FORAMINIFERAL BIOSTRATIGRAPHIC STUDIES OF MIOCENE STRATA OF WELL 01, SHALLOW OFFSHORE WESTERN NIGER DELTA, NIGERIA

Alkali, Y. B., Okosun, E. A. & Chukwu, J.N.
Department of Geology, Federal University of Technology, Minna, Nigeria

Abstract
The foraminiferal biostratigraphic analysis of the interval (6000 - 11250 feet) of well-01 shallow offshore western Niger Delta was conducted based on the study of one hundred and twelve ditch cutting samples. Standard method of processing foraminiferal was employed. The study aimed to establish biozonations, age of the sequence and to decipher environment of deposition of the sediment. Moderately rich and diverse foraminiferal species were recorded. Ninety six foraminiferal species were identified, of these 88 species (92 %) are calcareous while the remaining 8 species (8 %) are arenaceous. Of the calcareous forms, 59 % (57 species) are benthics, while the remaining are planktics. Planktic zones established in this study are Orbulina universa zone (N9), Globorotalia peripheroacuta zone (N10), while Brizalina mandoroveensis and Uvigerina sparsicostata were defined as benthic zones. The established zones were dated middle Miocene; below Orbulina universa zone is assigned early Miocene (N8) due to LDO (Last Down hole Occurrence) of Orbulina universa which defines early Miocene / middle Miocene boundary. The sequence of the well was deposited in inner neritic - outer neritic environments based on the occurrence of Ammonia beccarii, Lenticulina grandis, Eponides eshira, Lenticulina spp, Uvigerina sparsicostata

Keywords: Biostratigraphy: Bioevents: Planktic, Benthic: Paleoenvironment

Introduction

Well-01 studied is located in the shallow offshore, western Niger Delta basin of Nigeria, situated on the West African Continental margin popularly called the Gulf of Guinea. The Niger Delta basin lies between longitude 3° E and 9° E and latitude 4° E and 6° N (Figure 1). Detailed biostratigraphic analysis were carried out on ditch cutting samples retrieved from well 01 located, in the shallow offshore of the western portion of the Niger Delta, Nigeria. The aim of this study is to; determine the age of the interval, attempt Zonation of the strata using foraminiferal data and interprete the depositional environment of the sediments

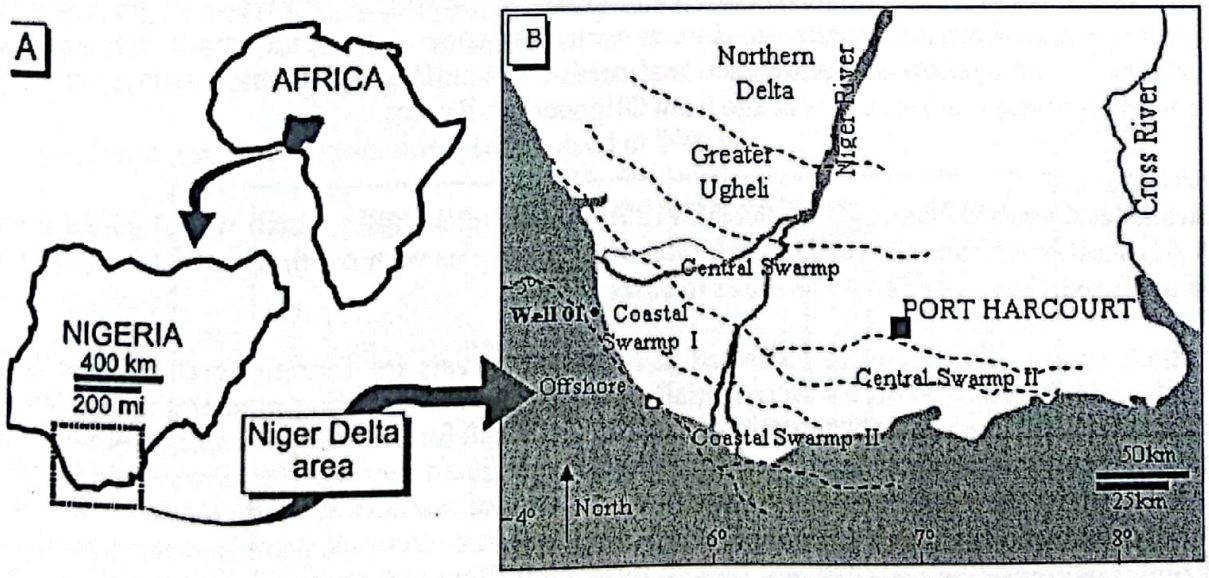


Fig. 1 Location map of well 01 shallow offshore Niger Delta, Nigeria

Statement of the Problem

Niger delta biostratigraphic data are mostly unpublished, being part of the confidential reports on petroleum exploration activities by multinational companies. Published work are mainly on the basins general sedimentology and stratigraphy. As the search for oil continues t o receive attention, an efficient tool to develop a chronosratigraphically control sedimentation models is needed and foraminiferal biostratigraphy will serve that purpose since they are distributed in a variety of marine environments through geological time.

