 0 | 0 | 0 |

CS- Coarse sand, MS-Medium sand, FS-Fine sand, WS- Well sorted, MWS- Moderately well sorted, MS-Moderately sorted, PS- Poorly sorted, VWS- Very well sorted, SFS-Strongly coarse skewed, PK-Platykurtic, MK- Mesokurtic, LK- leptokurtic, VLK- Very leptokurtic, ELK- Extremely leptokurtic

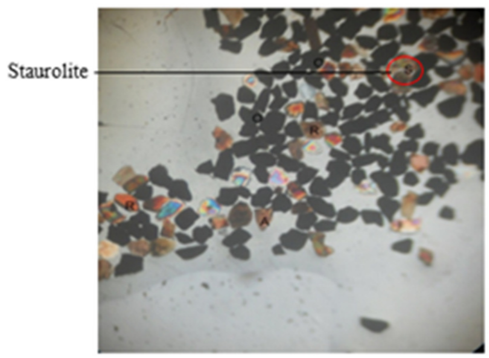
The heavy mineral assemblages in percentage across the study area has been presented in Table 3. The results obtained, (Table 3) in the study indicate that Ayogwuiri sandstone consists of zircon whereas tourmaline and rutile dominated the sandstone from Auchi. On the other hand, staurolite, garnet and kyanite were in abundance at Fugar and Fugar II.

Table 3: Summary heavy minerals in percentage

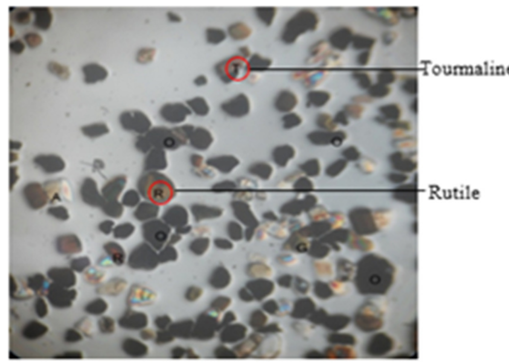
| Location code | Mineral weight percent (%) | | | | | |
|---|---|---|---|---|---|---|
| | Zircon | Rutile | Tourmaline | Staurolite | Garnet | Kyanite |
| FG | 19.50 | 18.70 | 19.80 | 21.10 | 17.40 | 23.30 |
| FGB | 21.10 | 20.60 | 19.80 | 22.00 | 22.10 | 22.00 |
| UZ | 16.20 | 20.00 | 16.70 | 17.40 | 22.10 | 20.40 |
| AU | 23.80 | 21.30 | 25.10 | 20.20 | 19.80 | 15.10 |
| AY | 19.40 | 19.40 | 18.60 | 19.30 | 18.60 | 19.20 |

The dominant minerals among others include zircon, rutile, tourmaline, garnet, staurolite and opaque for the heavy minerals (Plates 1a-d) and muscovite, rock fragments, quartz, heavy mineral, feldspar, and plagioclase for the thin section micrograph (Plates 2a-d). In each microphotograph, the minerals have been encrypted for easy identification. The results obtained from the heavy mineral assemblages which indicate a basement rock source from adjacent basement complex possibly from South-Western basement complex. Huntsmann-Mapila *et al.* (2005), from their studies pointed out that, tourmaline, garnet and rutile are commonly found in both acid igneous and metamorphic rocks to intermediate igneous rocks like granite and pegmatite. On the other hand, staurolite is mainly found in medium grade regional metamorphic and\or plutonic rocks like Gneiss whereas kyanite is a product of Aluminum rich metamorphic pegmatite and/or sedimentary rocks as pointed out by Dickinson *et al.* (1983) and Huntsmann-Mapila *et al.* (2005). The result of heavy mineral obtained in this study was juxtaposed with the QFL ternary plot of recycled orogeny to confirm the source of the sediments; the finding was in consonant with the earlier claim as a result of the sediments plot within the craton interior (Figure 3).

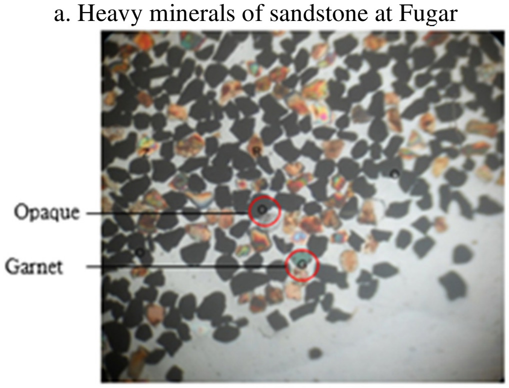
The modal composition of Ajali sandstone (Table 4) from which the ternary plots in Figures 2 – 5 were ploted, which are used in facies classification of the formation with respect to the provenance settings and paleoclimatic characteristics.



