PALYNOFACIES ANALYSIS OF IDA 4 WELL, NIGER DELTA, NIGERIA

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Abstract

Palynofacies analyses of the strata penetrated by Ida-4 wells were carried out with the aim of studying the stratigraphic sequence penetrated by the well in order to establish palynostratigraphic zones, relative age and the paleoenvironment of deposition. Fifty ditch cutting samples within the interval of 2179 – 3523 m were analyzed. The acid methods of sample preparation for palynofacies analyses were followed. The result of the analyses yielded low to abundant occurrences of pollen and spores with abundance of small, medium and large sizes of palynomacerals 1 and 2, few occurrences of palynomacerals 3 and 4. The lithology consists of alternation of shale and sandstone units with few intercalations of argillaceous sandstone units, indicating that the studied interval belongs to the Agbada Formation. The studied intervals were dated middle Miocene to late Miocene based on the recovered age diagnostic marker species such as *Zonocostatites ramonae, Multiareolites formosus, Verrutricolporites rotundiporus, Crassoretitriletes vanraadshoveni* and *Racemonocolpites hians.* Two interval range palynostratigraphic zones: *Multiareolites formosus – Zonocostatites ramonae, Verrutricolporites rotundiporus - Crassoretitriletes vanraadshoveni* and a taxon range zone: *Ainipollinite verus* zone were proposed. Paleoenvironmental interpretation was based on the palynofacies association and the lithology which revealed that the stratigraphic interval studied was deposited in the Coastal-deltaic (marginal marine) environments.

Keywords: Ida 4, paleoenvironment, palynofacies

1. Introduction

Palynofacies could be described as the entire acid resistant organic matter (palynological matter) constituents of sedimentary deposit. The term was first introduced by Combaz (1964) to describe the total microscopic image of the organic components in sedimentary rock samples. Subsequent authors have assigned different names to the organic components such as organic matter (Gehmann, 1962; Lorente, 1990; Batten and Stead, 2005), palynodebris (Boulter & Riddick 1986; Van der Zwan, 1990; Boulter, 1994) and kerogen or palynomacerals (Tyson, 1995; Araujo *et al.*, 1998; Whitaker, 1985; Oyede, 1992; Thomas *et al.*, 2015). Palynofacies was defined by Tyson (1995) as a body of sediment containing a distinctive assemblage of palynological organic matter thought to reflect a specific set of environmental conditions or to be associated with a characteristic range of hydrocarbon-generating potential. Batten and Stead (2005) defined palynofacies (palynological facies) generally to mean organic matter that is recovered from a rock or unconsolidated sediment by the standard palynological processing technique of digesting a sample in HCl and /or HF. Every sedimentary deposits containing organic matter have an associated palynofacies, which could be miospores (small spores and pollen grains), prasinophyte algal bodies, dinoflagellate cysts,

acritarch, foraminfera linings, structured fragments such as cuticles and wood tissues (phytoclasts or fragments of plants) and unstructured materials having an amorphous appearance. These organic matters are common, occurring in abundance in both continental and marine deposits. They are equally resistant to acid, high temperature and pressure, microbial decay and solutioning in water. Palynofacies analysis has several stratigraphic applications such as in chronostratigraphy, biostratigraphy and sequence stratigraphy. Its stratigrapic application is very useful on a local scale for fine correlation of reservoir units within oil-fields and to some extent on scale especially in areas or within successions which more conventional boistratigraphic markers are scarce or lacking (Batten and Stead, 2005). Palynofacies analysis is useful in the interpretation of the processes controlling deposition. It also provides basis for reconstruction of paleogeography, paleoecology, paleoenvironment and paleoclimate. Therefore this work is aimed at carrying out the palynofacies analyses of the ditch cuttings retrieved from Ida-4 well in order to establish the palynostratigraphic zonation, biochronology and paleoenvironment of deposition of the strata penetrated by the well. The studied well (IDA-4 well) is located in Ida field in the Niger delta. The coordinates that describe the locations of Ida-4 on the base map of Ida field is 69550 m North and 481875 m East (figure 1).

2. Literature Review

Niger delta lies between latitudes 4° and 6° N and longitudes 3° and 9° E in the Southern part of Nigeria (figure 2). Short and Stauble (1967) recognized three formations in the subsurface of the Niger delta. In ascending order, these formations are; the Akata, Agbada and Benin formations. The Akata Formation generally consists of open marine and prodelta dark grey shale with lenses of siltstone and sandstone. The Agbada Formation consists of cyclic coarsening-upward regressive sequences. The coarsening upward sequences are composed of shales, siltstones, and sandstones which include delta front and lower delta plain deposits (Weber, 1971). The Benin Formation comprises a succession of massive poorly indurated sandstones, thin shales, coals, and gravels of continental to upper delta plain origin. The three formations were deposited in continental, transitional and marine environments (Ola and Adewale, 2014). Doust and Omatsola, (1990) recognized depositional belts in the Niger Delta, These are: the Northern Delta, Greater Ughelli, Central Swamp, Coastal Swamp, and Offshore depobelts (figure 2).

They are distinguished by their age and most importantly their location. The most comprehensive contribution to the knowledge on the palynology of the Niger Delta was made by Germeraad *et al.* (1968). Their study was based on the palynomorph assemblages of the Tertiary sediments of three tropical areas: parts of South America, Asia and Africa (Nigeria). They established nine pantropical zones using quantitative base and top occurrence (numeric method) of diagnostic species such as *Echitricolporite spinosus, Crassoretitriletes vanradshoveni, Magnastrites howardi, Verrucatosporites usmensis, Monoporites annulatus* and *Proxapertites operculatus*. Evamy *et al.* (1978) established twenty nine informal palynological zones of the Niger delta using alphan umeric coding method which seems to form the background information for in-house zonal scheme of Shell Petroleum Development Company. Oboh *et al.* (1992) carried out palynological interpretation of the palaeoenvironments of Miocene strata of the well Igbomotoru-1, Niger delta. They used the lithology and the abundance or scarce occurrence of *Zonocostites ramonae* in the samples to interpret the environment of deposition to be largely transitional with marine influence.

