Biostratigraphy Of The Upper Tertiary Western Offshore, Niger Delta, Nigeria

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Abstract: In this studies, Stratigraphical and taxonomic studies are made of the arenaceous and calcareous as well as planktonic foraminifera of the Middle Miocene - Pleistocene strata of part western offshore Niger delta. Forty – one genera comprising ninety- six species have been identified from seventy- eight borehole samples. The species are composed of calcareous foraminifera typified by the Mililoides, Buliminids, Rotalids, Orbitoids, and planktonic forms. The arenaceous are typified by the Lituolids and they constitute the major fauna. The assemblages suggest that the strata containing them were deposited in a littoral to outer nentic environment in an area that was exposed periodically to the sea as evidenced by the foraminifera fauna assemblage. The studied is assigned a middle Miocene to Pleistocene age based on the presence of *orbulina universa and Sphaeroidinella dehisceus.* The abrupt break in the benthonic and planktonic foraminifera in the upper part of the well also marks the Pliocence - Pleistocene boundary.

Index Terms: Niger Delta, Biostratigraphy, Age, Zonation, offshore, foraminifera, Tertiary

(I) INTRODUCTION

The stratigraphy sequence of the Niger Delta comprises of three lithostratigraphic units (short & stauble 1967). The oldest, the Akata formation is characterized by black shales that are interpreted as marine shales or clays with occasional sand and sill interbeds which are considered as turbidites and continental slope channel fills.The Agbada Formation overlies the former, and it's characterized by an alternating sand and shale sequences believed to have been deposited under paralic conditions. The youngest, the Benin formation consist of massive continental (fluvialtile) gravels and sands The sediments of the Niger Delta span of period of 54.6ma during which, worldwide, some thirty-nine third –order eustatic sea level rises have been recognized (Adesida el al., 1979). A correlation with the chail of Hartland et al., (1990) confirms the presence of nineteen of such named marine flooding surfaces in Niger Delta, eight of which are locally developed. The Niger Delta is further subdivided into six depobelts namely,Northen Delta,Greater Ughelli, Central swamp, coastal swamp and offshore. The offshore Depobelts falls within the study area, this is the youngest of the depobelts.

(II) METHODOLOGY

Samples of approximately 50 grams at each sampled depth were treated with sodium carbonate, boiled for an hour on heating plate to disintegrate the clay, shale and free the fossils from the matrix .they were washed through a 75 micron mesh screen and the residue dried in an oven. The identification were made from available literature; and in all cases previously described specimen have been compared with the type figures and descriptions. Any difference in the type specimens have been noted in the systematic description The dimension of all specimen to nearest 0.01 mm are include in descriptions. The measurements were made using calibrated binocular microscope lens. Counts of the total foraminifera fauna base on the different genera and species were made to determine the relative abundance.

(III) PRESENTATION OF RESULT

BIOSTRATIGRAPHY The foraminiferal species encountered in the study can be seen on Plate 1. Out of the three lithologic units in the Okan 3, Ruta-9 and Irei wells analysed only the sand and shaly sand of the Agbada north is least fossiliferous. The silty shale of Akata Formation and the sandy shale of the Agbada South Formation are very fossiliferous. The benthonic foraminifera are more abundant than the planktonic in all the three units. The bentonic are 87.3 per cent of the total foraminifera count from top to bottom of the well while the planktonics are 12.7 per cent. The calcareous foraminifera make up about 74.7 per cent of the total while agglutinated make up about 25.3 per cent. The total identifiable fauna is composed of 40 genera, 97 species and 4 subspecies. The dominant benthinics are *Haplophragmoides Canariensis, Quinqueloeulina Seninulum, Lenticulian Muswayensis Alalsamina Wilcoxensis* and dominant planktionice are *Globigerina buloides* and *Globiferinoides trilobus trilobus.* They range from the lowest silty shale unit, to approximate depth of 972.3m except for the planktonics which continued from depth of 492.3m to the top of the well at depth of 400m. Other less dominant benthonics are *Amonia beccarii*, species of *Nodosaria, Dentalina Cibicides* and *Nonion.* They are found to occur discontinuously from the middle of the lowest sandy shale unit to depth of 972.3m, except for Ammonia beccarii which continues from depth if 492.3 to top of the well Other less dominant planktonics forms are *Orbulina universa* which span only the lower part of the well from 1673.9m to the lowest part at 2400m, and *sphaeroidinella subdehiseens* which is also restricted to the depth of *Orbulina*.

