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Biostratigraphy and Paleoecology of a Section of Shagamu Quarry (Southwestern Nigeria)

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ABSTRACT

Twenty one representative samples collected from the quarry of West African Portland Cement Factory in Ogun State, 60km from Lagos state were treated for microfauna as well as studying the Lithological contents in other to establish the Biostratigraphy, Paleoecology and Lithology of the exposed strata. The treated microfauna content yielded Planktonic and Benthonic foraminifera along with Ostracods. These are studied to interpret the Biostratigraphy and Paleoecology of the study area. The Planktonic foraminifera species includes; *Globorotalia aequa, Globorotalia acuta, Globorotalia pseudobulloides, Globigerina triculinoides*. Benthonic foraminifera species includes; *Bulimina asperoaculeata, Ammonia becarrii, Nonion costiferum, Bulimina paleocenica.* The microfauna assemblages show diagnostic Paleocene to early Eocene age. This is established by the presence of *Globigerina triculinoides* and *Globorotalia pseudobulloides* as indicative of Paleocene to early Eocene trends. Paleontological deductions and reconstruction were made on the basis of foraminifera and ostracod assemblage. The combinations of Planktonic and Benthonic as well as the lithological characteristics of the study area reveals that the environment of deposition may be inner neritic with middle neritic influence due to partial exposure to the sea and these could be correlated with other areas in the world.

Key words: Stratigraphy, Micropaleoentogy, Biostratigraphy, Paleoenvironment.

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INTRODUCTION

The Ewekoro Formation section of Shagamu quarry is composed mainly of limestone along with sand, laterite, clay and shale as its associated rocks. Limestone is a common sedimentary rock, estimation based on field survey and measurement shows that it forms about one-quarter to one-fifth of the stratigraphic record. They range from all ages; from the earliest Precambrian (Archean) but, they are much less abundant in older rocks than in the younger rocks (Pettijohn, 1949).The study area has attracted several workers in the past and the area has witnessed several paleontologic and stratigraphic studies. The exposure in the quarry is essentially the same as that in the Ewekoro quarry (Adegoke et al., 1976) which is the best exposure of sedimentary rocks in southwestern Nigeria. The Ewekoro quarry has been variously interpreted as being of Paleocene (Danian-Landenian) to Eocene age. Fayose and Azeez (1972) dated the strata lower Eocene age,

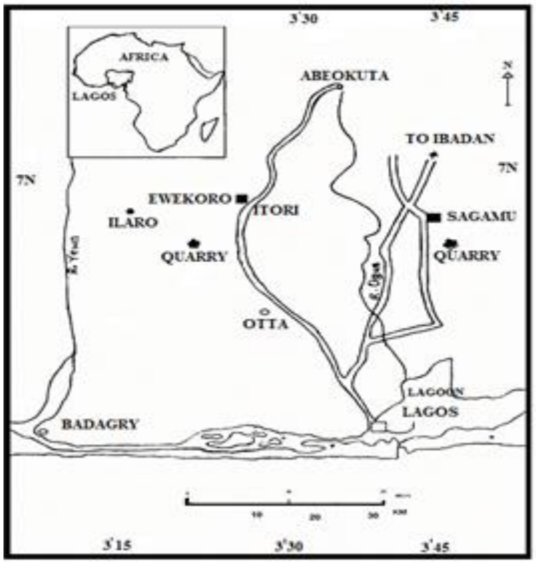

Figure 1. Location of studied area in this map.

based on the recovery of *Globorotlia subbotinae morozova* an index fossil of the lower Eocene from one limestone samples collected from the quarry. Reyment (1965) defined the Ewekoro Formation as relatively thick limestone, which he correlated with the Imo shale and to which he assigned a Paleocene age. In addition, he estimated the thickness to be greater than 14m.