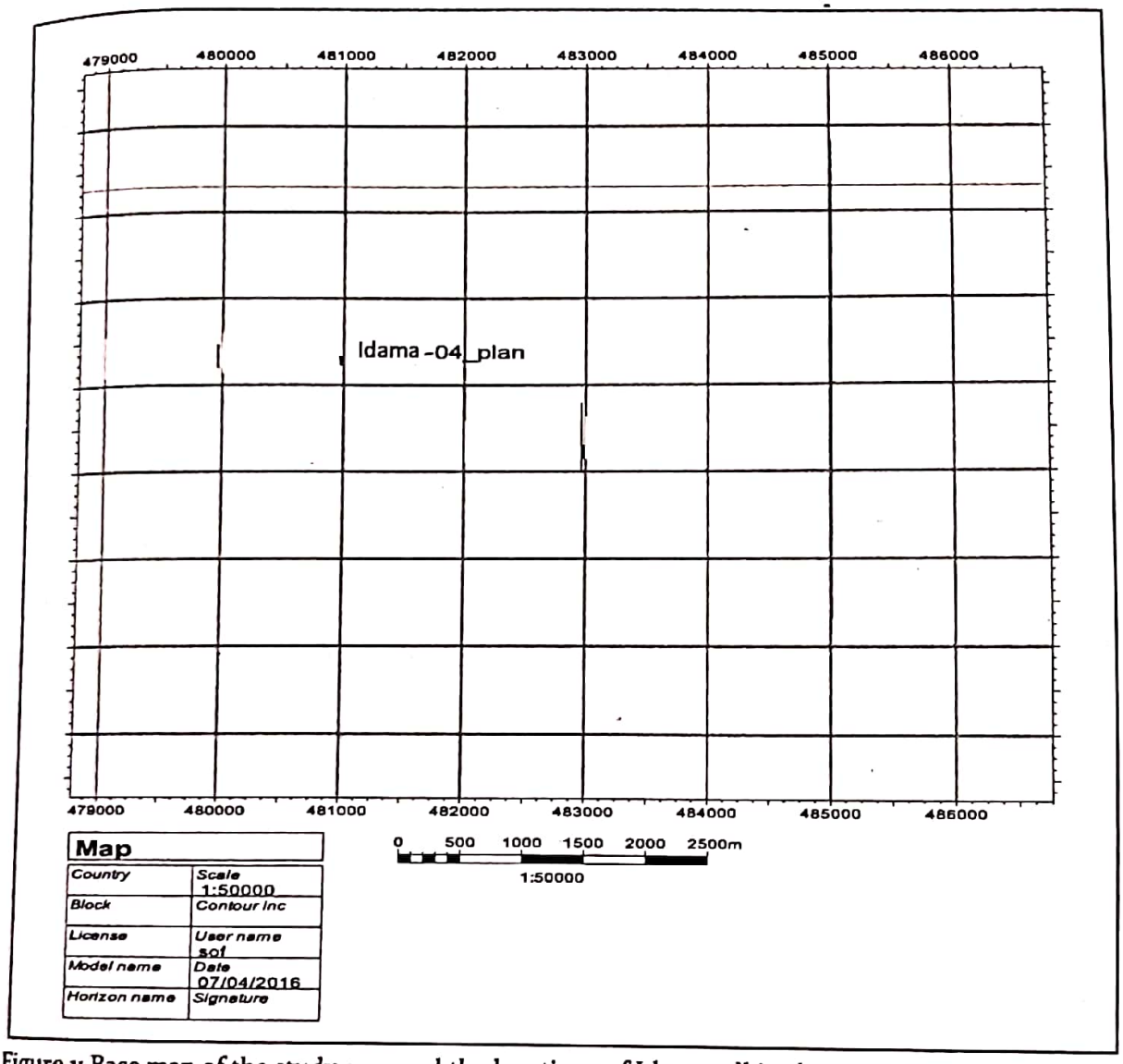

Figure 1: Base map of the study area and the locations of Ida-4 well in the Niger Delta.

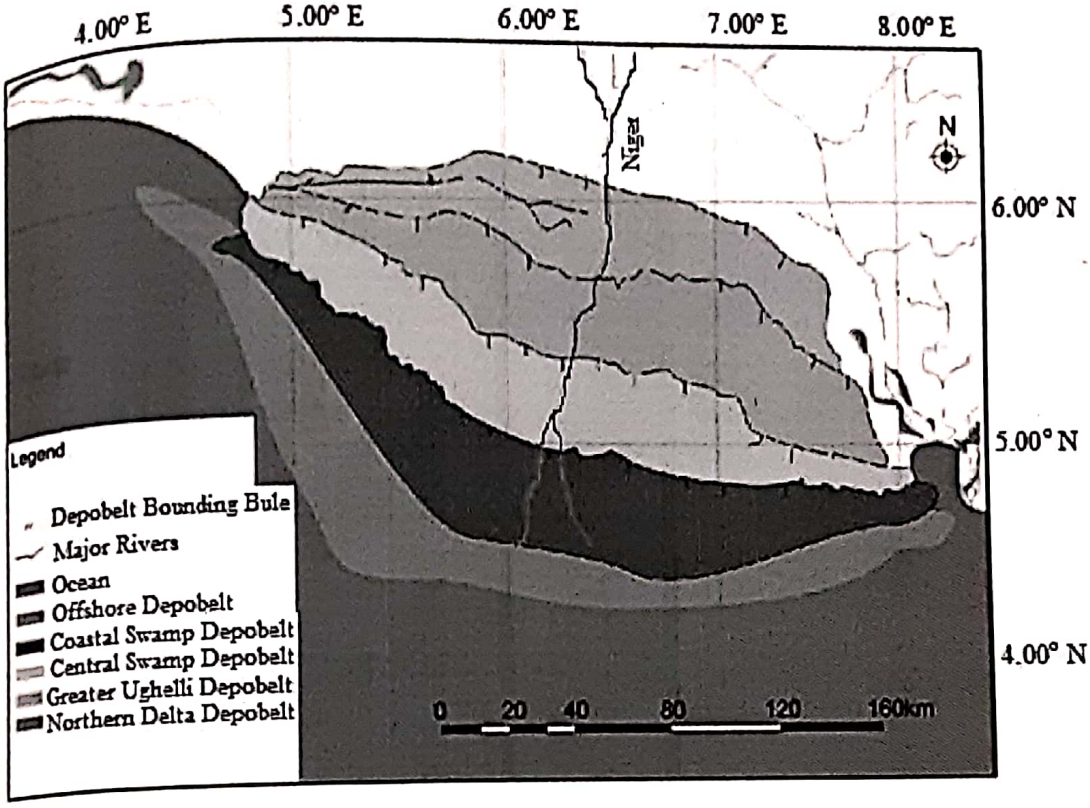

Figure 2: Depobelt map of the Niger Delta (modified after Okosun and Chukwuma-Orji, 2016)

3. Methodology

The materials used for this study include ditch cutting samples and wireline logs of Ida-4 well and they were provided by Chevron Nigeria Plc. All the laboratory facilities required were made available by Crystal Age Limited, Lagos where the laboratory analyses were carried out.