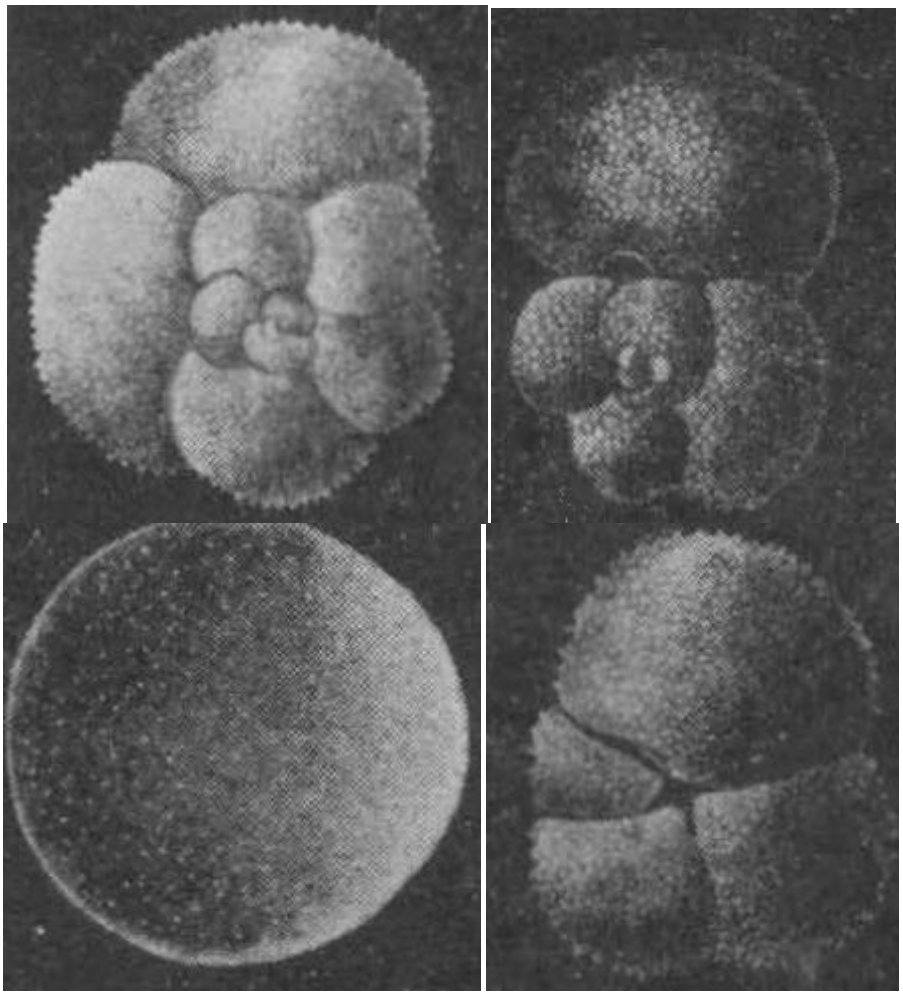

Plate 1:Pictures plate showing some of the foraminifera encountered in the study

The following rare benthonic foraminifera are the species of *Saccammina, Textularia, Miliammina Ammobaculites Ammotium Triloculina Spiroloculina Massilina, Brizalina, Bulimina, Uvigerina Cancris* There is a marked absence of fauna between depths 500m to 972.3m. The foraminfera above this interval show marked generic differentiation from these below the depth of 972.3m Globigerinoides trilobus and *Globigerinoides bulloides* which range across this show change in coiling direction. *Globigerinoides trilobus* is right-coiling beyond the 500m but below 972.3m it is left coiling.

(IV) DISCUSSION OF RESULT

(A) AGE AND CORRELATION Four planktonic foraminiferal age divisions are recognized in the Okan 3 : Middle Miocene, Upper Miocene, Pliocene and Pleistiocene. The age division is based on the presence of the stratigraphically important planktonic foraminifera which include *Globigerina Praedigitata, Globoquadrina altispira, G. dehissens, G. Humerosa, Sphaeroidinella Subdehiscens, S. dehissens, and Orbulina universa* d'Orbiany Middle Miocene age is suggested for the sediment at the base of the well extending from 2384.6m (7750ft) to 1683.1m (5470ft) based on the first appearance of *Orbulina universa* D'Orbigny. It is generally assumed that the successive taxa *Globigernoides trilobus* (Reuss) to *Orblina Universa* D'Orbigny as described by Blow (1956) from an evolutionary lineage. The Pliocene/Pleistocene boundary is placed at the depth of 972.3m on the basis of abrupt break in the span of both benthonic and planktonic foraminifera between 972.3m and 516.9m and the change in coiling direction of *Globigerinoides trilobus,*beyond this abrupt break. Above this boundary *Globigerinoides trilobus* is right coiling while beyond and below this it is left coiling. It has been suggested that the sudden changes in the coiling ratios are due to widespread changes in climate. Billi (1950,1951,1957b) used the changes in coiling direction ratios of certain species of planktonic foraminifera as stratigraphic markers in the Tertiary rocks of Trinidad. Very few paleontologists have followed this lead (Akers, 1955; Nagappa 1957; Jenkins; 1960), but this method has been applied more successfully by oceanographers to foraminifera from Pleistocene to Recent sediments (Ericson, et al 1954) and was also used to study sequences of populations from longer cores that penetrated the Pliocene (Ericson, et al 1963). The issue of discontinuity of benthic taxon as in the case of *Ammonia beccarii* which occurs above the suggested Pliocene/ Pleistocene boundary but so not occur again until further down the well at the depth of 1600m. On the basis of the foregoing discussion a Middle Miocene to Pleistocene age is

assigned to the studied section of Okan-3 well, Okan 3, according to this present paper is Middle Miocene to Pleistocene in age. Ruta – 9 (Duru1979) is Middle Miocene to Pleistocene in age. While Ireti – 9 (Ogundiran, 1978) is assigned Middle to Late Miocene. The only part of the Okan – 3 which can be correlated with the other two wells range from middle Miocene to Upper Miocene and correspond to depth of between 1360m to 2385m. Ruta – 9 Miocene corresponds to depth range of 1333m to 2513m, While Ireti – 9 Miocene is equivalent to depth range of 1200m to 2739m. The last appearance of *Orbulian universa* d'Orbigny in Ireti – 9 and Okan 3 are at depths of 1800m and 1750m respectively. The same characteristic planktonic foraminiferal markers are present in the zone of *orbulina universa* and these include *Globoquadina altispira Globigerinoides trilobus* Reuss *Globigerinoides obliqua* and *orbulina universa* d'Orbigny. *Sphaerifinella dehiscene* and Globoquadina altispira are also present. Geographically, Ruta – 9 and Ireti – 9 are situated on higer latitudes than Okan – 3 in the western offshore Niger Delta. The Miocene lithology of the section studied consist of sandy shale above and shale below.

(B) PALEOECOLOGY Several population characteristics discussed in this paper are considered to be important in the summary of foraminiferal paleoecology (Phleger, 1960, 1964), Bandy (1960), Walton (1964) and Funnell (1967). They include ratio of planktonic to benthonic specimens, number of benthonic specimens, important benthonic genera, and ratio of the arenaceous to calcareous specimen, faunal dominance species diversity and total foraminifera populations, which give some indication of the rate of clastic sedimentation. The Akata Formation which is of middle Miocene age consists lithologicallly of vary silty dark shale. The fauna comprises abundant benthonic foram including abundant species of *Haplophragoides, Lenticulian* and *Alabamina*. Other benthonics which are less abundant are the species of *Textularia, Quinqueloculina Nodosaria, Brizalina, Bulimina, Praebulimina Ammonia beccarii, Cibicides* and *Nonion.* The Planktonics include abundant *Orbulina universa,* less common species of *Globigerina Globigerinodes, Globorotalia, Globoquadrina Sphaeroidinella, Candeinia, Catapsydrax,* and *Candorbulina.* The presence of nodular ornamentation of *Bulimina* at this level indicates adaptation of the space to great depth. At the base of the Okan 3 at the depth of 2366m (7690ft) there is high foraminiferal number base an abundance of *Orbulina* but as from the depth of 2356.9m to 2227.7m the low foraminiferal count and low species diversity appear to indicate micro reducing environment even though the interstitial and overlying waters are oxidizing. As from the depth of 2190.8m (7120 ft) there is a marked increase in the number of foraminifera and sporadically high and low species diversity which appears to indicate a slow rate of clastic sedimentation. Calcareous foraminifera (80%) are more abundant than the arenaceous. Benthonics make up about 90% of the faunal assemblages and appears to indicate a shallow marine environment.