This was because the exposure of Ewekoro, where the limestone is quarried extensively is not representative. Borehole records however show that the limestone in this area usually ranges between 20m and 29m thick. The later workers preferred to restrict some of the formation’s name to crystalline limestone, which at the quarry area is 9 to12m thick. Reyment (1965b) carried out a Biostratigraphy study of some boreholes such as Akinside Borehole and on the basis of the ostracod and foraminifera recovered, the entire sequence was assigned an upper Paleocene (Landenian) age. In this research work the Ewekoro formation was said to be overlain by the Oshosun formation and Underlain by then Imo formation. The Ewekoro limestone is placed immediately above the Cretaceous-Tertiary boundary (Adegoke, 1969) with the Imo shale on top of the limestone, apparently equating both formations to the Paleocene. Ogbe (1972, 1974) at the Ewekoro quarry, reported an assemblage that includes *Globorotalia pseudobulloides* Plummer, *Subbotina triloculinoides* Plummer, and *Globorotalia varianta* Subbotina, from Danian to Early Thenetian. According to Adegoke et al. (1980), the upper part of the Akinbo formation and the horizons referred to as the Oshosun formation at the Shagamu quarry are devoid of foraminifera and macrofauna. Consequently, they cannot be dated on their faunal content. They are likely to be Eocene in age since lateral equivalent horizons at the Ewekoro quarry have been dated as Eocene (54.45 ± 2.7 million years, Adegoke et al., 1972). The objectives of this work include determining and identifying the lithology of the formation, to establish the biostratigraphy and age relation of Shagamu limestone to the rock unit in the Eastern Dahomey Basin and to use the available data to reconstruct the paleoecological settings and correlate the formation with other formations.

Geologic setting

The study area falls within the Eastern portion of Dahomey Basin. Shagamu Limestone is located at the quarry site of West African Portland Cement in the Shagamu village along Lagos, Ibadan and Benin road. It is located between latitudes 6^{o}15’N to 7^{o}15’N and longitudes 2^{o}45’N to 3^{o}55’N, Figure 1. It is about 63km Southwest of Abeokuta, 72km Southeast of Ibadan and 67km Northwest of Lagos.

The Dahomey basin is a margin sag basin which forms one of the series of West African Atlantic Margin rift Basins whose origin were related to the Late Jurassic to Early Cretaceous rifting that occur during the separation of African and South American lithospheric plates (Omatsola and Adegoke, 1981; Weber and Daukoru, 1975; Whiteman, 1982).The basin is separated from the Tertiary Niger Delta in the Eastern section by the Benin Hinge Line and Okitipupa Ridge and marks the continental extension of the chain fracture zone (Coker and Ejedawe, 1987; Onuoha,1999). It is bounded on the west by the Ghana Ridge, Which reflects that the basin stretched along the margin of the Gulf of Guinea through the coast of Nigeria, Benin Republic, Togo and Ghana (Burke et al., 1971; Whiteman, 1982).

The reviewed works of Adegoke (1967), Kogbe (1974) Billiman (1976), Omatsola and Adegoke (1981), Ako et al. (1980) and Idowu et al. (1993) on the stratigraphic setting of the eastern Dahomey basin in southwestern Nigeria identified five major lithostratigraphic formations from cretaceaous to Tertiary age. The successions from youngest to oldest includes: Abeokuta Group. (Cretaceaous), Ewekoro Formation (Paleocene), Akinbo Formation (Late Paleocene- Early Eocene), Oshosun Formation (Eocene) andIlaro Formation (Eocene). The Abeokuta group consists of three Formations (Ako et al., 1980; Haacket al., 2002), which are: Ise Formation Neocomian to Albian age, this overlies the basement rock and consist essentially of continental sands, grits and silt stone. Overlying the Ise Formation is the Afowo Formation Turonian to Maastritchtian age. This are deposited in a transitional to marginal marine environment and consist of course to medium grain sandstones, silts, shales and clays with the shale content increasing progressively upward from the base to the top. Billiman (1976).

The Araromi Formation conformably overlies the Afowo Formation and is Maastritchtian to Paleocene in age (Omatsola and Adegoke, 1981) and is composed of fine to medium grain sands at the base and overlain by shales and siltstone beds with thin interbedded limestone and marls. The Abeokuta group is conformably overlained by