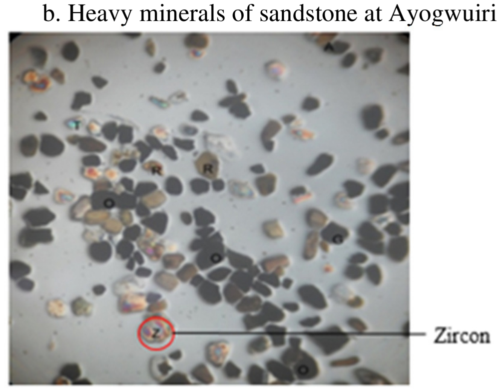

a. Heavy minerals of sandstone at Fugar




b. Heavy minerals of sandstone at Ayogwuiri

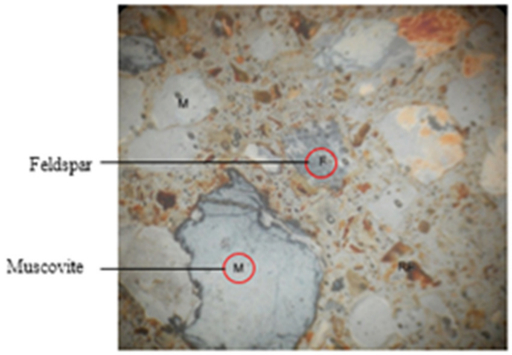



c. Heavy minerals of sandstone at Auchi

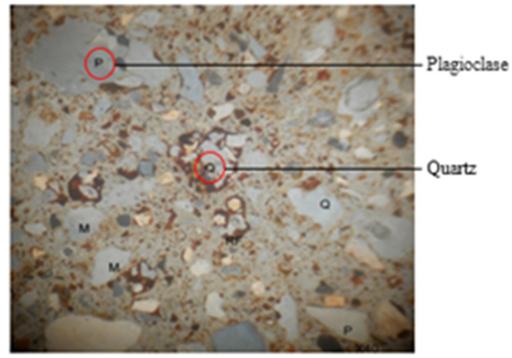



d. Heavy minerals of sandstone at Uzebba

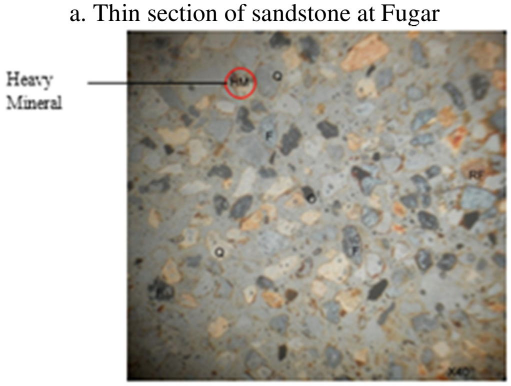
Plate 1a-d: Petrographic shot of heavy minerals assemblages in study area under cross polarized light (30x)
Z = Zircon, R = Rutile, T = Tourmaline, G = Garnet, S = Staurolite, O = Opaque, ZTR Index = Z + R + T/Total non-opaque×100



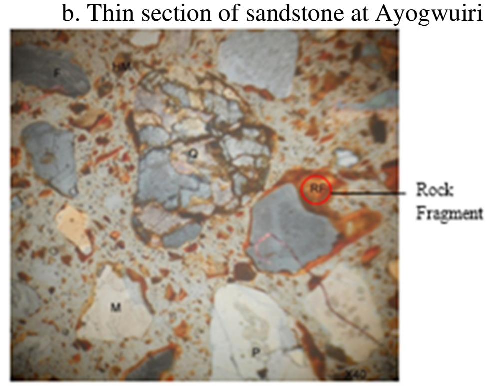

a. Thin section of sandstone at Fugar




b. Thin section of sandstone at Ayogwuiri




c. Thin section of sandstone at Auchi




d. Thin section of sandstone at Uzebba

Plate 2: Petrographic shot under plane polarized light (30×) of thin section of sandstone in study area.
M – Muscovite, RF- Rock fragments, Q – Quartz, HM - Heavy mineral, F-Feldspar, P-Plagioclase

