

Foraminiferal Biostratigraphy Studies Of Agbara 17 Well, Niger Delta Basin, Nigeria

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Abstract: The biostratigraphy of Agbara A-17 well which penetrated the Tertiary sediments of the Niger Delta well was studied. Stratigraphical and taxonomic studies are made of the arenaceous and calcareous benthonics as well as planktonic foraminifera of the middle Miocene to Pleistocene strata of southern Niger Delta. Benthonic foraminifera appeared to control about 58.45 percent and planktonic foraminifera control about 41.55 percent of the total fauna counts. Forty genera comprising forty five species have been identified from eighty five bore hole samples. The species are composed of calcareous benthonics which are typified by the Buliminids, Amphistigerinids, Rotalids Anomalinids, Alveolinellids and lituoloids. The calcareous are typified by Globigerinids and Globorotalids. The arenaceous are typified by *Urnula Artica*. The interval studied is assigned a Middle Miocene to Pleistocene age based on the presence of *Orbulina universa* (d'orbigny). The abrupt break in the span of both benthonic and planktonic foraminifera in the upper part of the well also marks the Pliocene/Pleistocene boundary. The fossil assemblages suggest that the strata containing them were deposited in littoral through neritic environment in an area that was periodically exposed to the sea as evidenced by the foraminifera fauna assemblage. The paleo environment of deposition of sediments in the Agbara-A17 well was shallow through neritic as indicated by benthonic and planktonic foraminifera.

Index Terms: foraminiferal, Niger Delta, Biostratigraphy, Age, Zonation, Agbara-17, Fauna

I. INTRODUCTION

The Marine deposition commenced within the Southern Nigerian Basin during Early Cretaceous time. The sediments penetrated by Agbara-A17 well form part of the Upper and Lower Tertiary sequences of the Southern Nigeria sedimentary Basin. Sedimentation in the Niger Delta, a part of the Southern Nigeria deposit began in the Upper Cretaceous and continued into the Tertiary and Post-Tertiary times. The Post-Tertiary times sedimentological history is dominated by marine regressions resulting in deltatic build-up. Thus the Upper Cretaceous-Tertiary sediments are made up of fluvio-marine deposits and coarse continental sands. The materials studied were obtained from Agbara-A17 well, one of the offshore wells located in Southern part of the Niger Delta, within Lat 3° 54N, Long 6° 40E. The samples were collected at regular intervals. The well ranges in depth from 500m to 2800m. The study is aimed at studying the Upper Tertiary biostratigraphy of Agbara-A17 well. The paleoenvironmental interpretation is based on the evaluation of lithology and faunal content.

II. METHODOLOGY

Samples of approximately 50 grams at each sampled depth were treated with sodium carbonate, boiled for an hour on hot plate to disintegrate the clay, shale and free the fossils from the matrix. They were washed through a 75 micro mesh screen and the residue dried in an oven. A close study of the samples using binocular microscope helped in producing a lithologic chart. The identifications were made from available literature, and in all cases previously described specimens have been compared with the type figures and type faunal based on the different general and species were made to determine the relative abundance.

Geology and stratigraphy of the study area

The Niger Delta is a large arcuate shaped basin of wave dominated origin protruding southerly into the South Atlantic along the West African Gulf of Guinea, covering a land mass 75,000 sq km. the history of the Niger Delta takes its inception in the lower Eocene as one of a major regression with a gradual Southward, classical pattern of a deltaic offlap sequence. This sequence started with coarse sandy

deposits and ended with marine clays which is observed both laterally and vertically in the Niger Delta. The maximum thickness of sediments is about 12,000m. The basin contains clastic sequences that have been divided into three lithostratigraphic units based on their depositional characteristics (Short and Stauble, 1967). The Oldest, Akata Formation is characterized by black shales that are interpreted as marine with occasional sand and silt interbeds which are considered as turbidites and continental slope channel fills. This is overlain by the Agbada formation which is characterized by alternating sand and shale sequences believed to have been deposited under paralic conditions. The youngest is the Benin Formation, and contain predominantly coarse sand that have been described as continental in origin (Burke, 1972; Adeniran, 1997). The system of biostratigraphical units adopted in this paper is based largely on Bolli and Saunders Coeblizl and Tappan.

III PRESENTATION OF RESULT

(A) LITHOSTRATIGRAPHY

The stratigraphic sequence established in the Agbara-A17 well. The sediments penetrated by the well fall within units as studied in (Short and Stauble, 1967). This is composed of:

- Agbada Formation and,
- Akata Formation.