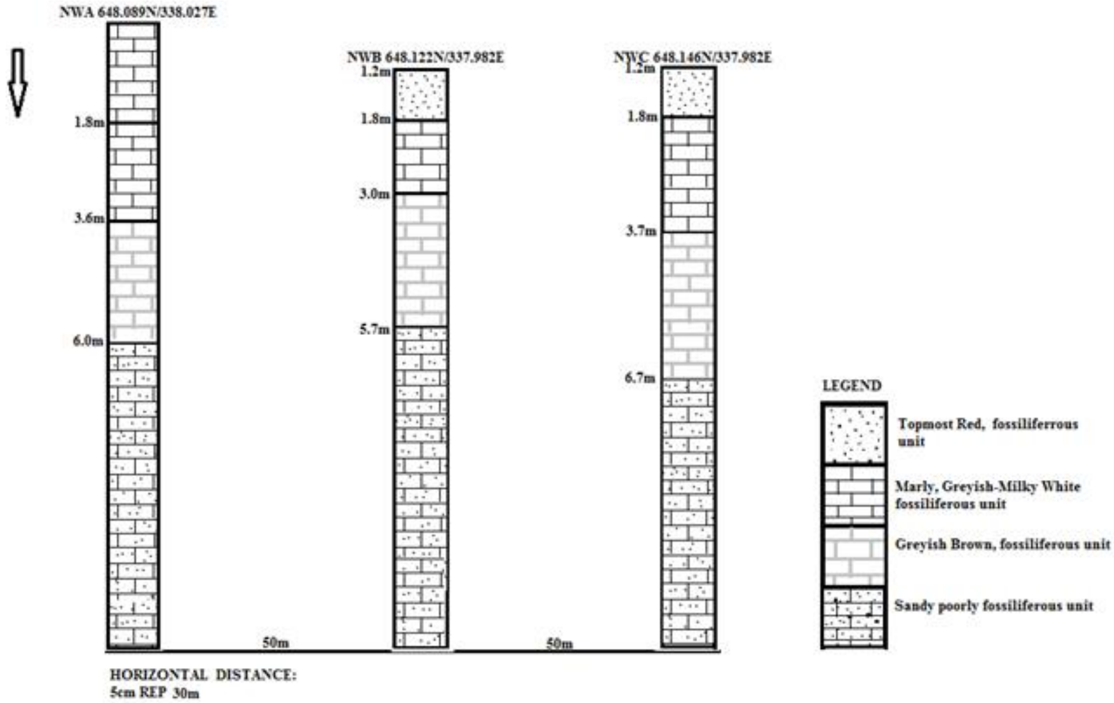

Figure 2. Lithostratigraphic section of the study area.

the Ewekoro Formation which consist of fossiliferous limestone which turn into marl and its arenaceous content increase towards the base as it grade into the underlying Abeokuta group (Adegoke et al., 1980). The Akinbo formation overlies the Ewekoro Formation and it is consist essentially of shelly gluconite rock bands about 0.3m (Ogbe,1972) that separate upper and lower unit consisting of Fossiliferrousshales with riddled bands and lenses of limestone and gluconite. Overlying the Akinbo formation is the pale greenish-grey laminated phosphatic marls, light grey white-purple clay with interbeds of sandstones of the Oshoshun formation which also consist of clay stone underlain by argillaceous limestone of phosphatic and glauconitic materials inthe lower part of the formation (Ako et al.,1980) the youngest formation is the Ilaro Formation which consist essentially of coarse sand of estuarine, deltaic and continental environment with rapid lateral facies change (Jones and Hockey, 1964)

METHODOLOGY

Detailed analysis and measurements were made and presentation was made on the level of reliability bearing in mind the accuracy level and precision of measurements taken through the field and Laboratory stage test. The samples were subjected to detailed processes and activities, which include lithological and micropaleontological analysis. Twenty one samples were collected from the strata exposed at the quarry (place the number of samples in the field section) within three sampling units. The sampling units were spread over 150 m lateral interval. Four distinct stratigraphic sequences were recognized with well defined transitional layers, two representative samples were collected as such no vertical interval was used.

The section map of study area was gotten and the lithology of the exposed strata accurately described as shown in the Figure 2. Samples were collected laterally and vertically from the dug well systematically. The depths of varying lithologies were recorded accordingly and samples were stored in a silt proof polythene bags and labeled immediately to avoid mixing. All field informations obtained was properly documented in a field note. The laboratory anlyses consists of two main phases: lithological description and micro paleontological preparation.

Microscopic study

This involves the visual observation and identification of samples gotten from the field. This was done to determine the grain morphologies, which includes grain size, shape of samples, and color of grain by the use of Olympus Binocular microscope under plane polarized light and cross nicols. Hand lens is also used to view structural features on the collected samples. Lithological description of the study area was achieved by describing the samples with respect to lithology and colour. Each sample was carefully examined under a binocular microscope to identify and describe lithological properties. Four distinct stratigraphic units were exposed at the localities sampled and three sampling points studied which are Northwest NWA. In each sampling point, two representative samples are collected from the four stratigraphic units.

Micropaleontological preparations

A total of nineteen species foraminifera and Ostracod were recovered from the exposed strata of the limestone units at the West African Portland Cement Factory Shagamu. The classification is founded on a clear hierarchy of morphological features which fulfils the demands of practical work (Lutherbacher, 1964). Supplementary paper used in this classification is by Leoblich and Tappan, 1964 in the treatise on invertebrate paleontology. The preparation of sample gotten from the field for microfauna analysis and can be grouped into these stages; sample Preparation, and boiling and washing. Samples were collected from the mapped areas in order to study the presence of microfauna. 25 g of each sample collected was weighed on a chemical balance, crushed in porcelain mortal and kept in labelled beaker. Hydrogen peroxide (H_2O_2), Calgon and distilled water was added to the sample in sufficient quantity.
This was left for a period of 24 h to allow disaggregating of the particles. The ratio of Hydrogen peroxide (H_2O_2) to distilled water was 1: 6. After soaking for 24 h the samples were then boiled in an aluminum pans on a stove for some minutes with continuous stirring and were allowed to cool. It was run under a gentle jet of water to decant the particles. It was thoroughly washed until the water is clear and mud traces are no more available. The samples were then filtered and filtrates were allowed to dry in the sun for some minutes. The dried samples were sieved into three fraction using 125 microns, 75 microns and 63 microns. Each fraction of the sieved samples was placed in an envelope dully labeled to ease the picking of the micro fauna because the binocular microscope easily focuses on the equidimentional particles. On picking, little portion were evenly on the black girded picking tray and examined under the binocular microscope. A picking brush with a moistened tip with a base of hand rested is used in picking the microfossils. However, most microfossil was seen in the 75 microns and 63 microns size ranges. The identification of the picked microfossils was done using a micropaleontological catalogues, monographs, manuals, journals of mining geology and other relevant materials dealing with the description of micro fauna in general.

RESULT AND DISCUSSION

Lithological Description

*Stratigraphic descriptions of sample*s

Four distinct stratigraphic units were exposed at the localities sampled and three sampling points studied which are Northwest A, North West B and North West C, NWA, NWB and NWC respectively. In each sampling point, two representative samples were collected from the four stratigraphic units.

NWA location: coordinate 6^{o}48'N/ 3^{o}38.027' E, Three samples were examined from four exposed units due to height constraint. Six samples were collected from the three units with total height of 12 m.
Unit 3
Colour: Greyish brown – reddish colour
Grain size: Marly, fine- medium grained, angular grained
Thickness: 1.8 m
Unit 2
Colour: Light brown
Grain size:Marly, Medium-coarse indurated unit and slightly sandy at the base with abundant macrofossils.
Thickness: 2.4 m
Unit 1
Colour: Dark brown
Grain size: Medium-coarse grained contain few calcareous shell fragments, with unconsolidated particles.
Thickness: 6m
It is the basal unit and marks a transition from the limestone formation into Abeokuta group.

NWB location: Coordinate 6^{o}48.146'N/ 3^{o}37.982'E. The total of seven samples was collected from four exposed unit. The sampling point is about 150 m from NWA location. Total height is 11m
Unit 4
Colour: Pink- reddish colour
Grain size: Coarse grained, fossiliferous
Thickness:1.2 m
Unit 3
Colour: Greyish- milky white
Grain size: Medium grained and fossiliferous
Thickness: 1.8
Unit 2
Colour: Grayish brown- milky white
Grain size: Medium grained, clayey with few fossil fragments.
Thickness: 2.7 m.
Unit 1
Colour: Brownish colour
Grain size: Medium- coarse, sandy at the base with few fossil fragments.
Thickness: 3.5 m

NWC location: Coordinate. Total of eight samples were collected from four exposed units. This is about 150 m from NWB location.
Unit 4
Colour: Reddish clay, topmost unit
Grain size: Fine grained fossiliferous
Thickness: 1.3 m
Unit 3
Colour: Dark grey
Grain size: Marly, fine grained, fossiliferous
Thickness: 1.8 m

Plate 1

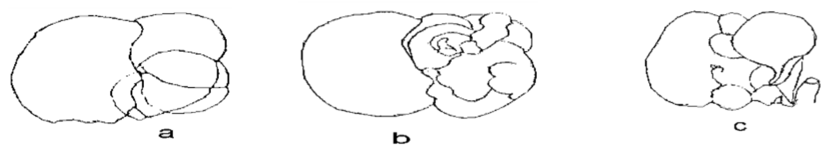

Figure 1. *Globorotalia pseudobulloides*. Plummer (72x) Dorsal view (b) ventral view (c) apertural view. Paleocene.