Table 4: Modal composition of sandstone facies

| Sample code | Quartz (%) | Feldspar (%) | Rock (lithic) fragment (%) |
|---|---|---|---|
| FG2 | 90 | 2 | 3 |
| FG10 | 90 | 3 | 3 |
| FG16 | 91 | 2 | 2 |
| FGII3 | 89 | 3 | 3 |
| FGII7 | 91 | 2 | 3 |
| FGII12 | 92 | 2 | 3 |
| UZ1 | 90 | 3 | 4 |
| UZ3 | 91 | 2 | 3 |
| UZ5 | 90 | 3 | 2 |
| AY1 | 90 | 2 | 3 |
| AY5 | 90 | 3 | 3 |
| AY9 | 91 | 2 | 3 |
| AU1 | 91 | 3 | 3 |
| AU4 | 90 | 2 | 3 |
| AU6 | 90 | 3 | 3 |
| Average | 90.40 | 2.30 | 2.90 |

Figures 2 and 3 represent the ternary plots for quartz feldspar lithic arkose classification scheme, which indicate that that Ajali sandstone is made up of quartz arenites from recycled orogeny and craton interior. Siliciclastic sedimentary rocks investigated in several regions of the world show that their chemical combination is largely dependent on their weathering conditions (Nesbitt *et al.,* 1996). The mineralogical and elemental composition (quartz, feldspar, rutile, garnet, tourmaline, rock fragment and $SiO_2$>90%) obtained in this study shows that Maastrithtian sediments of Ajali formation are similar to those obtained from granitic provenance as typified the result from Figure 2 which plots as quartz arenites.

Figure 4, indicates that Ajali sediments originated from the continental block provenance, while Figure 5, indicates that Ajali Sandstone was influenced by prevailing humid climate. The work of Sutherland *et al.*, (1994) supported the current study because of sediments plot in the humid environment following the QFR, ternary plot for provenance (Figure 4). Humid climate catalyses the weathering process which in turn facilitate the chemical maturity of sediments, and the $SiO_2/Al_2O_3$ which indicates progressive maturity further corroborates the provenance of the Ajali sediments as sourced from both igneous and metamorphic source. The preponderance of medium sand is attributed to intermediate energy during the time of deposition of the sediments. However, the low percentage of medium grain size with a corresponding high percentage of fine sand of 88.90% (table 2) obtained at Uzebba is a reflection of low energy from sediment source which could be as a result of fall in energy of transportation during transgression and deposition of the sediments. According to Baiyegunhi *et al.,* (2017), grain size characteristics are a fundamental feature of siliciclastic sediments and thus, it is one of the important descriptive properties of sedimentary rocks. The distribution of theses grain sizes is a function of the prevailing energy at the time of deposition.

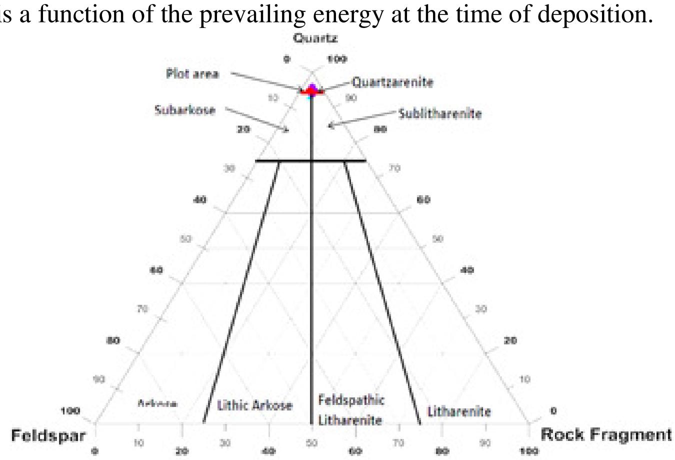


Figure 2: Quartz feldspar lithic arkose (QFL) classification scheme after Folk (1974).