(V) CONCLUSION

The Lithostratigrapic section of the 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 1300m to 400m shows evidence of regression. The changes in climatic and physiograhic factors from one region to another expressed through temperature, salinity gradients and depth result in changing values of calcium carbonate availability and hence in the distribution of the calcareous and agglutinated types of foraminifera. The total fauna are abundant from the middle to the lower part of the well and characterized by abundant bethonic species, which include *Haplophragmoides, Lenticulina Alabamina* and *Quinqueloculina*. The planktonics are characterized by abundant *Orbulina universa* d'orbigny at the lower part of the well, which corresponds to the outer neritic biofacies. The lithology of the well consists of sandy shale to shale units. The sandy shale lies within the Agbada Formation while the shale and silty shale are Akata. The lithology shows finning downwards which is typical of a delta. The presence of glauconite and bryozoans in the section indicate deep environment of deposition and slow rate of deposition. The presence of shell fragments between depths of 400m to 500m indicate high energy enrivonment. Okan 3, according to this paper is middle Miocene to Pleistocene in age. Ruta – 9 according to middle to Late Miocene by Ogundiran (1978). The only part of okan-3 which can be correlated with the other two wells range from middle Miocene to Upper Miocene and correspond to depth of between 1360m to 2385m . Ruta – 9 correspond to depth of between 1333m to 2513m, while Ireti – 9 Miocene is equivalent to depth of 1200m to 2739m.

REFFERENCES

[1]. Allen, J. R.L. (1965) Bull. Amer. Ass. Petrol. Geol.v. 49, No.5, pp. 547-600.

[2]. Allan, W. H. Be (1965) the influence of depth on shell growth in Globigerinoides sacculifer (Brady). Micropaleont., vol. H, No.1 pp. 81-97, pls.1-2.

[3]. Asano, kiyoshi (1960): the foraminifera from the adjacent seas of japan, collected by the s.s. soyo-maru, 1922-1930. parts-Nonionidae. Rep. scien. Rep. Tohoku university sendai, Japan. Vol. No.4.

[4]. Adegoke, O. S. (1979) foraminiferal Biostratigraphy of Bita LX-well. B. sc. Project Depart. Geot. University of Ibadan.

[5]. Adegoke, O. S., Dessauvagie, T.F.J., kogbe, c. a., (1971): planktonic foraminifera in Gulf of Guinea sediments: micropal, vol. 17, No. 2, p. 197-213.

[6]. Banner, F.T and Blow, W.H. (1965): 302. Globigerinoides quadrilobatus (D' orbigny) and Related Forms: Their Taxonomy, Nomenelatruel and stratigraphy. Rep. Contyr.

[7]. Bandy, O.L. (1963): MIOCENE – Pliocene Boundary in the Philippines as rlated to late

Tertiary Stratigraphy of Deep Sea Sediments. Rep. Scien. Vol. 142, No. 3597, Pp. 1290 – 1292.

[8]. Ishiwada, Y. (1964): Benthonic Foraminifera off the pacific coast of Japan referred to biostrotigraphy of the kazusa group. Geol. Sura. Japan Report no. 205.

[9]. Kieseliy;Lotsch, D. and Triimper, E. (19767); Planttonic foraminifera from the Oligo/Miocene of the German democratic Democratic republic (GDR). Rep. Proc 1st Inter. Conf. planlt. Micorofossils.

[10]. Lipps, J. H. (1964): Miocene planktonic foraminifers from Newport bay califorta tukane studies in geology vol 2 no 4

[11]. Norgan, D. S. (1964): foraminifera, stratigraphy and paleotology of the Aquia formation of Maryland and virgrinia. Cush. Found. Foram. Resear. Special. Public. No. 7

[12]. Petters, S. W. (1978): Nigerian Paleocene benthonic foraminiferal bioctratigraphy, paleoecology and paleoviogeogragy mar. micropaleontel., 4: 85-89.

[13]. Parker, F. L.(1967): Late tertiary biostratigraphyy (Planttonic Foraminifera) of Tropical Indo-pacific deep-sea cores. Bull. Amer. Paleont. Vol. 52. no 235.

[14]. Poore, R. Z. and Berggren, W. A. (1975): Late Cenozoic planktonic foraminiferal biostratipraphy and paleoclimatology of hatton – Rockall basub: DSDP Site 116. Rep. Jour. Foram. Resear. Vol. 5, no.4.

[15]. Pink, M. J. 91973: The development of the Odidi oil field. Shell – BP Petroleum Dev. Comp.