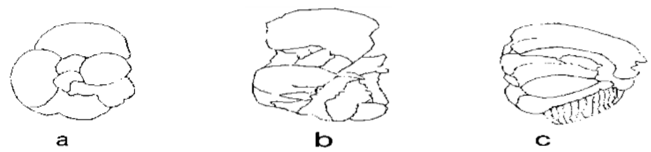

Figure 2. *Globorotalia wilcoxensis*. Cushman and Ponton (60x) (a)dorsal view (b)ventral view (c) apertural view.Lower Eocene.

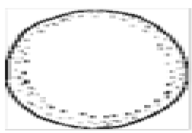

Figure 3. *Orbulina universa.* d'Obigny (72x) Miocene.

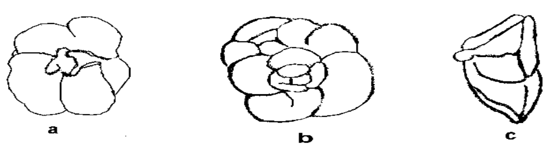

Figure 4. *Globorotalia acuta*. Toulin (60x) (a)ventral side (b)dorsal side (c) edge view showing the beaded keel. Upper Paleocene.

Unit 2
Colour: Greyish brown,
Grain size: Medium coarse grained, fossiliferous
Thickness: 3.2 m
Unit 1
Colour: Brownish
Grain size:Fine- coarse grained, sandy and poorly fossiliferous,
Thickness: 4.2 m
All the observation, identification and description of samples from each localities helps in the construction of lithostratigraphic column for each sampling location. These can be seen in Figure 2

Microscopic study

Biostratigraphy results

The stratigraphic units of the samples studied at the Sagamu quarry are moderately fossiliferous. The microfauna studied are essentially foraminifera and ostracods. The foraminifers encountered are planktonic and benthonic while the ostracods species are mainly smooth or unornamented forms.

Foraminifers

The foraminifers are the planktonic and benthonic species, which include *Globorotalia, Globigerina, Orbulina, Ammonia, Bolivina* and *Nonionella* species.

Planktonic Foraminifers

*The Globigerina triloculinoides specie (*Plate 1, Figure 1a-1c*)* of the *Globigerinidea* family and the *Globorotalia wilcoxensis specie* (Plate 1, Figure 2a-2c) of the *Globorotaliadea* family occur in all the localities of the study area, while the *Orbilina universa* d'Orbigny specie (Plate 1, Figure 3) of the *Globorotaliadea* family occur at the NWA locality. The *Globorotalidae* (Cushman, 1927) family has variety of species in the study area, the species include *Globorotalia acuta* Toulmin specie (Plate 1, Figure 4a-4c), is easily confused with the fine chambered variety of *Globorotalia velascoensis* but lacks the strong papillose surface, *Globorotalia acuta* specie (Plate 2, Figure 2a-2c) was originally described in the lower Eocene but was later proved by Leoblich and Tappan, 1957 to be of Upper Paleocene age, *Globorotalia*, *pseudobulloides* specie

Plate 2

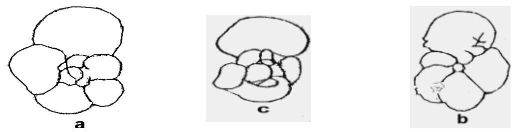

Figure 1. *Globorotalia pseudobulloides*. Plummer (72x) (a) Dorsal view (b) ventral view (c) apertural view. Paleocene.

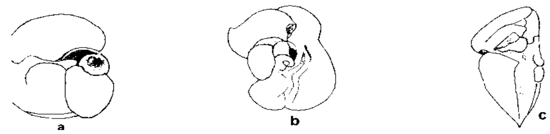

Figure 2. *Globorotalia aequa*. Cushman and Renz (60x) (a) ventral view (b) dorsal view (c) apertural view. Lower Eocene.

(Plate 2, Figure 1a-1c), It is of Paleocene age and it occur in all localities of the study area. *Globorotalia aequa* specie (Plate 2, Figure 2a-2c) (Cushman and Renz 1942), this species had been reported in Imo clay in eastern Nigeria. It also occurs in Western Nigeria in association with *Globorotalia esnaesis* and *Globorotalia wilcoxensis*. From the samples studied the peripheral keels run over on the dorsal side of the last chamber. It ranges in age from Paleocene to lower Eocene, it occurs in all locality of the study area.

