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Palynological data acquisition for forensic studies within the lower Benue Trough, Nigeria

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ABSTRACT

Palynological baseline data acquisition for forensic studies were carried out within the lower Benue Trough in the area bound by longitudes 6°38′E and 8°43′E and latitudes 4°40′N and 6°40′N. The study area includes locations in Agbani – Ihe town in Enugu State and Ogugu – Emohua town, in Enugu and Rivers States respectively. A total number of seventeen samples comprising of sandstone, siltstone and shale were collected across a geographic spread from north to south. The palynologic analysis yielded Nympheapollis clarus, Fenestrites spinosus, Cyperaceapollis sp and Stereisporites sp which corresponds to the Nanka Formation; Retitriporites heterobrochati, Aspleniumsporites trivedii, Retistephanocolpites gracillis, Elaeis guineensis, Echitricolporites spinosus, Multiareolites formosus and Matonisporites sp from Benin Formation. The samples yielded pollen, spores, fungal spore, dinoflagellate, acritarch, foram lining and diatom. The identification of these palynomorphs helped to generate a percentage distribution paleogeographic chart showing the occurrences of the different palynomorph groups. Five biozones were recognized, The first and fifth zones consists of the Zonocostites ramonae zone and Psilatricolporites sp zone respectively, indicating sedimentation in coastal and shallow marine environments in mangrove vegetation. The second, third and fourth zones (Echitricolporites spinosus, Echiperiporites sp, and Retitricolpites sp zones respectively) which are consistent with the presence of alluvial environments characterized by fresh water swamp.

Keywords: Forensic, Lower Benue, Palynology, Baseline Data

INTRODUCTION

The study area lies within the Lower and Southern Benue Trough. The Benue Trough formed as a failed arm of the triple junction when the north and south Atlantic were created during the Jurassic [2]. The Niger Delta basin is a prolific oil province within the West African sub-continent. It extends from the Calabar Flank and the Abakaliki Trough in eastern Nigeria to the Benin Flank in the west and it opens to the Atlantic Ocean in the south.

The concept of forensic palynology was first reported in Austria in 1959 and has remained untried in Nigeria [11]. Forensic palynology refers to the application of palynology for crime investigation. The expected production and dispersal patterns of spores and pollen (called pollen rain) for the plants in a given geographical region will yield the type of "pollen finger print" to expect in samples that come from that area [11,13]. Plants are among the best indicators of the environment for forensic studies; floral assemblages of plants are known to be characteristic of specific ecological zones and the occurrence of the fossils of such ecological indicator species in sediment is considered a reflection of contemporary ecological conditions for forensic studies [3,11].

OBJECTIVES OF THE STUDY

The research will enable a more robust and rational understanding of the application of palynology and provide valuable data for the following;

(a) Generating palynomorph assemblage data for forensic studies,

(b) Reconstruction of past environments which entails the study of the periodic changes in environment over geological time.

MATERIALS AND METHODS

Location and accessibility of the study area The area of study (Figure 1) covers some parts of Enugu, Abia, Imo and Rivers States. All in Nigeria. The Enugu State area comprises of Agbani in Nkanu West L.G.A, Ihe and Ogugu both in Agwu L.G.A. The area of study in Imo State is Umualumuoke and Ezinachi village, all in Okigwe L.G.A. The study area in Abia State includes Lokpanta in Isiukwuato L.G.A, Umuahia and Isieke-Ibeku both in Umuahia L.G.A, Ukpakiri in Obingwa L.G.A and also some parts of Ukwa-West L.G.A. In Rivers State, Rukpokwu in Obio-Akpor L.G.A and Emohua in Emohua L.G.A were also studied. The Study areas are located between longitudes 6°38′E and 8°43′E and latitudes 4°40′N and 6°40′N. The study areas as mentioned above are accessible through the Enugu – Port Harcourt expressway, Aba – Ikot Ekpene road and Umuahia – Owerri road.

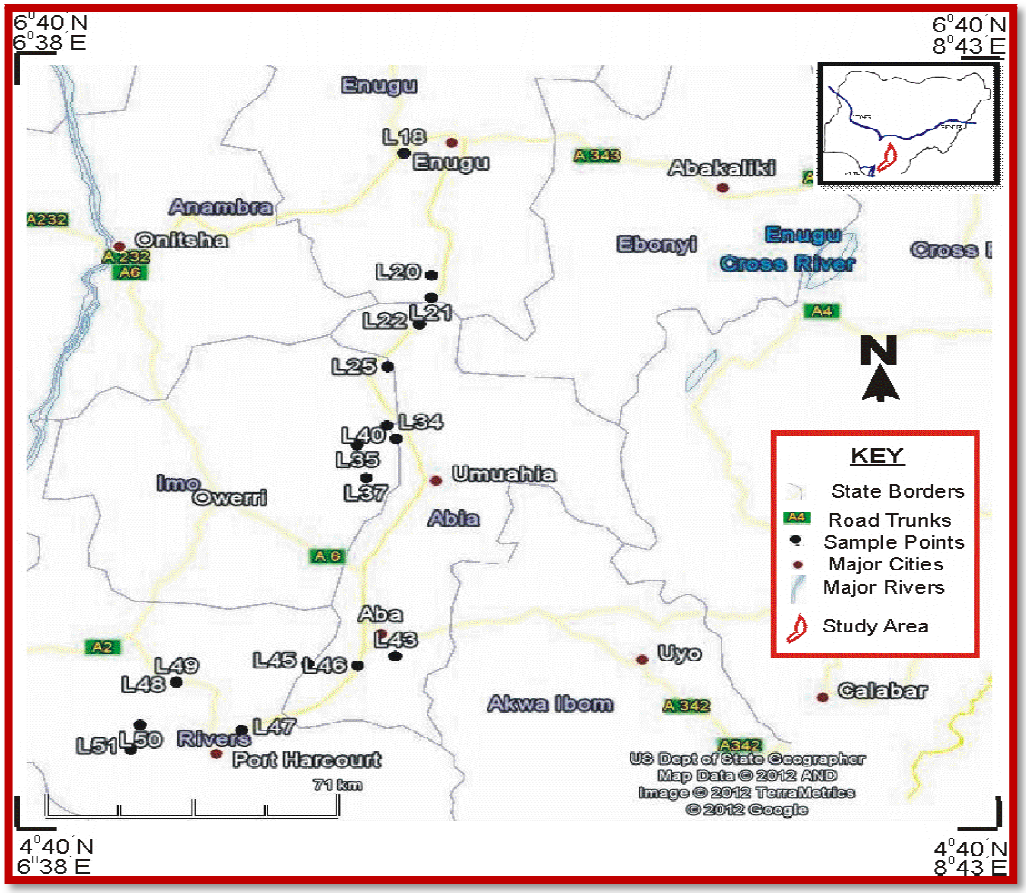

Figure 1: Location of the Study Areas

This research work undertook both field work and laboratory study approach. The samples obtained from the field were subjected to laboratory analysis and interpretation.

(a) Sample collection The field work was carried out with the aid of some basic instruments such as road map, