

## Micropaleontological studies of Ewekoro Sediments Southwestern Nigeria

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### Abstract

The study determines the micropaleontological studies of Ewekoro sediments in South Western region of Nigeria. The area of the study lies between latitudes 6°47N-6°53N and longitudes 335E-3°40E. Samples were collected from freshly exposed surface of Ewekoro formation of Dahomey basin at an interval of 2 m. These samples were subjected to lithological description to determine the grain size, color, sorting also to standard micropaleontological analysis to recover the foraminifera which were used to determine the age, paleoenvironment of deposition and stratigraphic equivalence of the formation. The study showed that the limestone at the basal part of the sequence were sub-angular to sub-rounded shaped, poorly sorted and with yellowish brown color indicate disturbed environment. While the upper shale are fined grained, greenish in color, dark-grey and showing high fissility. The foraminifera recovered include, *Lenticulina degolyeri*, *globorotalia*, *pseudomonardii*, *Globigerina linaperta*, *Globigerina yeguaensis* and *cibicides* sp. This is occurrence of some planktonic foraminifera which are indicative of marine environment. Therefore, there must have been an incursion of marine water into the environment. However, the paleoenvironment of deposition ranged from inner neritic to middle neritic.

**Keywords:** Micropaleontology; Lithological; Stratigraphic; Grain size; Tectonics; Foraminifera; Environment

### Introduction

A basin can be generally be defined as a depressional or shallow place and when filled or floored with different sort of sediments. It becomes a sedimentary basin. The various common rocks that in filled into a basin are: shales, limestones, clays, siltstone and sandstone. These sedimentary rocks are the end products of different sediments that had undergone the process of diagenesis. The pre-processes that occur before diagnosis include: weathering, erosion, transportation of sediments, accumulation of sediment (deposition) the weathering due to overburden pressure and lithification. The Dahomey Basin is an upper Cretaceous to Pliocene sedimentary basin found on the continental margin of Guinea Coast of West Africa. It extends from Southwestern Ghana in the West through the Republic of Togo and Benin into the Southwestern flank in Nigeria (Niger Delta), as far the Okitipupa ridge [1,2]. In Nigeria, we have the south-eastern part of the basin extending from present day Ogun State in the Southwest to Agbabu-Okitipupa in the present day Ondo State. This basin lies approximately between longitude 1°E and 6°E and latitude 5N and 8°N. It is narrow and parallel to the coast line. About 40% of the basin contains 10,000-12,000 of Cretaceous and Tertiary rocks lie within Nigeria. The axis and the thickness of the sediment in the basin occur slowly to the west by faults and other tectonics structures associated with the land-ward extension of fracture zone [3]. This basin sequence, comprise mostly of dark-grey shale, grey-whitish limestone, with little of siltstone as described by Omatsola and Adegoke, Adegoke et al. and Billmam [4-6].

The area of study lies on the topographic sheet of Nigeria sheet 24 (North East) published in 1982 by Federal Geological Survey. The Ewekoro quarry which is approximately 60 km Northwest of Lagos latitude 648°N-635°N and longitude 335°E-330°E (Figure 1).

The Ewekoro quarry falls within the tropical rain forest of the sub-equatorial southwestern region, Nigeria. It experiences "both wet and dry" seasons in a year, which is a typical nature of Nigeria climate.

The average relative humidity of the study area is between 75-95% while the average mean annual rainfall and mean monthly temperature are about 1,500-2000 mm and 22°C-22.5°C respectively.

The Cretaceous sediments of Dahomey basin are partly cut off from the sediment of Niger Delta basin again supported ages assigned to the sequences, EwekoroAkinbo and other Tertiary formations range in age from Paleocene-middle to upper Eocene and the sediments are deposited in both marine and transitional environment. The formation of Ewekoro proved to be of economic importance as it being quarried for a production like cement by Lafarge (West African Portland Cement Company) Ewekoro and Dangote group Cement Company.