3.1 Lithologic description

Lithologic description of the stratigraphic intervals studied was done by physical observation and feeling of the samples between fingers. Fissile or platy samples indicate shale while samples with fine to coarse grained sizes indicate sandstone units. The description was enhanced by the Gamma-ray log since high and low values of Gamma log signify shale and sandstone lithologies, respectively (Adegoke, 2002; Olayiwola and Bamford 2016).

3.2 Samples preparation for organic matter recovery

The standard acid method of sample preparation for organic matter recovery was followed. Fifty ditch cutting samples from Ida-4 well within the interval of 2152 – 3523 m were analyzed. Fifteen grammas of each sample were treated with 10% HCl under a fume cupboard for the complete removal of carbonates that may be present in the samples. This was followed by complete neutralization with distilled water before the next procedure. Then 40% HF was added to the sample which was placed on a shaker for 24 hours to speed up the reaction rate and to ensure a complete dissolution of the silicates that may be present in the samples and for the particles to settle down. Thereafter, the HF was carefully decanted, then followed by complete neutralisation with distilled water in order to remove fluoro-silicate compounds usually formed from the reaction with HF. Sieving and separation were performed using Brason Sonifier 250 to filter away the remaining inorganic matter (silicates, clay, and mud) and heavy minerals to recover organic matters. Brason Sonifier is an electric device used with the aid of 5 micron sieve and it operates in a sonic vibration

to filter out inorganic matter and heavy minerals. The sieved residue was given controlled oxidation using concentrated nitric acid (HNO_3). The level of oxidation required by each sample was closely monitored under a palynological microscope.

For palynomacerals recovery, the same procedure for sample preparation for palynomorphs recovery was followed, except that the oxidation process with HNO_3 was omitted in order not to bleach the palyno debris. The recovered organic matters were uniformly spotted on arranged cover slips of 22/32 mm and were then allowed to dry for mounting. The mounting medium used for permanent mounting of cover slip onto glass slide was Loctite (Impruv) and was dried with natural sunlight for 5 minutes. The slides were then stained with safranin-O in order to enhance the study of dinoflagellete cysts.

Both palynology and palynomaceral slides were examined under the Olympus Binocular light transmitted microscope. The palynomaceral slides were subjected to quantitative analysis of different types of palynomacerals (type 1, 2, 3, and 4) as well as structureless organic matter (SOM). Identification of palynomorph and palynomacerals were done through the use of palynological albums and the published works of previous researchers (Germeeraad *et al.*, 1968; Ajaegwu *et al.*, 2012; Bankole, 2010; Durugbo and Aroyewun, 2012; Ige, 2009; Ige *et al.*, 2011; Ola and Adewale, 2014; Oyede, 1992 and Thomas *et al.*, 2015).

4. Results and Discussion

4.1 Lithology

The lithology of the studied interval consists of alternating shale/mudstone and sandstone unites with few intercalations of argillaceous sandstone (sandy shale and siltstone) units (figure 3). This suggests that the studied interval belongs to Agbada Formation. The shale/mudstones are mostly grey to brownish grey in colour, moderately hard to hard, platy to flaggy in appearance. The sandstones are predominantly milky white to smoky, coarse to fine grained, angular to subangular to rounded, and poorly to well sorted in texture.

4.2 Palynology

The results of palynological analysis are presented in palynomorph and palynomacerals distribution charts of Ida 4 well (figure 3). The chart presents the different palynomorph taxa and types of palynomacerals encountered at the different studied depth intervals. Palynological analysis of the slides of Ida 4 well yielded significant number of pollen and spores with low to moderate diversity. Pollen and spores were dominant. Photomicrographs of some of the recovered forms are illustrated in plate 1.

The spores recorded include the species of *Laevigatosporites* sp, *Verrucatosprites* sp, *Aletisporites* sp, *Cyperaceaepollis* sp, *Lycopodium* sp, *Selaginella myosorus*, *Pteris* sp, *Stereiosporites*, *Crassoretitriletes vanraadshoveni*; *Acostichum aureum* and *Magnastriatites howardi*.

The pollen species recovered are: *Zonocostites ramonae*, *Monoporites annulatus*, *Racemonocolpites hians*, *Retistephanocolpites gracilis*, *Praedapollis flexibilis*, *Striatricolpites catatumbus*, *Retibrevitricolporites protudens*, *Pachydermites diederixi*, *Psilatricoloporites crasssus*, *Retitricolporites irregularis*, *Fenestrites spinosus*, *Peregrinipollis nigericus*, *Gemamonocolpites* sp, *Multiareolites formosus*, *Verrutricolporites rotundiporus*, *Nummulipollis neogericus*, *Canthium* sp, *Coryius* sp, *Psilatricolporites* sp, *Elaeis guineensis*, *Alnipollinites verus*, *Podocarpidites* sp and *Retitricolporites* sp.

The algal cysts present are *Botryococcus brannii and* no dinoflagellate cyst was recovered.

