Biostratigraphy and Paleoenvironmental Studies of Onigbedu Sediments, Ewekoro Local Government, Ogun State.

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Abstract- Eleven (11) outcrops samples in vertical succession at the blast surface of the purechem cement mine, Onigbedu, Ewekoro from the Akinbo and Ewekoro Formationsat an interval of one meter depth were reconnoiter in order to establish the lithofacies, age and paleoenvironment. The biostratigraphic results indicated that the study area was deficient of calcareous nannofossils as well as planktonic foraminifera but benthic foraminifera were moderate to abundant in sample S2 of the Akinbo formation and samples L2, L3, L4, L5, L6, and L7 of the Ewekoro formation. Microfacies analysis carried out on three selected samples of the Ewekoro formation harmonized with already existing lithofacies classification of the Ewekoro formation as Sample L2 and Sample L4 -Biomicite, Sample L6- Biosparite. The presence of foraminifera species consisting of rare calcareous benthic, absence of Planktics and Calcareous nannofossils indicate deposition in a shallow water. Foraminiferal assemblage is characterized by Valvulineria sp, Quinqueloculina sp, Hanzawaia concentrica, Calcareous indeterminate and Ostracod suggesting sediments deposition in a marginal marine setting (Coastal Deltaic). The results of the analyses also indicate that these outcrop samples were deposited during the late Paleocene epoch, estimated numerical age of 56.8Ma to 57.3Ma and straddling the Valvulineria martinezensis Niger Delta Benthic Foraminiferal zone.

Indexed Terms- Biomicrite, Foraminfera, Onigbedu and Palaeoenvironment..

I. INTRODUCTION

In Nigeria, marine macrofossil-bearing strata of Paleocene age are known in the Kalambaina Formation of the Sokoto area (Parker, 1964) and in the Ewekoro Formation of the Dahomey basin in the west (Jones and Hockey, 1964; Reyment, 1965a, Adegoke et al, 1971)

This latter formation, which is well exposed in the quarry of the Purechem cement at Ewekoro is the object of this study. Though the Cretaceous and Tertiary strata of Western Nigeria have been studied by a number of workers since Parkinson's (1967) pioneer work, Reyment, (1960) and others. The identity of the Ewekoro Formation was not recognized until recently. Nearly nothing was known of the fauna and flora until the initiation of series of studies by Adegoke in 1967. This oversight may have been primarily due to the heavy soil, vegetation cover and the lack of exposures.

The Ewekoro Formation was first described in detail and formally named by Jones (in Jones and Hockey, 1964). He selected Ewekoro as the type locality and described as type section of a composite section, 483 feet thick, compiled from Geological Survey of Nigeria boreholes 1582 and 1583 at Akinsinde, a village about 10 miles SSW of Ewekoro. The Ewekoro Formation as used by Jones also included the overlying shale which has since been referred to a different formation by all other subsequent workers except Antolini (1968) and Fayose and Asseez (1972).

Although there had been enough Foraminifera species investigation in the studied area (Adegoke, 1967), the Calcareous nannofossil species has not been deeply investigated. This study therefore integrates Calcareous nannofossil species research together with Foraminifera species to delineate the relative age and the depositional environment of the Ewekoro and Akinbo formations.

II. LOCATION OF STUDY AREA

The study area is located at Purechem Industries Limited, cement branch, Onigbedu village, KM 12 Itori Igbogila road. Ewekoro local government, Ogun state in the Dahomey basin of Nigeria. It lies within latitude 06º 57' 58.0" North and longitude 003º 06' 21.3" East with an elevation of 59m. A total of eleven samples were collected from the study area. S1, S2, S3, S4, represent samples from Akinbo shale formation and L1, L2, L3, L4, L4, L5, L6, represent samples from Ewekoro Limestone formation (Fig1).