Geology of the Niger Delta

The Stratigraphy of the Niger Delta is intimately related to its structure. The development of each being dependent on interplay between sediment supply and subsidence rate. Short and Stauble (1967) recognized three subsurface stratigraphic units in the modern Niger Delta. The delta sequence is mainly a sequence of marine clays overlain by paralic sediments which were finally capped by continental sands. The Stratigraphy of Niger Delta Basin are as follows:

Akata Formation: - The formation underlies the entire delta and forms the lower most units. It is a uniform shale development consisting of dark grey sandy, silty shale with plant remains at the top. The Akata formation is typically over pressured and believed to have formed during lowstands when terrestrial organic matter and clays were transported to deep water areas characterized by low energy conditions and oxygen deficiency (Stacher, 1995). It is over 4000 ft thick and ranges in age from Eocene to Recent and is believed to have been deposited in front of the advancing delta.

Agbada Formation: -The formation is a sequence of sandstones and shales with sandstone dominant in the upper unit and thick shales in the lower unit. It is very rich in microfauna at the base decreasing upwards suggesting an increase in the rate of deposition at the delta front. The grains are coarse and poorly sorted indicating a fluviatile origin. The Agbada formation covers the entire subsurface of the delta and may be continuous with the Ogwashi-Asaba and Ameki formations of Eocene- Oligocene age. It is over 10,000 ft thick and are the major hydrocarbon bearing unit in the delta.

Benin Formation: - The formation comprising over 90 % sandstone with shale intercalations extends from the west across the entire Niger Delta area and southward beyond the present coast line. The thickness though variable is estimated at about 6000 ft. It is coarse grained, gravelly, poorly sorted, sub-angular to well rounded and bears lignite streaks and wood fragments. The formation is characterized by structural units such as channel fills, point bars which indicate variability of the shallow water depositional medium. The Benin formation with very little hydrocarbon accumulation ranges in age from Oligocene to Recent.

Methods

Foraminiferal analysis was carried out on 112 ditch cutting samples which was obtained from well 01, shallow offshore Niger Delta. A total of 112 samples with depth range 6000 - 11250 ft were analyzed, the steps of analysis are as follows:

112 ditch cutting samples were collected at 60 feet intervals for foraminiferal analysis. The unwashed ditch cutting samples were initially rinsed to remove drilling mud and then dried. A standard weight (20 grams) of each dried sample was soaked for 4 hours in kerosene, followed by detergent - water solution soaked overnight. The disaggregated samples were then washed under a running tap water over a 63 µm mesh sieve. The washed residues were then dried over a hot electric plate and then they were sieved into three main size fractions, namely: coarse, medium and fine. They were then bagged and picked for foraminifera and recorded. The statistical data were recorded using the Strata Bugs software. The complete microforaminiferal data were plotted in colour using the Strata Bugs software at 1:5,000 scales with depth in Y-axis and the

identified taxa in X-axis for the well. The Strata Bugs software plotted charts were interpreted using the first and last occurrence of diagnostic taxa, the assemblages, ratio of taxa occurrence, taxon quantitative distribution within the Stratigraphic interval.

Results

The following foraminiferal species were identified : *Globorotalia fohsi peripheronda* Blow and Banner, *Globorotalia mayeri* Cushman and Ellisor, *Globoquadrina continuosa* Blow, *Praeorbulina transitoria* Blow, ,*Orbulina universa* d'Orbigny, *Praeorbulina sicana* De Stephani Bolli and Saunder, Globigerina *Praebulloides* Blow ,*Brizalina mandoroveensis* Graham, de Klasz & Rerat, *Brizalina interjuncta* Cushman, *Brizalina scalprata miocenica* Macfadyen,*Spirosigmoilina oligoceanica* Cushman,*Uvigerina sparsicostata* Cushman and Laiming,*Lenticulina grandis* d Orbigny, *Bulimina* sp,*Ammonia beccarii* Linne, *Hopkinsina* sp *Lenticulina inornata* Cushman ,*Uvigerina sparsicostata* Cushman and Laiming, ,*Orbulina bilobata* (d'Orbginy),*Quinqueloculina* sp. (Cushman), *Globorotalia menardii* (Bolli),*Globigerinoides conglobatus* (Brady), *Globigerina ruber* (d' Orbginy).