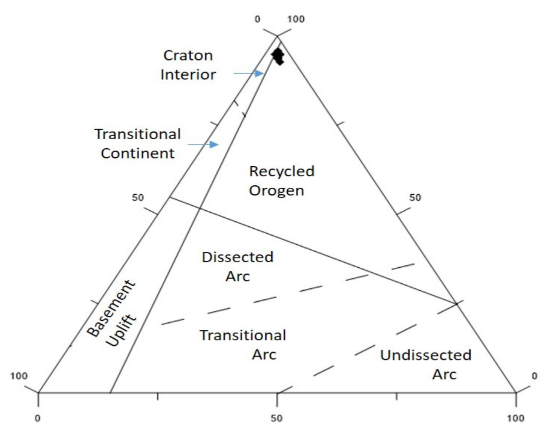


Figure 3: QFL ternary plot of tectonic setting after Dickinson et al., (1983)

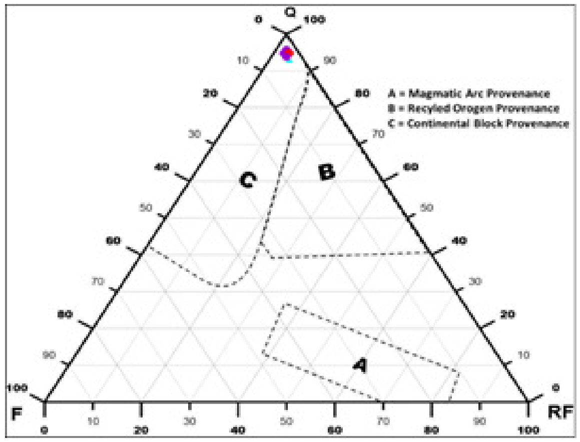



Figure 4: QFR ternary plots of provenance setting for sandstones of the study area modified after Dickinson *et al.* (1983)

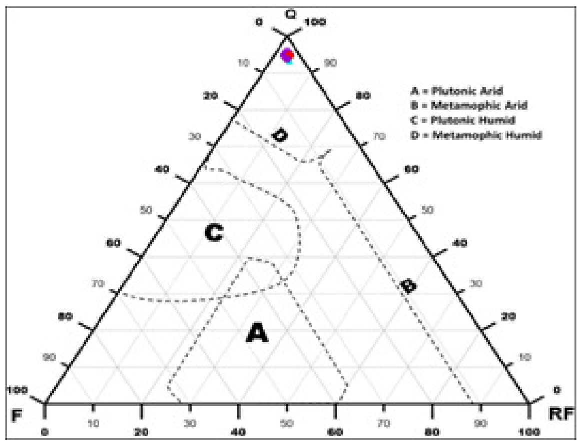



Figure 5: QFR ternary plot of paleoclimatic setting for Ajali Sandstones modified after Suttner *et al.* (1994)

Additionally, weathering indices of the metallic oxide in Table 5 were computed to determine weathering source of the sediments that were laid down as Ajali formation. Refering to table 6, from the Lindsey, (1999) classification scheme of sandstone, a Log $SiO_2/Al_2O_3$ value of 2.18 and mean silica ($SiO_2$) of 98.11% for this study confirms the Ajali sandstone as a siliceous quartz arenites. Condie and Conway (1992), Armstrong-Altrin *et al.*, (2004), Okunlola and Idowu, (2012) opined that geochemical signatures of clastic sediments can be utilized to infer provenance characteristics of the sediments. In the same vein, Hayashi *et al.* (1997) pointed out that $Al_2O_3/TiO_2$ ratio increased from 3 to 8 for mafic igneous rocks, 8-21 for intermediate rocks 21-70 for felsic igneous rocks. The $Al_2O_3/TiO_2$ ratio for the Ajali Sandstone with an average 3.25ϕ suggests a basement rock that forms the sediments of Ajali were mafic igneous rock source.
Figure 6, shows correlation of metallic oxides, in other to evaluate the degree of relationship between the metallic oxides. The positive correlated oxides at $\alpha$ 0.05 (Figure 6) is an indication of a common source. There is an observed regression from the alumina – silica towards the transition oxides (Fe and Ti) as revealed from the result of Table 5. This finding further authenticates the chemical disintegration of the unstable minerals to the more stable ones due to the weathering conditions that prevailed during sediment deposition.