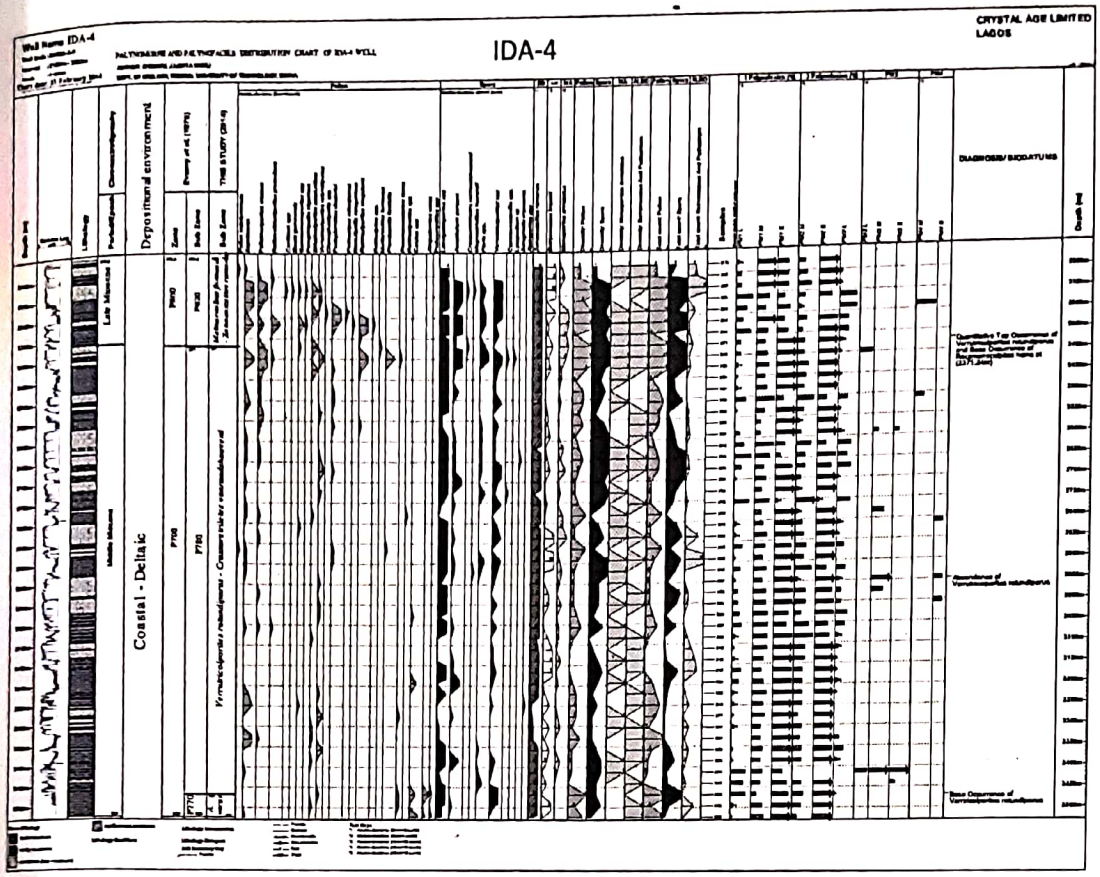

Figure 3: Palynomorph and palynofacies distribution chart of Idama-4 well

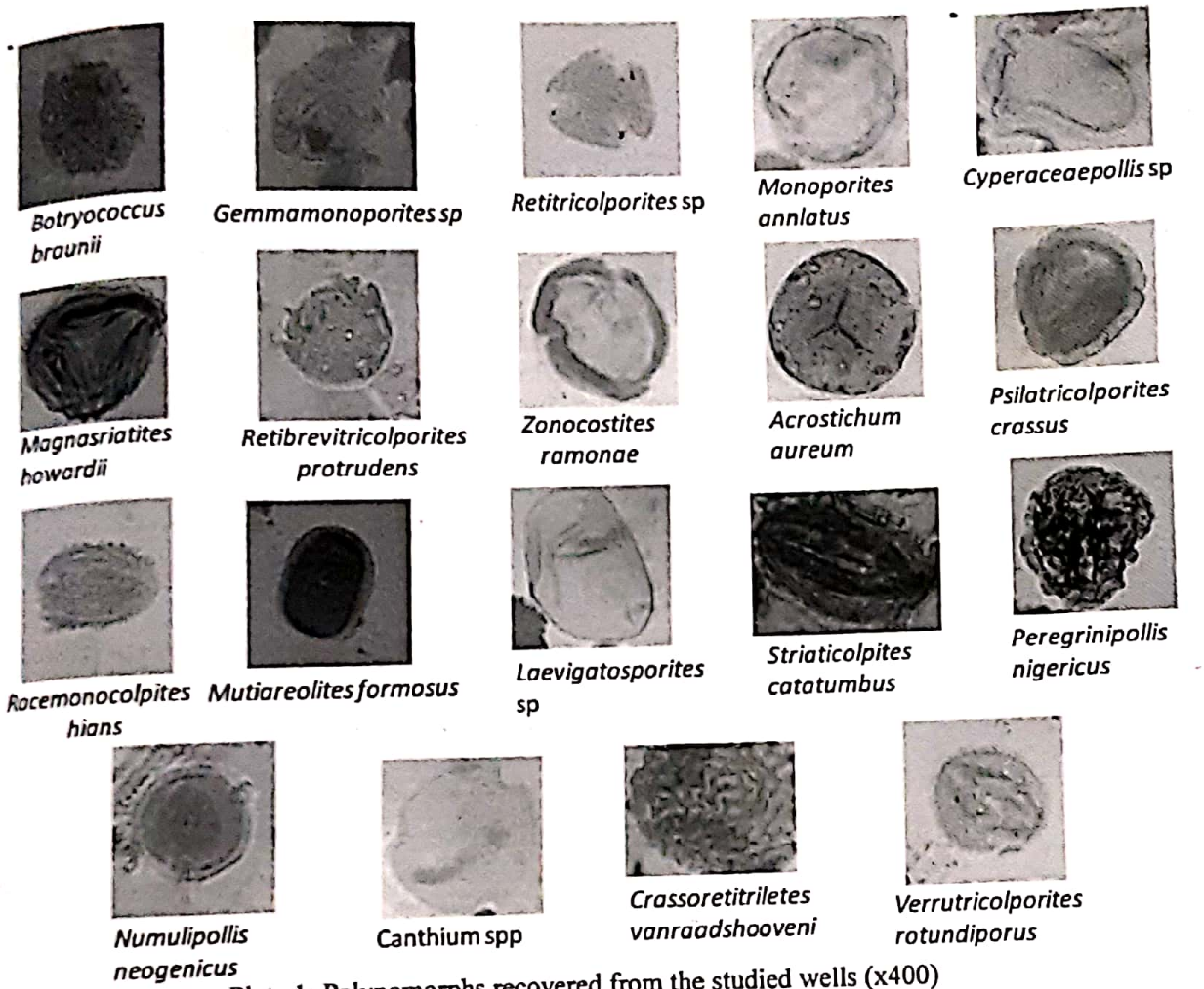

Plate 1: Palynomorphs recovered from the studied wells (x400)

4.3 Palynomacerals

The palynomacerals analysis yielded abundant records of palynomercerals 1 and 2, few occurrences of palynomacerals 3 and 4 and no record of (SOM) structureless organic matter (plate 2, figure 3).