Appendix A shows the depth to depth foraminiferal assemblage indicating specie abundance and diversity, it is observed that transgressions are marked by introduction of rich and diverse forms while regressive sequences are shown by reduction both in abundance and diversity. The depth of 7800 ft, 8420 ft and 10770 ft is characterized by maximum abundance and diversity and as such represents a point of maximum transgression. From the foraminifera range chart shown in Appendix A biostratigraphic zones presented in Table 1 were established on the basis of introduction of two or more new forms. Data generated from Table 1 was used to carry out the following interpretation

Zonations: The Stratigraphic interval studied in well 01 has been subdivided into biostratigrpaphic zones based on foraminiferal distribution. The planktic zones of N8, N9 and N10, respectively represented by Undiagnostic zone, *Orbulina universa* zone and *Globorotalia peripheroacuta*. While the benthic zones are *Brizalina mandoroveensis* and *Uvigerina sparsicostata* corresponding to lower and upper part of N10 zone respectively as defined by Bolli (1966 a). Below *Orbulina universa* zone is assigned early Miocene (N8) due to LDO *Orbulina universa* which signifies the termination of early Miocene and beginning of middle Miocene, though diagnostic species was not recovered the first occurrence of *O. suturalis* was put at the lower / middle Miocene boundary (Bolli & Saunders 1985)

The establishment of these zones placed the age of the section studied as early - middle Miocene and provide valuable data for differentiation of zones, which could be identified not only throughout the Niger delta but could also be correlated with sections in other parts of the world.

Table 1 Foraminiferal Biozonations Recognised in Well 01

Depth (ft)	Epoch/ Period	Hardenbol et. al., (1998) Scheme	Blow (1979)	Berggren et. al. (1995)	This Study		Bioevents
					Planktic	Benthic	
6000	Middle Miocene	7240 13.4Ma	N10	M7	Globorotalia peripheroacuta	Uvigerina sparsicostata	6220 FDO Uvigerina sparsicostata; 6620 FDO Brizalina interjuncta
7000						Brizalina mandoroveensis	7200 - FDO Brizalina mandoroveensis
8000		14.8Ma 8440	N9	M6	Orbulina universa	Undiagnostic	LDO Globorotalia fohsi peripheroacuta
9000		16.0Ma					9580 LDO Orbulina universa
10000	Early Miocene		N8	M5	Undiagnostic		10600 LDO Hastigerina sp.
11000 11250							

Paleoenvironmental interpretation Marine microfossils are of practical value to

micropaleontologists in establishing depositional environments Interpretation of depositional environment is based on the concept that past environments may have contained many analogous components and hence modern environmental indicator faunas are carefully applied to the understanding of both recent and past environments. This assumes that the principle of uniformitarianism is operative (Ellison, 1951).

Benthic foraminifera are heavily relied upon due to their relative lack of mobility making them facies controlled and hence good indicators of depth, temperature, amount of light, water composition and other bottom conditions. One curious feature of benthic foraminifera is the similarity of faunas in geographically widespread environments characterized by many similar chemical or physical parameters. Besides many benthic foraminifera have essentially cosmopolitan distributions, both in the Recent and the past. (Boersma, 1978).

The environments of deposition encountered in the well range from shallow marine to outer neritic marine environments. Most intervals occur within the neritic realm as indicated by the occurrence of such neritic species *Ammonia beccarii, Eponides eshira, Lenticulina inornata, Florilus costiferum, Bolivina scalprata miocenica Bolivina interjuncta, Bolivina mandoroveensis, Uvigerina sparsicostata and Uvigerinella sparsicostata*