Benthonic Foraminifers

Rotalidae Ehernbary, 1939, *Nonionidae* Schultze, 1854, *and Buliminidae* Jones, 1875 are the three family of the benthonic foraminifers in the study area. *Ammonia beccarii* specie (Plate 3, Figure 1a-1c) of the *Rotalidae Ehernbary*, 1939, family, is a common species in the littoral regions of warm seas. It is a cosmopolitan species occurring in marine as well as brackish water at depth not greater than fifty fathoms. Renz (1948) states that when *Ammonia beccarii* is found in great number, *streblus beccari* (Ammonia beccari) provides an excellent ecological marker for shallow water lagoonal-brackish conditions, it is of lower Miocene, it occur in all locality. *Nonion costiferum*, Cushman, 1934. specie (Plate 3, Figure 2a- 2c) of the *Nonionidae* Schultze, 1854, family form is similar to Cushman's figured type; it was first described in the monetary Miocene shale in California. *N. custiferum* occurs in the Oligocene sediments in the Afowo 1 section and becomes abundant in the lower Miocene.it occur in all locality of the study area.

Bulimina paleocenica Brotzen, 1948 specie (Plate 3, Figure 3a.) of the *Buliminidae* Jones, 1875 family is triserial in early stages, well finely to coarsely perforate aperture extending up from base of apertural face. it occur in all localities of the study area.

The microfaunal assemblages show diagnostic Paleocene to early Eocene age. This is established by the presence of *Globorotalia acuta* ***(***Toulmin, 1957), *Globorotalia wilcoxensis* (Cushman and Ponton, 1932), *Globorotalia pseudobulloides* (Plummer)*Globigerina triloculinoides, Globorotalia aequa.* Plummer, *Globorotalia cerroazulensis* Cole 1928, *Nonion costiferum* (Cushman), *Ammonia beccarii* LINNE and *Bolivina asperoculeata* BROTZEN. *Bulimina asperoaculeata, Bulimina paleocenica*

The presence of *Globorotalia acuta* is indicative of upper Paleocene age (Loeblich and Tappan, 1957) and lower Eocene age. This was described at the depth of 370m-373m at a Borehole near Araromi in Southwestern Nigeria by Reyment (1957*).* This was also at water supply borehole north of Ilaro at a depth of 50m(Reyment, 1957).

Ostracods

The Ostracod assemblage includes such species as *Cytherella (Cytherella) austinensis* (Plate 4, Figure 1a-1d.), *Paracypris cf wamiensis*, Bte (Plate 4, Figure. 2a-2b), *Brachycythere cf sapucariensis* (Plate 4, Figure 3a - 3b), *Cytherella kunradensis* (Plate 4, Figure 4a-4c), *Ovocytherida symetrica*,(Plate 5, Figure 1a- 1c.), *Mehesella,* Reyment (1960) (Plate 5, Figure 2a- 2c), *Brachycythere aff angulate,* Grekoff (1957), (Plate 5, Figure 3a-3c.), *and Ovocytheridea nuda* Grekoff, 1951,(Plate 5, Figure 4a- 4c.). Ostracods species which are Maastrichtian and recorded in various locations of Nigeria (Reyment, 1960) include the following: *Cytherella* ***(****Cytherella) kunradensis* VAN VEENS, *Mehesella paleobiafrensis, Ovocytherella symmetrica, cytherella (cytherella) austinensis, Brachycythere aff angulata* and *Ovocytherella nuda.*

Mehesella paleobiafrensis was originally recorded in Gbekebo borehole at a depth of 916m – 919m also the borehole at Araromi at a depth of 472 – 474m to range from upper Maastrichtian to Paleocene. Reyment (1960) noted that *Mehesalla paleobiafrensis* Paleocene which is important in the cretaceous tertiary Stratigraphy of West Africa. It also cuts across the cretaceous tertiary boundary.

Plate 3

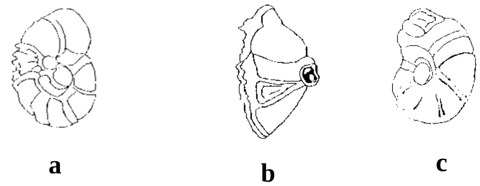

Figure 1. *Ammonia beccarrii* (Linne) (60x) (a) ventral view (b) dorsal view (c) edge view.Lower Miocene (Aquitarian)

Figure 2. *Nonion costiferum*. Cushman (60x) (Benthonic).(a) Side view (b) apertural view.Oligocene.