4.3.1 Palynomaceral 1 (PM1)

In this study, the observed palynomaceral 1 appeared orange-brown to dark-brown in colour, opaque, irregular in shape, structureless and varies in preservation (plate 2). Oyede (1992) described Palynomaceral 1 as particulate organic matter (Alginite) that is orange-brown to dark-brown in colour, dense in appearance, irregular in shape, structureless and varies in preservation. It is heterogeneous and of higher plant in origin and some are products of exudation processes such as the gelification of plant debris in the sediments. Palynomaceral 1 includes small, medium and large sizes of flora debris, humic gel-like substances and resinous cortex irregularly shaped materials (Oyede, 1992 and Thomas *et al.*, 2015).

4.3.2 Palynomaceral 2 (PM 2)

The PM 2 observed in this study is irregular in shape, brown-orange in colour, and platy in structure (plate 2). According to Oyede, 1992, palynomaceral 2 (Exinites) is usually brown–orange colour, structured but irregular in shape. It encompasses platy like structured plant materials (leaves, stems or small rootlet

debris), algae debris and a few amounts of humic gels and resinous substances. It is more buoyant than palynomaceral 1 because of its thinner lath-shaped character.

4.3.3 Palynomaceral 3 (PM 3)

The PM 3 observed in this study, generally is translucent and contained stomata, pale to brown in colour and is irregular in shape (plate 2). Oyede, 1992 stated that PM 3 (Vitrinite) is pale, relatively thin and irregularly shaped and occasionally contains stomata. Also, it includes structured plant material, mainly of cuticular origin and degraded aqueous plant material. It is more buoyant than palynomaceral 2 (Thomas *et al.*, 2015).

4.3.4 Palynomaceral 4 (PM 4)

The observed PM 4 in this study varies from black to dark brown in colour, with blade or needle like shapes (plate 2). Oyede (1992) described PM 4 (Inertnite) as being black to charcoal black in colour. Also, it is equidimensional, blade or needle shaped material. It is uniformly opaque and structureless, but may occasionally show cellular structure. The components of this palynomaceral are of different origins and they include compressed humic gels, charcoal and geothermally fusinized material. Blade-shaped palynomaceral 4 is extremely buoyant and resistant to degradation. Thus, they are often transported over long distances (Oyede, 1992 and Thomas *et al.*, 2015). Concentration of PM-4 characterizes high energy environment.

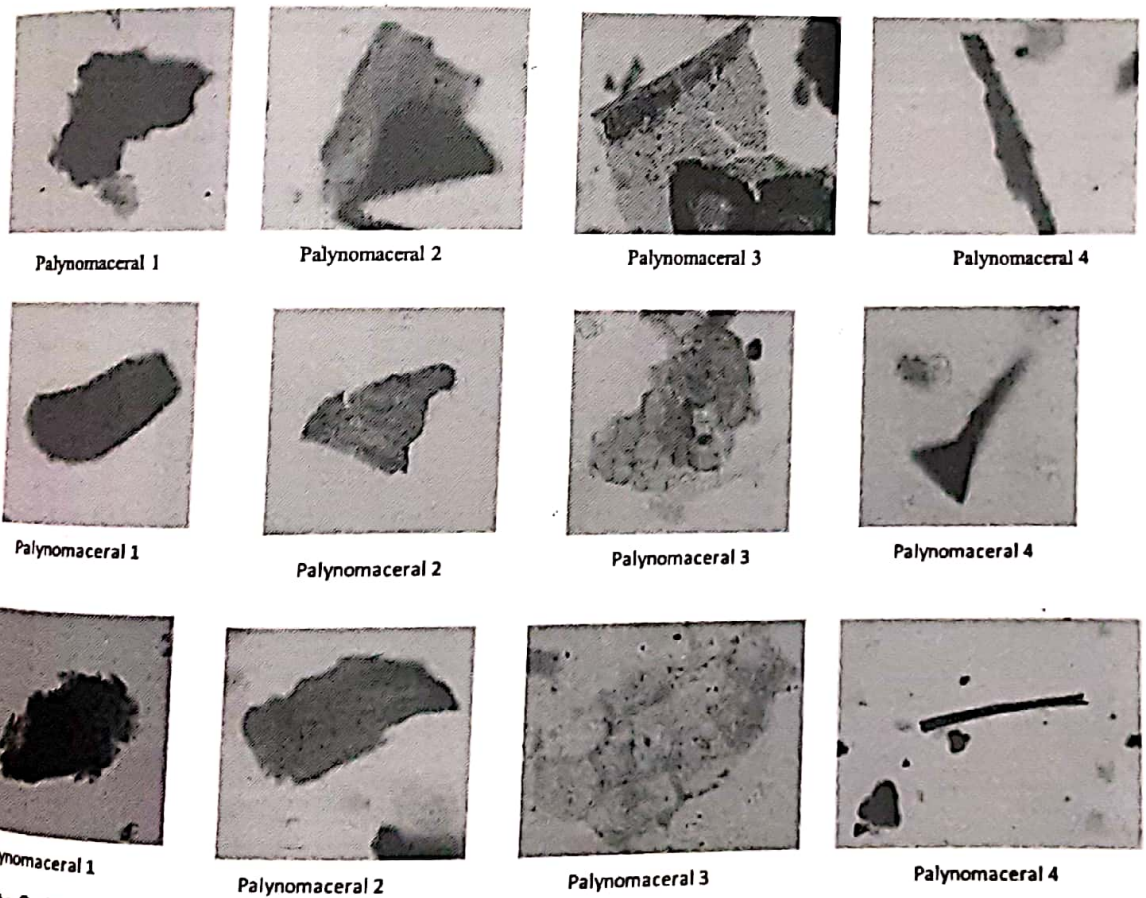

Plate 2: Types of palynomacerals recovered (x400).