Several studies have been carried out on the Cretaceous-Eocene sediments of Dahomey basin particularly on micropaleontology, hydrogeology of Ewekoro shale and limestone. In early 1960's, the first work carried out by Parkinson on the post Cretaceous stratigraphy of southern Nigeria has made ways for more intensive work on the Ewekoro formation of the Western Dahomey basin. Other contributors are: Reyment, Coker, Deklsz, Eames and Fayose [7-11] have all provided valuable knowledge of the basin and its formations.

The following micro fossils so far found in the different sedimentary sequences by different authors like Reyment, Bergree, Adegoke et al. and Adegoke [12-15]; include *Globorotalia pseudo bulloides*, *G. Velaseoesis*, *G. acuta*, *Globigerina triloculinoides* assemblages, Reyment [13] also listed a typical Paleocene Ostracods fauna. There are also faunas like; molluscas, corals, crinoids, crustaceans, pelagic and planktonic foraminifera [15]. These fauna assemblages have been very useful in dating the different sedimentary rocks of the Dahomey basin, as well as in the reconstruction of paleoenvironment of deposition.

Publications like Fayose, Folk, Kogbe, Frankle and Gemeraad

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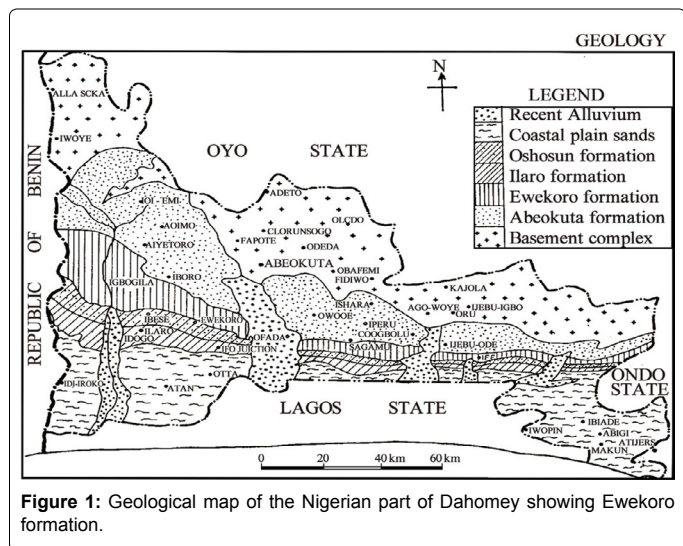


Figure 1: Geological map of the Nigerian part of Dahomey showing Ewekoro formation.

[16-20] who worked on the dolomitization of the Ewekoro formation has also been helpful. The tectonic evolution and Cretaceous stratigraphy of the Dahomey basin and the subsequently opening of the Atlantic Ocean by Omatsola and Adegoke [4]; had shed more light on the structural framework of the basin. Therefore, this study is aimed at presenting a vivid but comprehensive report of Ewekoro's shale and limestone in Dahomey basin from the foraminifera point of view. In the study, geological information of the sediments such as; age, depositional history, stratigraphic equivalence, textural and mineralogical characteristics, correlation and environmental deposition are documented based on micro fauna assemblages.