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Table 5: Weathering indices of the major oxides

| Oxides | Locations | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FG2 | FG7 | FG16 | FGB3 | FGB7 | FGB12 | AY1 | AY5 | AY9 | AU1 | AU4 | AU6 | UZ1 | UZ3 | UZ5 |
| $Al_2O_3$ | 0.50 | 0.60 | 0.90 | 1.00 | 0.50 | 0.30 | 0.50 | 0.60 | 3.00 | 0.90 | 0.40 | 0.20 | 1.00 | 0.86 | 0.70 |
| $Fe_2O_3$ | 0.40 | 0.97 | 0.57 | 0.20 | 0.80 | 0.80 | 0.29 | 0.30 | 0.50 | 0.40 | 0.40 | 0.40 | 0.30 | 0.30 | 0.20 |
| $SiO_2$ | 98.80 | 98.10 | 96.93 | 98.00 | 98.25 | 98.90 | 99.10 | 98.44 | 95.00 | 98.20 | 99.10 | 99.40 | 97.56 | 98.20 | 98.05 |
| $TiO_2$ | 0.20 | 0.20 | 0.10 | 0.50 | 0.30 | <0.10 | 0.09 | 0.20 | 0.40 | 0.30 | 0.10 | <0.10 | 0.80 | 0.40 | 0.90 |
| LOI | 0.0 | 0.13 | 0.37 | 0.41 | 0.05 | <0.01 | 0.02 | 0.14 | 0.91 | 0.20 | <0.01 | <0.01 | 0.34 | 0.24 | 0.15 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| $SiO_2/Al_2O_3$ | 197.60 | 163.50 | 108.70 | 98.30 | 196.6 | 329.70 | 198.20 | 164.30 | 31.70 | 109.10 | 248.00 | 497.50 | 97.60 | 122.8 | 140 |
| $Al_2O_3/TiO_2$ | 2.50 | 3.00 | 9.00 | 2.00 | 1.70 | - | 2.50 | 3.00 | 7.50 | 3.00 | 4.00 | - | 1.25 | 2.00 | 0.80 |
| $Log(SiO_2/Al_2O_3)$ | 2.30 | 2.21 | 2.04 | 1.99 | 2.29 | 2.52 | 2.30 | 2.22 | 1.50 | 2.40 | 2.40 | 2.70 | 1.99 | 2.09 | 2.15 |

Table 6: Guidelines for chemical classification of sandstones

| Author | Weathering indices | Quartz type |
|---|---|---|
| Lindsey (1999) | Log ($SiO_2$:$Al_2O_3$) > 1.50 | Quartz arenite |
| | Log ($SiO_2$: $Al_2O_3$) < 1.00 | Gray wacke |
| Current study | Log ($SiO_2$: $Al_2O_3$) = 2.18 | Quartz arenite |

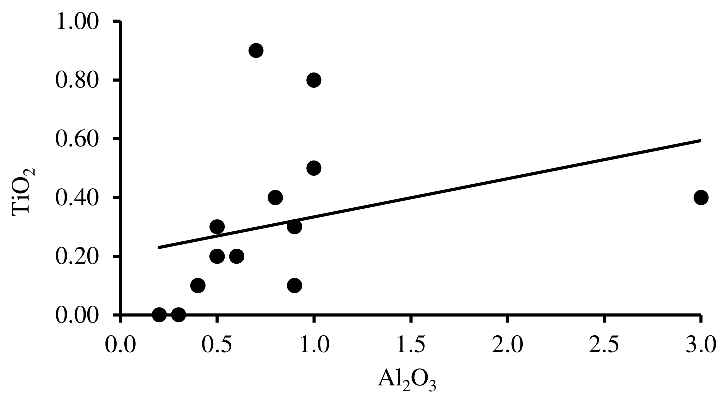


Figure 6: Correlation of $Al_2O_3$ against $TiO_2$

## 4. CONCLUSION

The geological terrains of the Ajali sandstone, Anambra basin South western Nigeria is dominated by medium grained, moderately sorted sandstone which is characteristic of the Ajali formation. The textural studies revealed an intermediate energy for the transporting medium, mesokurtic to leptokurtic grains that are symmetrical. The leptokurtic grains sizes as discussed in this study confirmed that Ajali sediments were deposited during intermediate to high energy condition. Geochemical investigation of the formation, weathering indices and the petrographic composition indicates siliciclastic sandstone composed of quartz arenites from a granitic and metamorphic provenance which were deposited during a prevailing oxidizing humid paleoclimatic condition. The ternary plots for quartz feldspar lithic and arkose classification scheme indicate that Ajali sandstone is quartz arenites from a tectonically recycled orogenic craton interior.

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## 6. CONFLICT OF INTEREST

There is no conflict of interest associated with this work.

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