(1) Agbada Formation It is characterized by the alternation of sand stone and shale with shale intercalations relatively thin. The base in this work is placed at the depth of 1700m and the upper limit is at 500m. Thick coarse to fine quartz grain sand extends from the base to depth of 1560m. It grades into shale sand where it terminates at the top of the well at depth of 500m.

(2) Akata Formation The lowest unit penetrated by Agbara-A17 well is the uniform silty shale. Akata formation is characterized by grey silty shale which is typically fossiliferous. The silt is dominantly quartz grain. Planktonic foraminifera make up less than 50% percent of the microfauna. The benthonic foraminifera assemblages make

up more than 50 percent of the microfauna and this indicates deposition of the shale on a shallow-marine shelf. The base of this unit within Agbara-A17 well is at 2800m while the top is at 1700m, where it grades into the overlying Agbada formation.

(B) BIOSTRATIGRAPHY FAUNA

The faunal pictures from the study area are shown on plate 1. The sandy shale of the Agbada formation are very fossiliferous than the silty shale of Akata formation. The benthonic foraminifera are more abundant than the planktonics in all the three units. The benthonics are about 64.28 percent of the total foraminifera count from top to bottom of the well while the planktonics are about 35.72 percent. The calcareous foraminifera make up about 37.95

percent of the total faunal count while arenaceous make up about 2.05 percent. the total identifiable foraminifera faunal is composed of 46 genera, 46species. The dominant benthonics are *Alveolinella boscii*, *Quinqueloculina seminula*, *Triloculina trigonula*, *Chrysalidinella dimorpha*, *Asterigerina carinata*, *Cibicides refulgens*, *annulocibides projectus* and dominant planktonics are *globigerina bulloides*, *Globigerinoides rubra* and *Globorotalia fimida*. They are restricted to the silty shale unity of Akata formation the less abundant benthonic foraminiferas include *Bolivina incrassata*, *Uvigerina pigmea*, *Amphistegina lessonii*, *Bolimina kickapoelensis*, *saccamina*, *miliamina*, *Ammodiscus pennyi*.