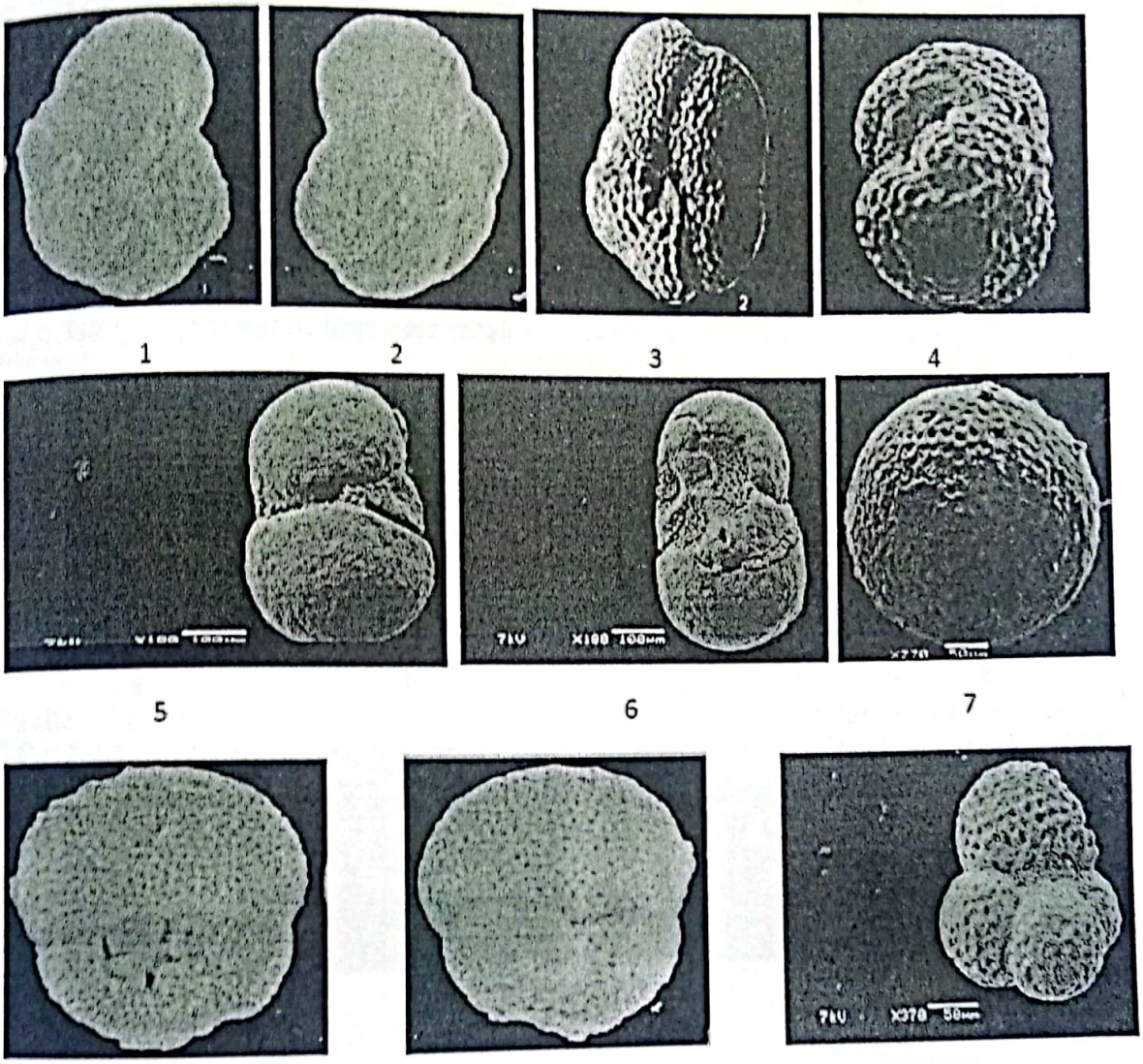
Conclusion

This study involved the biostratigraphic and paleoenvironmntal analysis of well 01, shallow offshore western Niger delta, Nigeria. 112 ditch cuttings were utilized for the extraction of foraminifera.

The studied interval (6000 -11250 ft) has been subdivided into bioststigraphic zones based on the vertical distribution of the foraminifera. The distribution allowed the delineation of three planktic foraminiferal zones, the zones are from base to top as follows: undiagnostic , *Orbulina universa* and *Globorotalia fohsi peripheroacuta*. These zones are equivalent to N8, N9 and N10 respectively of Blow,1979 (Table 1). Also two benthic zones of *Brizalina mandoroveensis* and *Uvigerina sparsicostata* were established.