III. METHODOLOGY

Eleven (11) outcrop samples were obtained from Purechem cement mine, Ewekoro L.G.A, Ogun State, at 1metre depth interval to each other for both Calcareous nannofossil and Foraminifera species analysis from the mine's blast face. The first four samples were taken from the overlying Akinbo shale formation and were labeled S1- S4 while sample 5-11 were taken from the Ewekoro limestone formation and were labeled L1- L7.

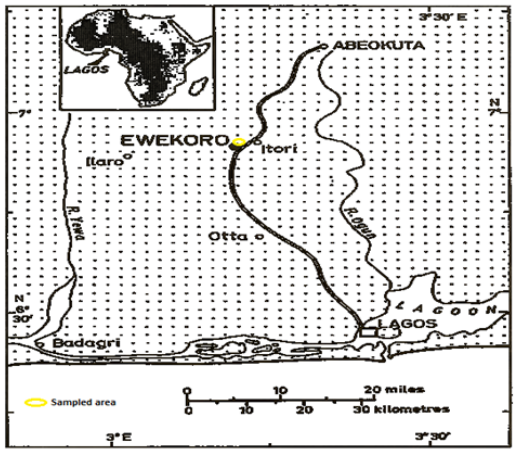


Fig. 1 Location map of the study area (modified from Adegoke, 1977).

A. Lithostratigraphic description

Each of the sediment samples collected was disaggregated and lithologically analysed under the binocular microscope for colour, texture and minerals constituents. Thin sections slide for limestone samples were prepared using the standard procedure and were studied under reflected light binocular microscope.

B. Nannofossil sample preparation

Samples were processed for nannofossil analysis. The prepared slides was then exposed to sunlight, and then later studied under the transmitted light microscope. This sample preparation technique allow better distribution of nannofossil on a microscope slide and a much higher confidence level of reproducibility in quantitative or semi quantitative analysis (Muza, 2000). A total of eleven slides were prepared and were studied and analyzed under transmitted light microscope at x1000 magnification.

C. Foraminiferal sample preparation

Eleven (11) samples each weighing 20g was also processed for foraminifera study. The samples was dried and weighed prior to wet sieving through a 63µm sieve. Depths on samples are correctly labeled on the clean aluminium sample bowls to avoid mixup.30 ml of kerosene is poured into sample to soak and disintegrate the samples for about 7 hours. Kerosene was drained out and sample was soaked in water. Friable samples were first partially disaggregated by hand and then soaked in hydrogen peroxide and calgon before washing. Consolidated samples were disaggregated by mild heating and treatment with 20% hydrogen peroxide for about 10 minutes.

Each sample is then washed over a 63 microns sieve with water from a hand directed water jet. After every use, the sieve was dipped in a dilute solution of methyl blue dye to identify contaminants from previous samples and it was thoroughly washed to remove the contaminant from previous sieving. The residue collected from the sieve is replaced in the sample bowl and dried on the hot plate at ~50°C. The dried residue were then sieved over 20 and 80 mesh sieves for the coarse and medium fractions while the finest residue in the receiver is treated as fine fraction.

Foraminifera and other calcareous microfauna were picked from the dried samples employing a binocular microscope at X1000 magnification. The foraminifera were identified following classification of Bolli and Saunders, (1985) and Loeblich and Tappan (1987).

IV. RESULTS AND DISCUSSION

A. Lithological description of samples

The lithology of the studied samples S1- S4 were predominantly clayey with inclusions of minerals such as gluconite while the samples of L1-L7 are predominantly calcite

Some samples are rich in fossil content such as sample S2, L2, L5, L6, L7 and contain shell fragments of pelecypods, mollusk and other unknown shell fragments. Presence of ferruginous minerals probably may account for brownish colouration of some samples. Some of the samples especially the topmost Akinbo shale samples S1, S2, were weathered.