Plate 4

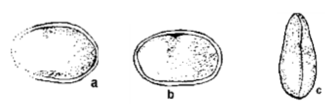

Figure 1.*Cytherella austinensis* Alexander? X 60 (a) left lateral view of Carapace (b)right lateral view of Carapace (C) Anterior view of Carapace.

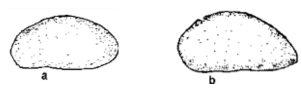

Figure 2. *Paracypris cf. wamiensis* Bate (a) right valve (b) left valve.

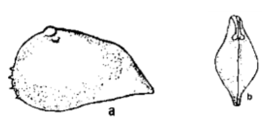

Figure 3.*Brachycythere cf. sapucariensis* Krommelbein x 60 (a)side view of left valve (b)Dorsal view of the Carapace.

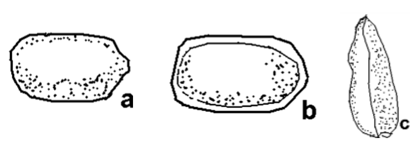

Figure 4. Cytherella (cytherella) kunradensis Van veen x 60 (a) Right side of Carapace (b) Left side of Carapace (c) Dorsal aspect of Carapace.

Cytherella (cytherella) kundradensis VAN VEEN (sp. JONES). Ovocytheridea symmeritrica Reyment, FAYOSE et al, Mehesella paleobiafrensis.

Cytherella (cytherella) kunradensis VAN VEEN was described initially from the maastrichtian of Lemberg, Holland. In western Nigeria it was found in the oolitic

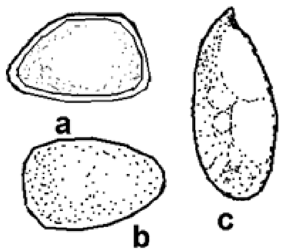

Figure 1. *Ovocytheridea symmetrica* Reyment x 60 (a) Left lateral view (b) Right lateral view (c) Anterior view

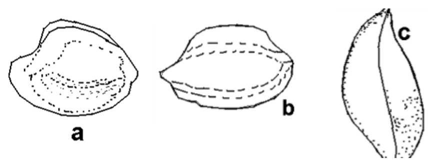

Figure 2. *Mehesella paleobiafrensis* Reyment x 60 (a) Right side view of a Carapace (b) Left side view of a Carapace (c)Dorsal view of a Carapace.

Figure 3. *Brachycythere aff angulata* Grekoff x 60 (a)Right side of a Carapace (b) Left side of a Carapace (c) Dorsal view of a Carapace.

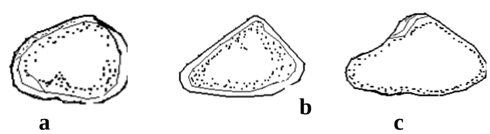

Figure 4. *Ovocytheridea nuda* Grekoff x 60 (a) Dorsal view of a Carapace (b) Right side view of a Carapace (c)Left side view of a Carapace.

limestone, Awle River Benin and Araromi which were all upper Maestrichtian. The age of the sequence from where it was recorded has been dated through the occurrence of ammonite *Spendiscus studeri* Reyment.

The occurrence of *Cytherella (Cytherella) austinensis* Alexander (Plate 4, Figure1a-1d), *Ovocytheridea symmetrica* Reyment, *ovocytheridea nuda* Reyment and *Brachythere angulata* Reyment have all been dated to Coniacian age (Reyment, 1955). The same sequence of strata at Lamja also contains Coniacian ammonite species.

Cytherella (cytherella) *austinensis* is of the Pecan Gap formation (Campanian). This would put its oldest North American occurrence above that of the Nigerian. *Ovocytheridea* Grekoff (1951) was initially related as being of Campanian age. From the following foraminifera and Ostracod assembly such as *Globorotalia acuta, Globorotalia wilcoxensis* Cushman and Ponton, *Globorotalia pseudobulloides* PLUMMER, *Globorotalia cerroazulensis* COLE, *Globigerina triloculinoides* PLUMMER, *Nonion costiferum* CUSHMAN, *Ammonia beccari* LINNE and *Bulivina asperoaculata* BROTZEN and Ostracods such as *Cytherella (Cytherella) kunradensis* VAN VEEN, *Cytherella sp.* JONES, *Ovocytheridea symmetrica* REYMENT and *Mehesella paleobiafrensis* REYMENT, the studied sections are probably older than the Paleocene. The presence of upper Maastrichtian Ostracods is suggestive of transition from Maastrichtian Abeokuta group to dominant Paleocene formation, which is Shagamu quarry.