Paleoenvironments of deposition of the studied well interval range from shallow marine to outer neritic marine environments due to the occurrence and distribution of *Ammonia beccarii, Eponides eshira, Lenticulina inornata, Florilus costiferum, Bolivina scalprata miocenica Bolivina interjuncta, Bolivina mandoroveensis, Uvigerina sparsicostata, Uvigerinella sparsicostat*

PLATE 1 (PLANKTIC FORAMINIFERA)



1 2 3 4

5 6 7

8 9 10

1-2 *Globorotalia fohsi peripheronda* Blow and Banner, 1969 x 200

3 *Globorotalia mayeri* Cushman and Ellisor, 1939 x 200

4 *Globoquadrina continuosa* Blow, 1959 x 150

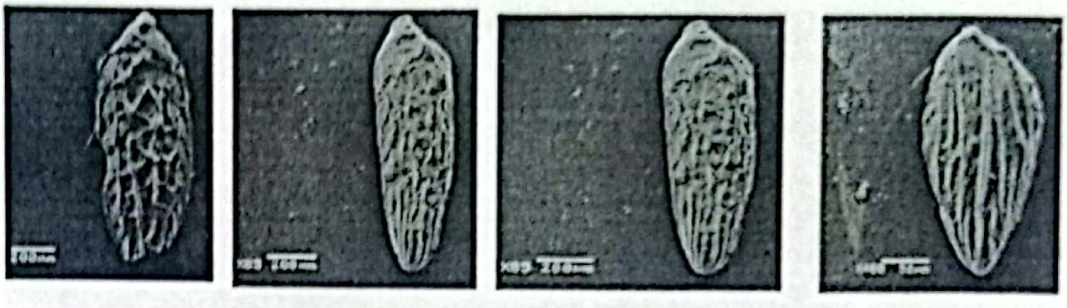
5-6 Praeorbulina *transitoria* Blow,1956 x 100

7 *Orbulina universa* d'Orbigny, 1839 x 270

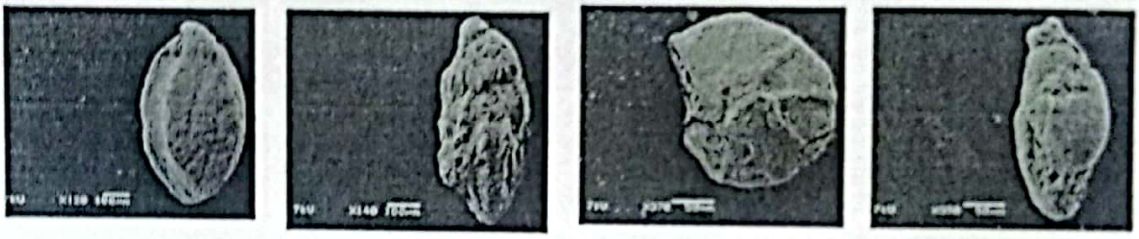
8-9 Praeorbulina *sicana* De Stephani Bolli and Saunder 1985 x 200

10 Globigerina *Praebulloides* Blow,1959 x 370

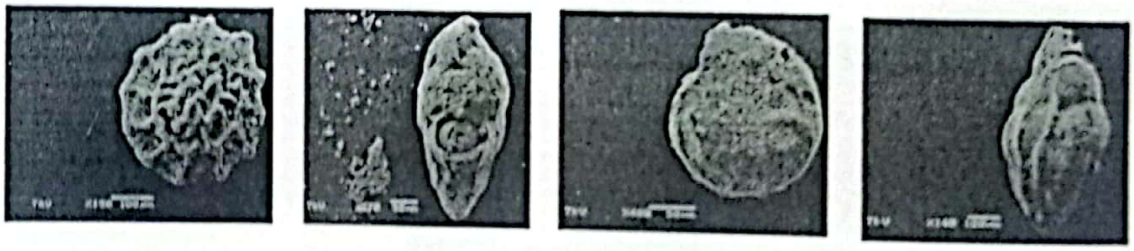
PLATE II (BENTHIC FORAMINIFERA)



1 2 3 4



5 6 7 8



9 10 11 12

x 1	*Brizalina mandoroveensis* Graham, de Klasz & Rerat, 1962	x 200
2&3	*Brizalina interjuncta* Cushman, 1926	x 75
4	*Brizalina scalprata miocenica* Macfadyen, 1930	x 400
5	*Spirosigmoilina oligoceanica* Cushman, 1910	x 120
6	*Uvigerina sparsicostata* Cushman and Laiming, 1931	x 140
7	*Lenticulina grandis* d Orbigny 1938	x 370
8	*Bulimina* sp	x 350
9	*Ammonia beccarii* Linne, 1758	x 100
10	*Hopkinsina* sp	x 270
11	*Lenticulina inornata* Cushman ,1926	x 400
12	*Uvigerina sparsicostata* Cushman and Laiming, 1931	x 140