B. Lithologic slide (microfacies)

The result of the analysis shows that the samples, L2 and L4 are Biomicrite (Fig 2 and 3respectively) i.e., their carbonate grains are in a mud-supported fabric/ matrix and contains inclusion of algal structures, while the third random sample, L6 is Biosparite (Fig 4) i.e., the carbonate grain were in a fabric/ matrix in which grains are in contact, creating an intact grain framework in which voids may or may not be filled with mud and also contains algae structures. Red algae and pellets are the fossils present in all the samples. Some of the fragments are not readily identifiable. The samples were picked between 4-11 meters of depth. The samples are generally pelletoidal. The grains look like they were in the process of ferruginization indicate a near surface occurrence.

The presence of micrite in limestone is commonly interpreted to indicate deposition under quiet-water conditions where little winnowing of fine mud took place (Stanley and Hardie 1999).

The presence of sparry calcite cement in intergranular limestone pore spaces indicates that grain framework voids were empty of limemud at the time of depostion under aggitated water conditions that removed fine mud (Rezak and Lavoie, 1993).

SAMPLE L2- The lithofacies test carried out on this sample shows that it is Biomicrite i.e, it has mud supported and has more than 10% grains and contain lime mud. The percentage of micrite to sparite is 70% to 30%. It contains red algae, pellets.

SAMPLE L4- The lithofacies test carried out on this sample shows it is Biomicrite. The percentage of micrite to sparite is 80% to 20%. It Contains Gastropod, Foraminifera and some accessory minerals.

SAMPLE L6- The lithofacies test carried out on this sample shows it is biosparite with percentage of micrite to sparite being 27% to 75%. A lot of pellets, some red algae were seen.

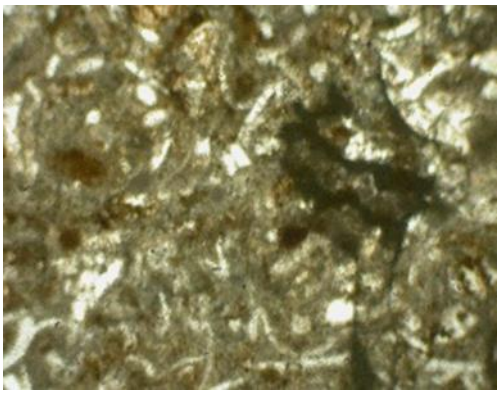


Fig. 2: Sample L2 Lithofacies slide (biomicrite) Mg× 1000

C. Biostratigraphy Calcareous Nannofossil

The whole samples analysed for Calcareous nannofossils in this study were barren, this could be attributed to the environment of depositions. And may probably be due to the preponderance of clastic sediments deposited within the fluvial (Coastal Deltaic) Shallow Inner Neritic and Inner Neritic environments which are likely unsuitable for abundance preservations. This deduction is also supported by the absence of planktic foraminifera in the whole samples analysed.

Calcareous nannofossils are also planktic in nature. Therefore, because of the absence of calcareous nannofossil, dating for the samples intervals with the aid of Calcareous nannofossil was not established