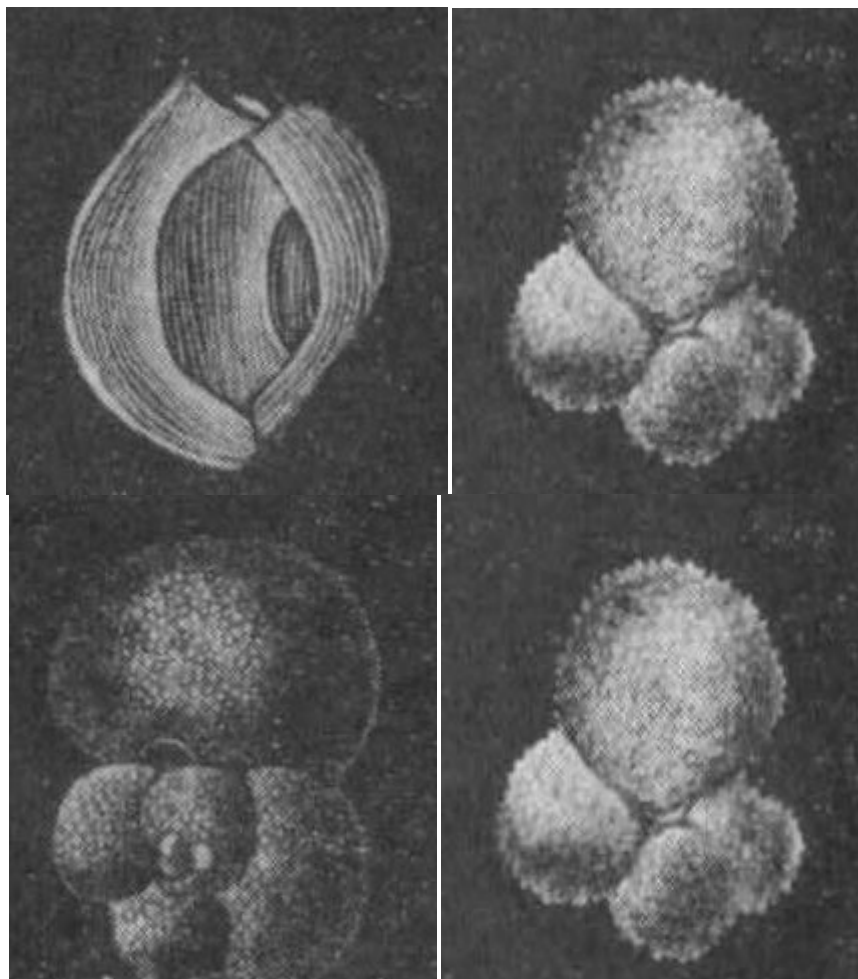


Plate 1: Showing some of the palynomorphs encountered in the study

They are found to occur discontinuously, from the middle of the lowest sandy shale unit. Other less dominant planktonics forms are *Orbulina universa* which span only the lower part of the well from 2800m to the depth of 1190m. There is a marked absence of fauna between depths 620 – 870m.

IV. DISCUSSION OF RESULT

(a) AGE SUB-DIVISION:

In recent years, the biostratigraphic subdivision of the Tertiary sediments has been increasingly refined by means of planktonic foraminiferas. Generally age divisions are based on the presence of stratigraphically important planktonic foraminifera. In Agbara-A17 well Middle Miocene is suggested for the sediment at the base of the well at the depth of 1840m based on the first appearance of *Orbulina Universa d'orbigny*. Drooger (1956) stated that *Orbulina*

Universa d'orbigny made its appearance in the Tortonian. Blow (1957) on the other hand stated that *Orbulina* *Universa* appeared first in the Upper Agutarian of Sicily as defined by the occurrence of *Miogysin Irregularis* and *Miogysinoides complanata*. This was also confirmed by Blow (1956), Banner and Blow (1959), and Leikins (1964) that really *Orbulina* *Universa* would have existed in the area of the Agutarian basin during the deposition of Agutarian and Burdigalor rocks because of large number of species of planktonic foraminiferas that are present in these rocks. Jenkins (1965) concluded that *Orbulina* *Universa* must have made its initial appearance in post-Burdigalian time. The first appearance is at the depth of 1840m and the last appearance is at the depth of 1190m. Bandy (1963) suggested that the *Orbulina* datum represents the base of the Burdigalian or Middle Miocene within bathyal deposits of tropical areas. The last appearance in the Agbara-A17 is also taken as the boundary between the Middle Miocene and Upper Miocene. The Miocene to Pliocene has been determined by Wollin and Bandy (1963) using the first appearance of species "in abundance" as being events which could also be used for correlating over long distance. It is here suggested that "in abundance" is too vague a term. It is also distinctly possible that species of planktonic foraminifera reaches their peak of abundance at different times in different oceans. Bandy suggested that *Globigerina* *bulloides* (Parker and Jones) "in abundance" marked a datum-line coinciding with the Miocene-Pliocene boundary. This is shown at the depth of 960m. The Pliocene/Pleistocene boundary is placed at depth of 750m on the basis of abrupt break in the span of both benthonic and planktonic foraminifera between 700m and 750m. In general, on the basis of the above planktonic foraminiferas appearances, the age of Agbara-A17 well has been placed between Middle Miocene and Pleistocene.

(b) PALEOECOLOGY:

The depositions of sediments in any given may consist of marine and non-marine environment, may be part of a wide lowland or continental shelf or close to high mountains, humid or arid, warm or cold environment. The sum total of these various factors in the geographic environment determines the sedimentation sequence of the area. A semi-quantitative analysis and generic predominance is especially effective in paleoecological interpretation. (Phleger, 1960, 1964), Bandy (1960), Walton (1964) and Funnel (1967) considered several characteristics such as, ratio of planktonic to benthonic specimens, number of benthonic specimens, important benthonic general, ratio of arenaceous to calcareous specimen, faunal dominance and species diversity and total foraminifera populations, which are some indication of the rate of clastic sedimentation. A slow rate of sedimentation would affect the planktonic foraminifera fauna living in the water and the foraminifera number. Studies of Recent Fauna from the North eastern Gulf of Mexico by Bandy (1956) indicate that *Ammonia* *Beccarii* is especially characteristic of shallow water. The Akata Formation which is of Middle Miocene age consists lithologically of very silty shale. The Akata Formation is rich in foraminiferas which indicate deposition on a shallow marine shelf. According to Short and Stauble (1967) faunal assemblages indicating deep water or Bathyal deposition have not been found in wells drilled into the Akata