4.4 Palynostratigraphic zonations and biochronology

The palynostratigraphic zones proposed in this study were based on the international stratigraphic guide - an abridged version of Murphy and Salvador (1999). The works of Germeraad *et al.*, (1968); Evamy *et al.*,

(1978); Ige, (2009); Oboh *et al.* (1992), Bankole, (2010); Aturamu & Ojo, (2015) and Olayiwola, & Bamford, (2016) were consulted. Age diagnostic marker species were used to determine the age of the studied intervals in the well. Three biozones were proposed in the studied wells: *Multiareolites formosus – Zonocostatites ramonae*, *Verrutricolporites rotundiporus* - *Crassoretitriletes vanraadshoveni* and *Ainipollinite verus* zones.

i. *Multiareolites formosus – Zonocostatites ramonae* Zone (Interval zone)

Stratigraphic interval: 2179 – 2371 m

Definition: The top of the zone is defined by the first downhole occurrence (FDO) of *Zonocostatites ramonae* at 2179 m while the base is marked by the last downhole occurrence (LDO) of *Multiareolites formosus* and *Crassoretitriletes vanraadshoveni* at 2371 m.

Characteristics: The assemblages of palynomorphs taxa that characterize this zone include *Zonocostatites ramonae*, *Crassoretitriletes vanraadshoveni*, *Nummulipollis neogericus*, *Multiareolites formosus* and *Retibrevitricolporites protrudens*. Other taxa occurring within the zone are sapotacea, *Psilatricoloporites crassus*, *Peregrinipollis nigericus*, *Laevigatosporites* sp, *Verrucatosprites* sp, *Aletisporites* sp, *Pteris* sp, *Acostichum aureum* and *Magnastriatites howardi*.

Age: The zone is dated late Miocene because of the presence of *Crassoretitriletes vanraadshoveni*, *Multiareolites formosus* and *Peregrinipollis nigericus*.

Remark: The zone is equivalent to P800 zone and P820 subzone of Evamy *et al*, (1978). The zone is marked by very rich recovery of *Zonocostatites ramonae*, *Monoporites annulatus*, *Botryococcus braunii* and *Laevigatosporites* sp. There is single occurrence of *Podocarpus milanjianus* within the zone. The base occurrence of this species marks late Miocene – early Pliocene boundary (Morley, 1997). Its occurrence within the zone could have resulted from caving in and mixing of rock cuttings during drilling. Also occurring within the zone is pollen indeterminate which could probably be reworked specimens because it is not well preserved. The single occurrence of *Proxapertites cursus* an Early Eocene to Early Miocene species at 2371 m could have resulted from reworking of older sediments into younger sediments.

ii. *Verrutricolporites rotundiporus* - *Crassoretitriletes vanraadshoveni* Zone (Interval zone)

Stratigraphic interval: 2371 - 3469 m

Definition: The top of the zone is defined by the last downhole occurrence (LDO) of *Crassoretitriletes vanraadshoveni*, *Multiareolites formosus* and base regular occurrence of *Gemamonocolpites* sp at 2371 m while the base is marked by the last downhole occurrence of *Verrutricolporites rotundiporus* at 3469 m.

Characteristics: The zone is characterized by the presence and lowermost documented occurrence of *Racemonocolpites hians*, *Retibrevitricolporites protudens*, *Pachydermites diederixi*, *Psilatricoloporites crasssus*, *Gemamonocolpites* sp, *Multiareolites formosus*, *Verrutricolporites rotundiporus* and sapotaceae within the zone. The occurrence of *Zonocostites ramonae* and *Monoporites annulatus* are rich within this zone.

Age: The zone is dated middle Miocene because taxa such as *Verrutricolporites rotundiporus*, *Retibrevitricolporites protudens*, and *Racemonocolpites hians* are diagnostic of middle Miocene.

Remark: The is equivalent to P700 zone and P780 subzone of Evamy *et al*, (1978)

iii. *Ainipollinite verus* Zone (Taxon-range zone)

Stratigraphic interval: 3469 - 3523 m

Definition: The top and base of the zone is defined by the first and last downhole occurrence of *Ainipollinite verus* at the depth of 3469 and 3523 m respectively. The first and last downhole occurrence of *Podocarpidites* sp also marks the top and base of the zone.

Characteristics: The zone is characterized by the lowermost documented occurrence of *Striatricolporites catatumbus*, *Laevigatosporites* sp, sapotaceae, *Zonocostates ramonae*, *Acrostichum aureum*, *Monoporites annulatus* and *Racemonocolpites hians*. *Retibrevitricolporites protrudens*- a species with an age range of Oligocene to Pliocene has its LOD within the zone.

Age: The zone is dated middle Miocene. The stratigraphic position of the zone and the presence of the above mentioned taxa that defined and characterized the zone aided its age assignment.
Remark: The zone is equivalent to P700 zone and P770 subzone of Evamy *et al*, (1978).

4.5 Correlation of the established palynostratigraphic zones with the Niger delta Cenozoic chart
The established zones of this study and the P zones equivalent of Evamy *et al*., (1978) are correlated with the Niger delta Cenozoic chart (figure 4). The correlation reveals that the studied well is located in the coastal swamp depobelt. It also confirms the assigned age of the studied interval to be middle to late Miocene.