Paleoecological interpretation

The paleoecology of the section has been interpreted from the range; nature and distribution of fauna. The foraminifera and ostracod assemblage were used in paleoecological reconstruction and deductions. Considerations of paleoenvironmental deposition are discussed. The West African margin has been depositionally active since initial rifting took place in the Early Cretaceous (Jansen et al., 1984; Nürnberg and Müller, 1991), resulting in three sub-basins developing along the West African passive margin, including the Lower Congo basin (Broucke et al. 2004). Paleoecology deductions and reconstructions were made on the basis of foraminifera and Ostracods assemblage. This is so because, Planktonic foraminifera are stratigraphically very valuable for they permit worldwide correlation possibilities. The rich fauna of the Ostracod offers strong evidence for the shallow nature of environments and has proved useful for correlation between the sedimentary basins of West Africa. All this factors are considered in this project. The microfauna assemblage of the studied section of the Shagamu quarry however suggests that the environment of deposition may be inner neritic with middle neritic influence due to partial exposure to the open sea.

This is confirmed by the combination of Planktonic and benthonic foraminifera such as *G. acuta, G. pseudobulloides, G. triculinoides, Bulimina paleonica* and *Bolivina asperoaculeata*. The notable presence of unornamented Ostracod species: *Ovocytheridea ruda* and *Bracyhycythere aff.angulata* were also included. The arenaceous forms of the foraminifera encountered are suggestive of upper continental slope to marginal marine (enclosed) environment of deposition. This has the combined characteristics of the inner-neritic environment and the outer neritic environment. This is because it is a transition between the two. At a certain level, high Planktonic to benthonic ratio was noticed which indicates increased depth of deposition away from the shore line (Douglas, 1973). It was supported by low specimen dominance and high species diversity which are indications of increasing water depth (Yousseffins, 1978).

The presence of Planktonic foraminifera such as *Orbulina universa* and *Globigerina triloculinoides* and deep water benthonic species serves to confirm the environmental regime in the nerritic (Petters, 1982). Also at another level, decrease (from the base to the top) in specimen abundance and species diversity was noticed. Here, the Planktonic to benthonic ratio was at its lowest level and Planktonic were almost absent rather, the presence of shallow water benthic was recorded. The occurrence of benthonic species is controlled to a great extent by physical factors of depth, temperature, amount of light, turbulence of the water, character of the bottom sediment chemical factor of water salinity, available elements and biological factors of the food supply, symbolic organisms, parasites and predators (Leoblich and Tappan) while Planktonic foraminifera are influenced by the same chemical and biological factors but the important physical influence are the temperature, current, turbulence and turbidity. The lithology Figure 2 of the studied section exposed at the Shagamu quarry is suggestive of upper continental slope to marginal marine environment of dark grayish brown limestone with abundant fossil fragments. It is also indicative of a high energy environment with maximum wave action. They are suggestive of upper continental slope to marginal marine (enclosed) environment of deposition.

Conclusion

The sample collected from the section of Shagamu quarry was used to establish the stratigraphic and taxonomy studies with the use of foraminifera and Ostracods. Nineteen (19) species of micro fauna foraminifera identified, seven (7) of which were Planktonic and four (4) benthonic. However, eight (8) Ostracods species were recovered. The section contained few diagnostic fossils on which Paleocene- early Eocene age has been suggested. It contains mainly unornamented ostracods and planktonic foraminifera, which are stratigraphically very valuable. However, they permit worldwide correlation possibilities. Ostracods species are essentially useful for correlation between the sedimentary basins of West Africa (Benin, Togo, and Côte d'Ivoire). They also offer strong evidences for the shallow nature of this environment.

The microscopic lithology description of the Paleocene early Eocene Ewekoro formation reveals that the sediment is rich in fossil fragments and coarse grained sands which are indicative of a high energy shallow marine environment of deposition with maximum wave action. The population and diversity of the fossils are thus affected by these conditions. Succinctly, the occurrence of species such as *G. cerroazulensis* Cole restricts the sediment to Paleocene-Eocene (no this age *because G. cerroazulensis* is a marker of middle Eocène) so also *G. pseudobulloides*. Reyment (1965), Adegoke (1979) and Ako et al. (1980) proposed a Paleocene age for Ewekoro formation, Fayose and Azeez (1972) however proposed a lower Eocene age based on the presence of *Globorotalia (Morozovella)* and *Bolivina ottaensis*.

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