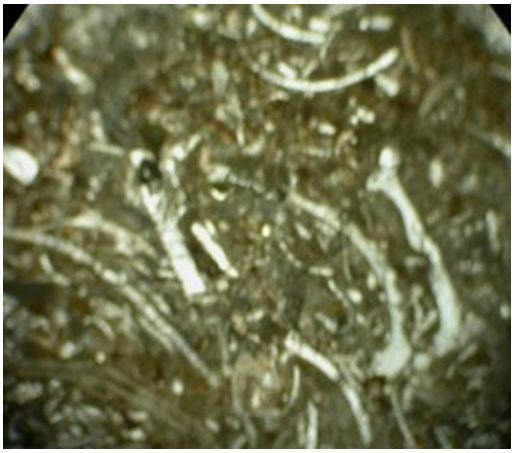


Fig. 3: Sample L4 Lithofacies slide (biomicrite) Mg× 1000

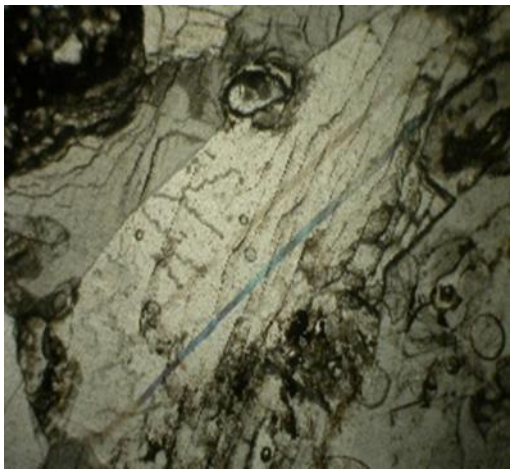


Fig.4: Sample L6 Lithofacies slide (biosparite) Mg×1000Biostratigraphy

D. Foraminiferal Zonation

The Foraminiferal zonation of these samples was guided by the works of Blow (1969, 1979) and Bolli and Saunder (1985)while the numerical ages (Ma) were based on the works of Vail and Wornardt (1991) and Berggren (1995). Condensed sections/Maximum Flooding Surfaces were correlated to the Global Cycle Chart of Haq, et al (1988). Important Foraminiferal bioevents considered include:

First Downhole Occurrence (FDO) of Chrono stratigraphically significant planktic/benthic Foraminiferal species.

Table 1: Foraminiferal Biostratigraphic summary of outcrop samples.

Foraminiferal Biostratigraphic summary of Outcrop samples (First Downhole Occurrence of stratigraphically important Foraminiferal species)				
Depth (m)	Epoch/Period	Age (Ma)	Zones (Blow 1969, 1979)	Significant Foraminiferal datums
S1	First sample analysed			
S1-L7	Late Paleocene	56.8 – 57.3	P4	Interval characterized by co-occurrences of Valvulineria martinezensis (Valvulineria sp.8), Lenticulina cf. pseudomamilligerus, Valvulineria sp. 8b (Hanzawaiaconcentrica), Eponides cfs eudoelevatus and Valvulineria sp.
L7	Last sample analysed			

*FDO =First Downhole Occurrence *LDO = Last Downhole Occurrence

Last Downhole Occurrence (LDO) Table 1 Planktic/benthic Foraminiferal marker species. Foraminiferal abundance and diversity peaks dated with Foraminiferal markers species whose stratigraphic ranges are well established in the Niger Delta and worldwide.

The results of the analysis indicate that these outcrop samples (Table 1) were deposited during the late Paleocene epoch, of estimated numerical age of 56.8Ma to 57.3Ma (Vail and Wornardt, 1991 and Berggren, 1995) and straddling the Valvulineria martinezensis Niger Delta Benthic Foraminiferal zone, which corresponds to P4 planktic zone of Bolli and Saunders (1985) and Blow (1969,1979).

Index species among the recovered benthic Foraminiferal assemblages have been used in dating and zoning the intervals. Details are given below (Fig. 5): Sample: S1- L6 (0 -10m)