### Material and Methods

The samples used for this study were obtained from a freshly exposed surface in Ewekoro quarry in Ogun state. Three samples were collected from freshly exposed surface to avoid picking weathered and contaminated sample. The sample were taken at an average interval of 2 m from the bottom of the well upwards to prevent stratigraphic leakages i.e. fragments of overlying strata will not contaminate the underlying strata. This fresh sample taken were immediately kept and sealed in polythene bags and labeled indicating the lithology. The samples collected were studied with the binocular microscope. The binocular microscope was used because of the physical properties of the samples are not visible on hand specimen. But, with the aid of the binocular microscope, the color, grain size, roundness, sorting etc. of each sample are determined. The process of sample preparation for micro paleontological study involved weighing, soaking, washing, sieving, drying and labeling of samples. About 40 g of each sample were weighed on the beam balance and observed in small tray under the binocular microscope. From this, the description on the lithology and the fossil content were made. Each of the weighed samples was crushed and soaked in hydrogen peroxide at room temperature for about 48 hours to disaggregate or dislodge the sediments from the fauna content present. After the time had elapsed, the hydrogen peroxide was decanted and the samples were again soaked in detergent were then washed, on at a time, under a jet of running water using the 63 µm and 73 µm sieve. The residue of each sieve was properly washed with water, placed in well-labeled plastic container and left to dry. Fossil were picked out from this dried sample at a magnification of 70X under the binocular microscope. The picked fossils of each sample were put in a labeled slide for a detailed identification and drawing.

## Results and Discussion

### Lithologic description

The Ewekoro shale and limestone has been studied using binocular microscope. The shale is dark-grey in colour, fine grained with high fossility; consist of carbonate stain, well sorted with shell fragments. The glauconitic shale is greenish in color, fine to medium grained, sub-angular and moderately sorted and not friable, while the limestone is whitish in color, consist of carbonate shell and quartz grains, sub-angular and moderately sorted and fine to medium grained. Table 1 show the lithologic description of the samples under binocular microscopes and this indicates that, the shale unit with aforementioned textural appearance shows it must have been transported from a very long distance before deposition in its present site. Attrition and abrasion capacity during the course of transportation are responsible for the sub-angular form of the limestone. The degree of sorting of the sediments which vary from moderately sorted to well-sorted is an indication that the sediments were deposited in quiet, low energy environment which allow sediments of similar size to accumulate together. While the basal limestone, were deposited in a disturbed environment.

Moreover, two major lithologies were recognized in the stratigraphic interval of 1-15 m of Ewekoro quarry. The two lithologies are the upper layers shale and the bottom layers limestone. The upper layers shales are very fossiliferous and the following foraminifera were recovered: *Lenticulina degolyeri*, *Globorotalia*, *Pseudotopilensis*, *Cibicides hampdenensis*, *Eponides pseudo elivatus*, *Globigerina angulisuturalis*. While the bottom layered limestone consist of *spirifer*, *cenoceras* sp., *pelecypoda*, calcareous broken shells. Also, in the recovery foraminifera *Globigerina yeguaensis*, *Globorotalia* sp., *Lenticulina degolyeri* and *cibicides* sp., are in abundance and also *Globorotalia* sp. are very common on all shale of the unit of the quarry. This foraminifera assemblage is similar to the assemblages of kalambina and Dange formations of the Ilumeden basin (Sokoto basin), which are dated Paleocene age.

### Foraminifera assemblages

The samples collected from Ewekoro quarry at different intervals were prepared for foraminifera studies. Therefore, Table 2 reveals that the fauna recovered in the samples were identified based on their characteristic features (chamber shape and sculptures), which have varied appearance of the resistant outmost wall. The micro fauna are fairly high in abundance and diversity in the samples. Though, few samples are very poorly fossiliferous. The recoverable fauna are majorly planktonic foraminifera especially at the upper part of the sequence. This could be as a result of the depositional environment.

### Geologic deduction from foraminifera assemblages

The various form of foraminifera recovered from samples collected at Ewekoro quarry of Dahomey Basin can be compared to be similar the

SAMPLE NUMBER	DEPTH (M)	LITHOLOGY	DESCRIPTION
S3	15	Shale	Fine grained with light grey in color, high fossility with carbonate stain, fine grained, well sorted.
S2	13	Glauconitic shale	Greenish in color, fine grained and not friable.
S1	12	Limestone	Whitish in color, presence of carbonate shale and quartz grains, sub-angular and moderately sorted, fine to medium grained.

Table 1: Lithologic description of samples under binocular microscopes.