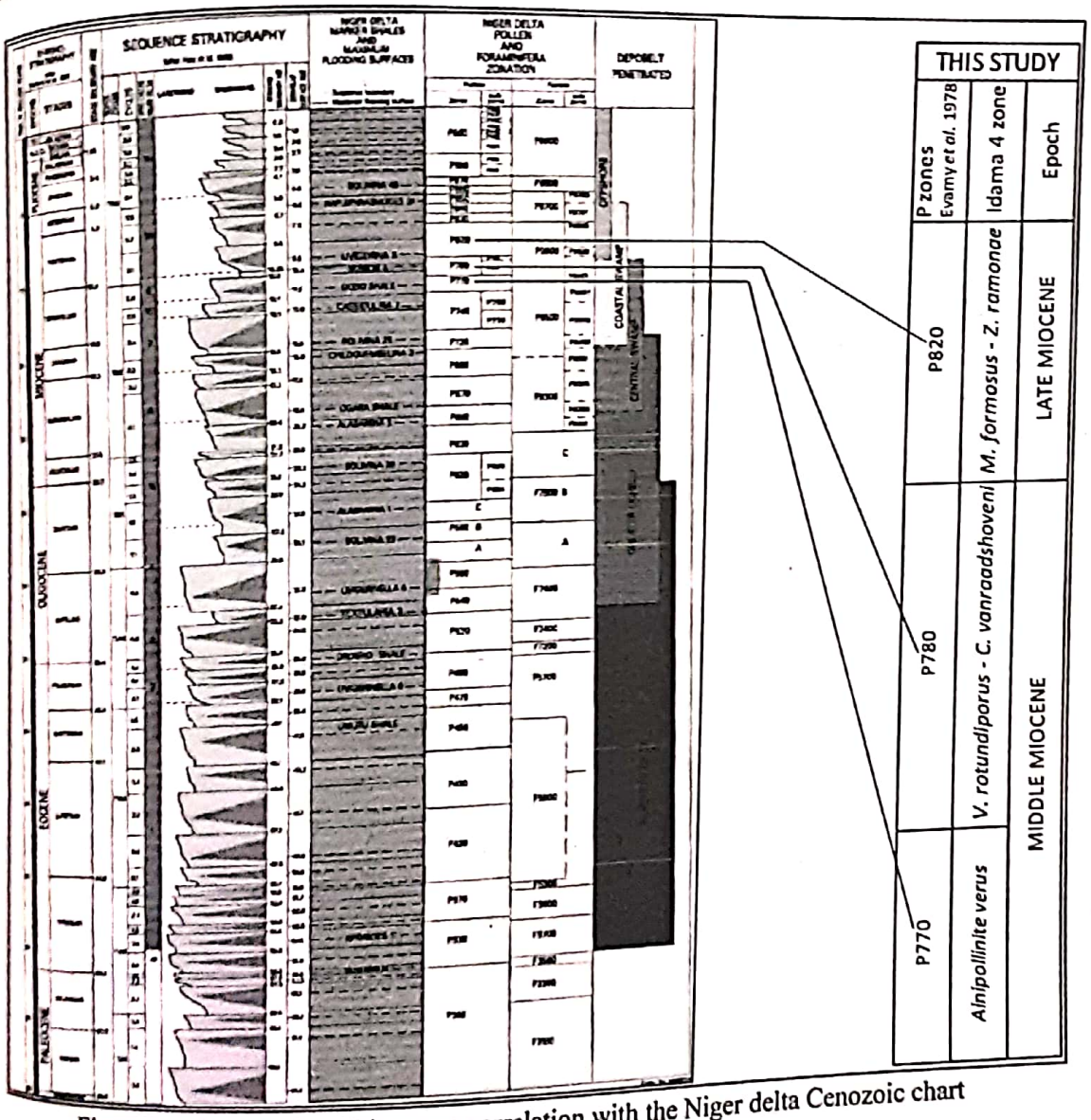

Figure 4: palynostratigraphic zones correlation with the Niger delta Cenozoic chart

4.6 Paleoenvironment of deposition
This involves the periodic changes in the depositional environment over geologic time. Evaluation of paleoenvironment of deposition is essential because different depositional environment give rise to reservoirs with different qualities and characteristics such as porosity, permeability, heterogeneity and

architecture. Inference of the paleodepositional environments of the studied wells was made based on the following criteria:

i. The nature of organic matter (palynomercerals) recovered in the studied interval. The terrestrial/coastal and marine depositional environments have been distinguished to have distinctive and characteristic palynofacies (Oyede, 1992 and Thomas *et al.*, 2015). The terrestrial/coastal environments are characterized by poorly sorted palynomacerals 1 and 2, absence of dinocysts and common to abundant occurrence of fungal spores while marine environment is characterized by a good sorting of organic matter predominantly small to medium, common to abundant palynomacerals 1 and 2, some needle-shaped to lath-shaped palynomaceral 4 and presence of dinocysts and or foraminifera linings (Oyede, 1992).

ii. Association of environmentally restricted diagnostic species such as *Zonocostites ramonae, Monoporites annulatus, Pachydermites diederixi, Psilatricoloporites crasssus, Laevigatosporites* sp and *Botryococcus braunii.*

Based on the above mentioned criteria, lower delta plain to delta front and prodelta (subaerial delta to subaqueous delta plains) environment within coastal – deltaic environment of deposition have been inferred for the sediments encountered in the analyzed intervals of Idama 4 well (table 1 and figure 5).

The intervals; 2179 – 2800 m, in Idama 4 well was delineated to have been deposited in the lower delta plain environment. The lower delta plain is equivalent to fore shore and fluvio-marine environment (figure 5). The reasons for this deduction are:

i. The intervals are characterized by high representation of mangrove, freshwater swamp and rainforest swamp taxa, freshwater algae, savana and montane taxa such as *Zonocostites ramonae, Monoporites annulatus, Striatricolpites catatumbus, Retibrevitricolporites protudens, Pachydermites diederixi, Psilatricoloporites crasssus, Verrutricolporites rotundiporus, Botryococcus braunii, Acrostichum aureum, Pachydermites diederixi* and *Laevigatosporites sp.*

ii. The abundant records of palynomacerals 1 and 2 indicate coastal deltaic environment of deposition with influx of fresh water from the moderate quantities of *Botryococcus braunii,* and *Laevigatosporites* sp recorded within the interval in Idama 4 well.

iii. Aggradational, progradational and retrogradational log motifs characterize the sands (intercalated by shales) in the interval suggest their deposition as channel / bar complexes in a delta plain – delta front setting. Lithologically, the sands are milky white, very fine to medium – grained, occasionally coarse to very coarse –grained/ granule -sized, poorly to well sorted and sub-angular to sub-rounded. The shales are reddish brown to grey, silty, platy and moderately soft to moderately hard. These criteria indicate deposition in lower deltaic plain environments.

Table 4.1: Environment of Deposition in Idama 4

Idama 4 well intervals (m)	Inferred Depositional environment
2179 – 2800	Subaerial delta (lower delta plain/fore shore)
2800 – 2885	Subaqueous delta (delta front/lower shore face) plain
2885 – 3523	Subaqueous delta (delta front to prodelta) plain