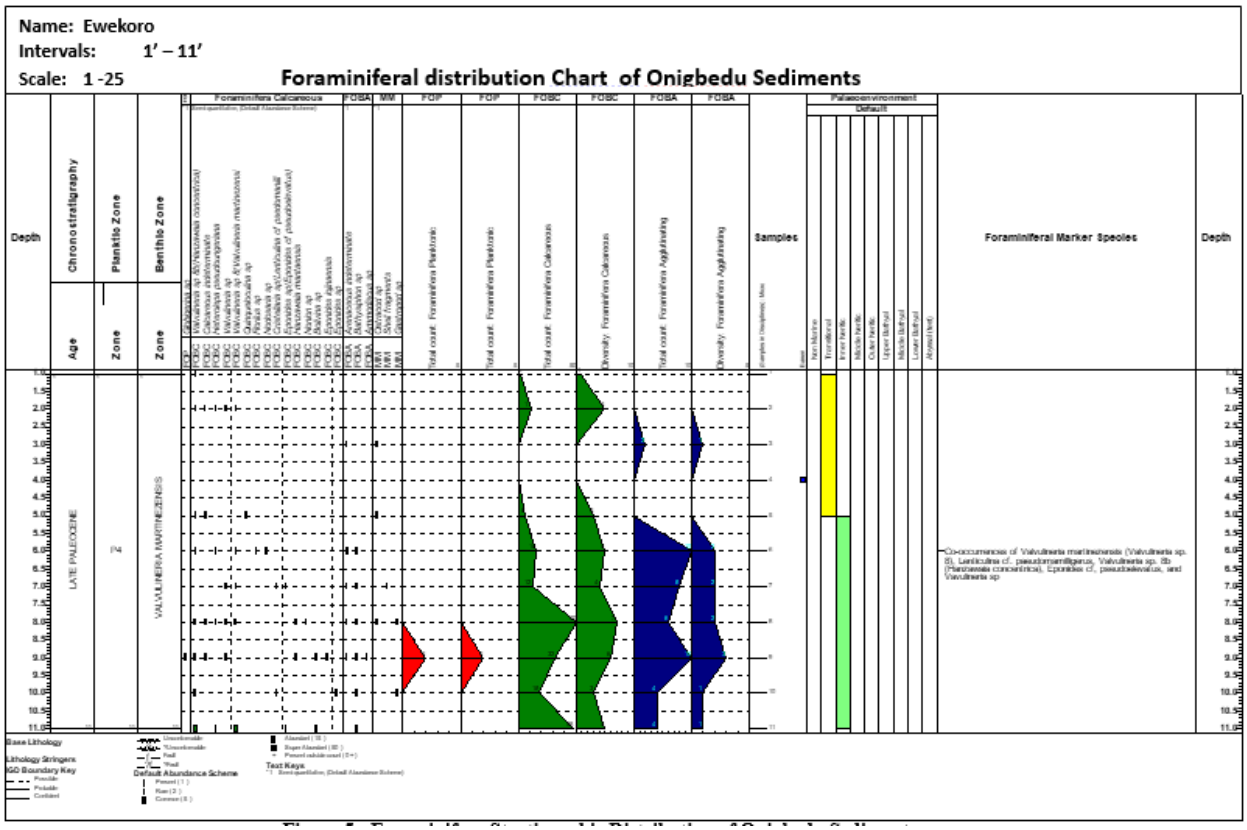


Figure 5: Foraminifera Stratigraphic Distribution of Onigbedu Sediments

Planktic zone: P4
Benthic Foraminiferal Zone: Valvulineria martinezensi. Estimated numerical age: 56.8 – 57.3Ma (Vail and Wornardt, 1991)

Definition**:** The top of this zonal interval is placed at Sample S1 (First sample analyzed). The base is marked at Sample L7 (Last sample analyzed).

Sample S1-L7:

- Interval is characterized by fair to moderate recovery of Foraminiferal species.
- The following events were recorded within this interval and also confirmed the late Paleocene age assignment
- Occurrence of benthic foraminifer Valvulineria martinezensis (Valvulineria sp.8) in samples S1, S2, L2, L3, L4 and L7 suggesting a late Paleocene age
- Occurrence of Lenticulinacf.pseudo mamilligerus in samples L3 and L6 also indicate a late Paleocene
- Presence of Eponidescf pseudoelevatusin samples L3, L6 and L7 is late Paleocene- early Eocene

precisely Ypresian stage (Niger delta Cenozoic geological data table).
- The co-occurrences of Valvulineria sp. 8b (Hanzawaiaconcentrica), Eponidesiojinaensis, Valvulineria sp., Bolivina sp also support the late Paleocene age.

Relative abundance Calcareous nannofossils and Foraminifera species in the samples.

Barren samples

In all the eleven (11) samples analysed for calcareous nannofossils, all samples demonstrated total barrenness. A number of factors could be responsible for this barren calcareous nannofossil samples which could range from methodology, environmental factors but the major factor responsible for the barreness is the paleodepositional environment conditions of the samples (due to the preponderance of clastic sediments deposited within the fluvial (Coastal deltaic) shallow inner neritic and inner neritic environments). These conditions are not favourable for the deposition and preservation of calcareous nannofossils. (Stehli, 1964).