*Globorotalia* sp, *Cibicides hampdenensis*, *Globigerina linaperta* of kerikeri formation of Chad basin [21]; which is dated Paleocene age. Also, the foraminifera assemblages of the Gambia, Kalambania and Dange units of Sokoto basin which include; *Globigerina trilocularis*, *Globigerina praebulloidis* [22]. They are all indicative of Paleocene age. Therefore, based on the written information, the rock samples studied for this work is here dated Paleocene age because of the strong similarity with work of Kogbe and Reymont [13,18].

### Geological age

The geologic age of the sequence of Ewekoro formation of the Ewekoro quarry is dated Paleocene age (Figure 2). The age is characterized by the planktonic forams (*Globigerina* sp., *globorotalia* sp.) and benthic forams (*Cibicides* sp., *Ammonia beccarii*) all dates Paleocene [15,23-25].

### Foraminifera description systematics

**Family:** Globorotaliidae

**Description:** Test trachoids, earliest chambers often like *Globigerina* with a rough cancellated exterior, biconvex, dorsal side more or less flattened, ventral side strongly convex, wall calcareous,

SAMPLE NUMBER	DEPTH (M)	RECOVERABLE FORAMINIFERA
S3	15	<i>Cibicides</i> sp. <i>Globigerina yeguaensis</i>
S2	13	<i>Globigerina ciperroensis</i> <i>Lenticulina degolyeri</i> <i>Globorotalia</i> sp. <i>Globigerina yeguaensis</i> <i>Globigerina angulisuturalis</i> <i>Cubicooides</i> sp.
S1	11	<i>Spirifer</i> , <i>Cenoceras</i> sp., <i>Pelecypoda</i> Calcareous, broken shells

**Table 2:** Showing the recoverable foraminifera in different samples with depth in Ewekoro Quarry.

perforate frequently spinose in whole or in restricted area aperture large, opening into the umbilicus which is either open or particularly cover by a lip.

**Occurrence:** Cretaceous to recent

**Family:** Lagenidae

**Genus:** *Lenticulina*

**Description:** Test similar to *Robulus*, tending to become uncoiled in the same species, the apertures radiate, at the peripheral angle, the silts equal.

**Occurrence:** Permian-recent

**Family:** Globigerinidae

**Genus:** *Globigerina*

**Description:** Test trichoid throughout, umbilicate, chambers in the young especially of the micropheric form in a flattened trachoid from like discorbis, usually smooth and the wall thin, later chambers globular, wall calcareous, thick and cancellated, in the well preserved especially pelagic specimens, clothed with long slender spines coming from the angles of the cancellation surface areas, the base of such areas with the pores of the wall; aperture large, opening into the umbilicus.