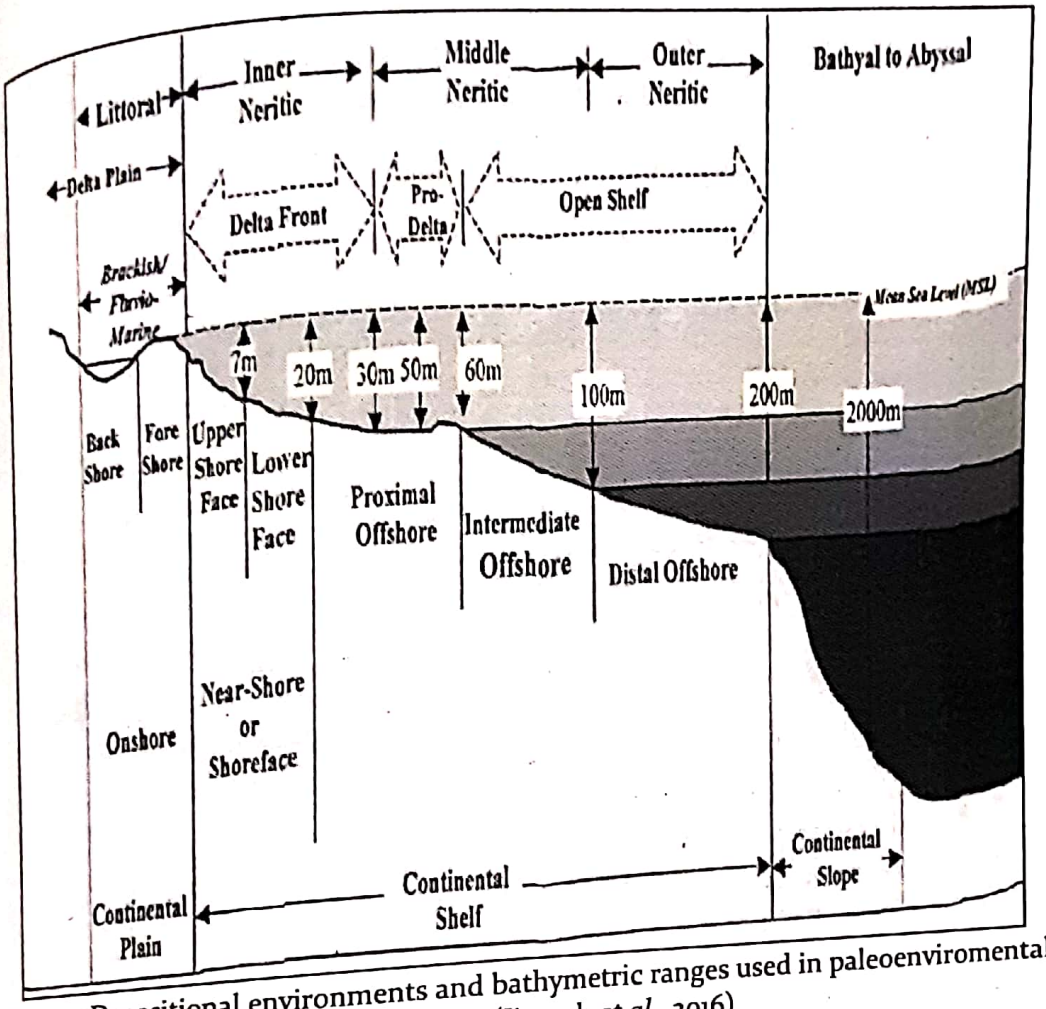

Figure 5: Depositional environments and bathymetric ranges used in paleoenviromental interpretation (Ijomah *et al.*, 2016)

Similarly, the interval: 2800 – 2885 m well was delineated to have been deposited in delta front (inner neritic) environment of deposition. The criteria for this deduction are:

i. The intervals are characterized by increased representation of montane taxa such as *Monoporite annulatus*, reduced occurrences of mangrove, freshwater swamp and rainforest swamp taxa compared to the above intervals.
ii. The palynomacerals 1 and 2 that occur are more of large and medium sizes than the small size.
iii. The sands and shale intercalations in this interval are characterized by blocky / aggradational log motifs (slightly serrate cylinder on funnel – shaped log character); suggesting their deposition as channels / channel fills in a delta front setting.

The lowermost segment: 2885 – 3523 m of Idama 4 well is also inferred to have been deposited in delta front to prodelta environment of deposition. The reasons for this inference are:

i. The intervals are characterized by moderate representation of mangrove, freshwater swamp and rainforest swamp taxa *Zonocostites ramonae, Monoporites annulatus, Striatricolpites catatumbus, Retibrevitricolporites protudens, Pachydermites diederixi, Psilatricoloporites crasssus, Verrutricolporites rotundiporus, Botryococcus braunii, Acrostichum aureum, Laevigatosporites sp* and *Pachydermites diederixi*, rare to non representation of savanna and montane taxa suggesting subaqueous delta environment.
ii. They are characterized by moderate to good sorting of palynomacerals 1 and 2, predominantly common to abundant small to medium sizes.

iii. The lithology is mostly shaly intercalated with sandstone units. The sand units exhibited multiserrate funnel, cylinder/ subtle bell-shaped GR log profiles interpreted as subaqeous mouth bars and distributary channel deposits indicates prograding shoreline.

5. Conclusion

Palynofacies were carried out on the strata penetrated by Idama 4 well using the ditch cuttings and gamma ray log provided by Chevron Nigeria Limited. Fifty ditch cutting samples within the interval of 2152 – 3523 m. in Idama 4 well were analyzed. The analysis yielded low to abundant recovery of pollen and spores, small to large sizes of palynomacerals 1 and 2, few occurrences of palynomacerals 3 and 4. The lithology showed alternation of shale and sandstone units with few intercalations of argillaceous units, indicating Agbada Formation. The alternation of shale and sandstone units forms good targets in petroleum exploration because they act as seal and reservoir rock units. The studied intervals were dated middle Miocene to late Miocene based on the recovered age diagnostic marker species such as *Multiareolites formosus, Verrutricolporites rotundiporus, Crassoretitriletes vanraadshoveni* and *Racemonocolpites hians*. Three palynostratigraphic zones were established in the three wells using the international stratigraphic guide for establishment of biozones. *Multiareolites formosus – Zonocostatites ramonae, Verrutricolporites rotundiporus - Crassoretitriletes vanraadshoveni* and *Ainipollinite verus* zones were established. The three zones proposed are equivalent to P770, P780 and P820 of Evamy *et al.*, (1978). These were correlated to the Niger delta Chronostratigraphic chart. The correlation shows that the age of the studied interval of the well is middle to late Miocene and falls in the coa stal swamp depobelt of the Niger delta. The proposed palynostratigraphic zones of this study could contribute to the harmonization of Niger delta floral biozonation scheme. Coastal-deltaic (lower delta plain to prodelta) environments of deposition have been inferred for the studied interval based on the lithology and the palynofacies association.

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