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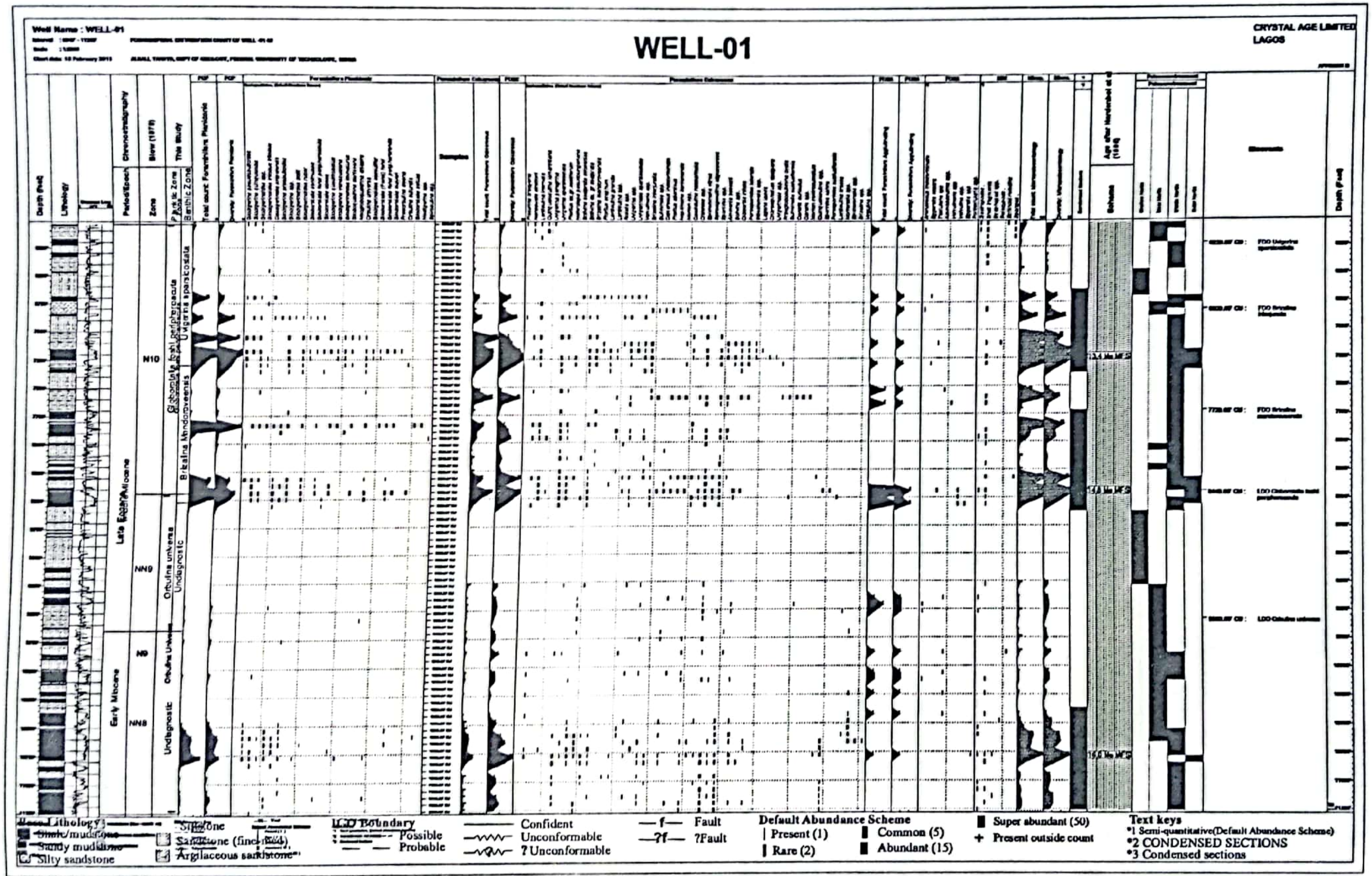
APPENDIX A: Foraminiferal Distribution Chart of Well 01. Shallow Offshore Western Niger Delta



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