In Foraminiferal species recovery, only sample S4 is barren of Foraminiferal species. All the samples were generally barren of the planktic Foraminiferal species and this is attributed to their deduced paleoenvironment of deposition conditions. (Tipsword et al, 1966).

Samples with abundant microfossil occurrences

For the bentic Foraminiferal species type, the most productive samples showing fair to moderate occurrence are S2, L2, L3, L4, L5, L6, and L7. These are mainly from the Ewekoro formation and only one sample from the Akinbo shales contains abundant bentic Foraminiferal species

In general, the benthic Foraminifera species Valvulineria sp demonstrate a more abundant occurrence across the samples in the study area occurring in samples S1, S2, L2, L3, L4, and L7.

E. Paleoenvironmental interpretation

Integration of micropaleontological characteristics studied in this work has enhanced the deductions of varying depositional environments over these samples analyzed (Fig. 5).

These deductions were based primarily on benthic Foraminifera assemblage, abundance and diversity of species. Presence or absence of planktic foraminifera and calcareous nannofossils also helped in deciphering open ocean environments. Details of the paleoenvironmental interpretations are presented below:

Samples S1-L1, Coastal Deltaic (Marginal Marine)

The presence of few Foraminiferal species consisting of rare calcareous benthic and absence of planktics and nannofossils indicate deposition in a shallow water. Foraminiferal assemblage is characterized by Valvulineria sp, Quinqueloculina sp, Hanzawaiaconcentrica, Calcareous indeterminate and Ostracod suggests sediments deposition in a marginal marine setting (Coastal Deltaic). (Tipsword, et al, 1966).

Samples L2-L7, Inner neritic

This interval is characterized by a gradual increase in the abundance and diversity of Foraminiferal species. The absence of calcareous nannofossil and a corresponding absence of planktic Foraminiferal species in most of the samples suggest shallow water setting. The ione occurrence of broken Globigerina species in sample L5 suggests nearness to open marine setting.

Foraminiferal assemblage consists of Hanzawaiaconcentrica, Eponidesiojinaensis, Lenticulinacfpseudomemilligerus, Eponides cf pseudoelevatus, Valvulineria martinezensis, Bathysiphon sp, Valvulineria sp, Nonion sp and Ostracod which are suggestive of deposition in Inner neritic environment. (Tipsword et al, 1966).

Generally, the low abundance and low diversity of foraminifera recorded in all the samples are also consistent with deposition in a marginal marine to inner neritic setting where the waters were somewhat brackish.

V. CONCLUSION

Foraminifera and Calcareous nannofosssil study has been carried out on the Ewekoro and Akinbo formations within a depth of 0-11m from the

overlying Akinbo formation downward into the Ewekoro formation. The lithological analysis on the samples of the Ewekoro formation shows that the bulk lithofacies are made up of mainly crystalline calcite which are medium grain, with streak of sandstone and contains red algae inclusion. The Akinbo shale samples were mainly grey in colour.

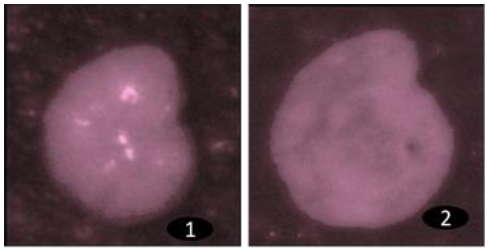
The sampled sediments were barren of calcareous nannofossils while the Foraminifera assemblage in the study interval are poorly preserved, because the entire section was barren of planktic foraminifera. Benthic Foraminifera species were the key forms encountered from the analysis.