**Occurrence:** Cretaceous-recent

**Family:** Anomalinnidae

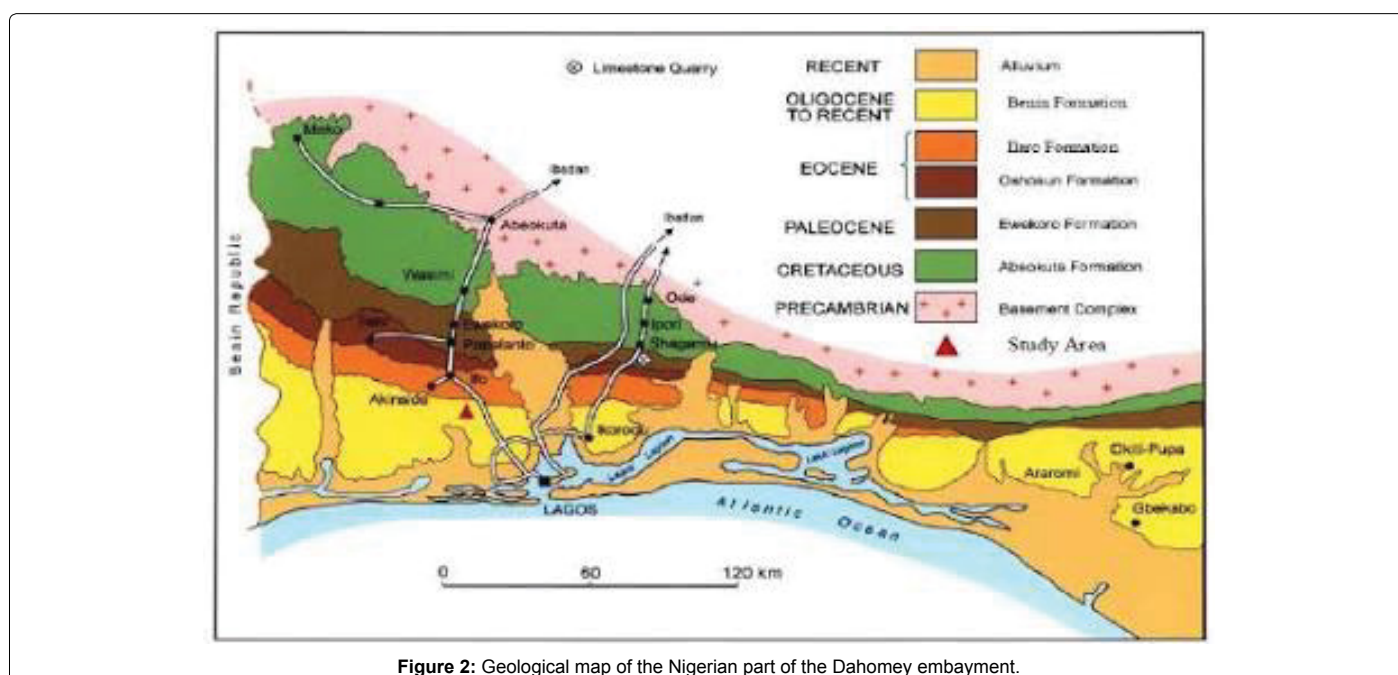
**Genus:** *Cibicides*

**Description:** Test plans convex, trochoid, usually attached by the flattened dorsal soidi, wall calcareous, coarsely perforated aperture peripheral at the base of the chamber sometimes extending ventrally, but extension dorsally between the inner margin of the chamber and the previous whorl nearly the length of the chamber.

**Occurrence:** Jurassic, Cretaceous-recent

### Paleo-environment of deposition

The Paleo-environment of the studied interval is generally marine.



**Figure 2:** Geological map of the Nigerian part of the Dahomey embayment.



This characterized by the type of lithology (limestone and shale) and the derived bentonicforams. The lithological sequence varies from limestone at the base to the light grey shale at the top. The Paleobathymetry could vary slightly but all deposited in a marine environment.

## Conclusion and Recommendation

The textural and lithological appearances of Ewekoro shale dark-grey colored with fine grained sizes and limestone, which is yellowish brown with sub-angular, sub- rounded shape. This indicates that the basal limestone of the sequence was deposited under disturbed condition while the shale sequence was deposited in a low energy environment. The micropaleontological analysis carried out on the samples yielded diagnostic assemblages of foraminifera. The recoverable foraminifera include *Globigerina yeguaensis*, *Globigerina pseudotopilensis*, *Cibicides* sp., *Lenticulin adegolyeri*, and *Globigerina angulisuturalis*. All these microfauna are dated paleoenvironment of deposition is thought to have been deposited in a continental environment with a later incursion of marine water. The marine setting Deepings downward from the shale sequence at the top to the carbonate deposit at the bottom.

As a result of these, the following recommendations are hereby suggested to the government and to the various oil films:

1. The Ewekoro sediment is of high economic value and therefore the area should be explored in detail.
2. The presence of Benin formation and some other fossils and the occurrence of favorable rock types associated with petroleum may indicate the presence of crude oil.

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