Formation. This is because seasonal change of temperature diminishes downward, and below a depth of 200m, it is absent. Temperature acts as a barrier to the dispersal of marine animals in a manner comparable to a high mountain range as a hindrance to the spread of land animals. The Akata Formation Fauna comprises of common benthonic foraminifera which are species of *Annulocibicides*, *Ammonia*, *Asterigerina*, *Bulimina*, *Alveolinella* and *Urnula*. The planktonics include species of *Globigerina*, and the less common species of *Orbulina* and *Globorotalia*. Calcareous foraminifera are more abundant than the arenaceous. At depths of 2790m, 2480m, 2470m, the benthons are more abundant with percentage of 100%. This depth of 2480m, the planktons is frequent with percentage of 68.18%. This indicate outer neritic environment. The Agbada Formation which consists lithologically of coarse to fine shaly sand at depth of 1700m, grades from coarse to fine grained sand and again becomes shale at depths of 1260m to 1230m, then to coarse sandy shale at depths of 1230m to 1170m. The top of this is overlain by coarse to fine sand intercalated with shale to depth of 500m. Early work recognized presence of both marine and non-marine environments in many of these thin shales unit (Moor, 1929). The benthonic foraminifera consist of abundant species of *Alveolinella*. The planktonics consist mainly species of *Globigerina*, *Globigerinoids* and *Globorotalia*. The percentage of benthons are 63.64%, 72.22%; 9001%; 72.22% 73.33%; 75.91%; 64.37% and 78.05% respectively. This indicate inner neritic environment. The abundant benthonic foraminifera in the middle Miocene to lower Pliocene marks a long regressive phase punctuated by short transgressive phases. The regression of the sea during Upper Miocene exposed the area to sub-aerial erosion resulting in deposition of sandy shale. There are abundant fragmented shells at depths of 780m, 790m, 800m, 900m, 910m, 980m, 1000m, 1120m, 1130m, 1180m, 1200m, 1210m, 1240m, 1250m, 1260m, 1380m, 1490m, 1780m, indicating turbulent environment. Parker (1954), Phleger (1955) established that individual species have discrete depth ranges over which they occur in addition to discrete geographic distribution. The presence of *Quinqueloculina*, *Triloculina*, *Miliola* are usually excellent indices of nearshore shallow conditions.

V CONCLUSION

The lithostratigraphic section of Agbara-A17 well shows a coarsening upward sequence which normally typifies a deltaic facies change. It is a dynamic and prograding Delta as the upper section from about 1350m to 500m indicates. The lithology of the well consist of sandy shale to shale units. The sandy shale unit lies within the Agbada Formation while the shale and silty shale units are Akata. The changes in climatic factors such as temperature, salinity and depth result in changing amount of calcium carbonate availability and hence probably the distribution of calcareous and agglutinated types of foraminifera. The total foraminifera faunal are abundant from the middle to the lower part of the well and characterized by abundant species of *Alveolinella*, *Triloculina*, *Annulocibicides*, *Asterigerina* and *Ammonia*. The planktons are characterized by abundant *Globigerina*, *Bulloides* at the depths of 960m and 980m, which correspond 64.37% for benthonic foraminifera. This probably indicates inner neritic

environment. At the depths of 740m, 1110m, 1200m and 2760m, the benthons and planktons foraminiferas attain 50% mark each which probably represent middle neritic environment. The percentage of planktonic foraminifera at depths of 2480m, 1740m, 1660m, 1540m, 1230m, and 650m, the percentage of planktonic and benthonic foraminifera is 100% each. A single species is represented at these depths. The presents of a single species could be as a result of contamination introduced during drilling. The presence of *Orbulina*, *Universa* and abundant planktonic species has helped greatly in the deliniation of the boundary between Middle Miocene/Upper Miocene, Upper Miocene/Pliocene and Pliocene/Pleistocene age. Agbara-A17 well, according to this paper is Middle Miocene to Pleistocene in age. The following time-stratigraphic and biostratigraphic subdivisions may be established in the well.

1. Middle Miocene boundary which is placed at 1840m by the first appearance of *Orbulina Universa*.
2. Middle Miocene to Upper Miocene boundary which is placed at 1990m depth by the "in abundant" planktons.
3. Finally Pliocene to pleistocene boundary placed at 760m depth on the basis of abrupt break in the span of both benthonic and planktonic foraminifera.

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