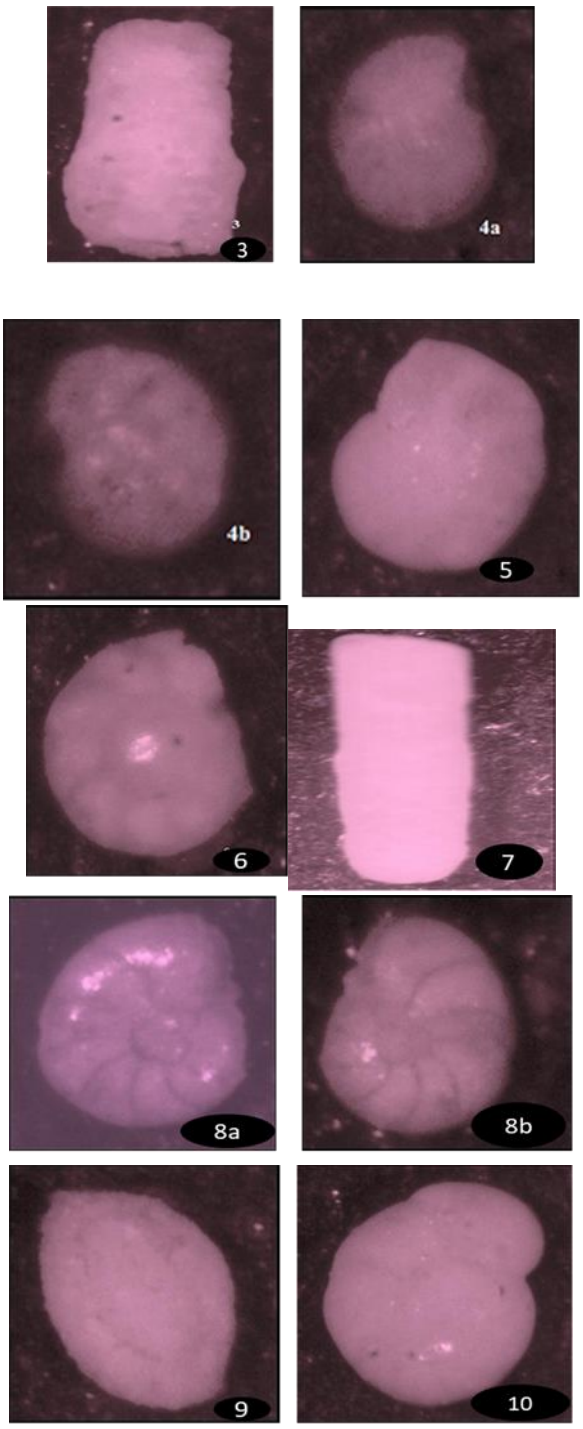
The results of the analysis indicate that these outcrop samples were deposited during the late Paleocene epoch, of estimated numerical age of 56.8Ma to 57.3Ma and straddling the Valvulineria martinezensis Niger Delta Benthic Foraminiferal zone, which corresponds to P4 planktic zone of Bolli and Sanders (1985) and Blow (1969,1979).

The analyzed section has been interpreted to be deposited in the coastal deltaic to inner neritic environment based on the distribution of typical deep water araneaceous Foraminiferal species recovered in the studied section of the well. The predominance of the araneaceous forms over calcareous forms in this environment may also be interpreted to deposition in a dysoxic shelf environment which is an environment with low concentration of oxygen (Berggren, 1995).

APPENDIX

Photomicrograph of Some Species





1. Valvulineria sp 8b (Hanzawaia concentrica) Smith
2. Ammodiscus glabratus
3. Bathysiphon sp
4. 4a Eponides pseudoelevatus (umbilical side) Reuss and Garrett

5. 4b Eponides pseudoelevatus (spiral side) Reuss and Garrett
6. Heterolepa pseudoungeriana
7. Lenticulina pseudomamilligerusus
8. Nodosaria sp
9. 8a. Valvulineria sp (umbilical side)
10. 8b. Valvulineria sp (spiral side)
11. Quinqueloculina sp (Chapman)
12. Valvulineria sp 8(Valvulineria martinensis) Smith

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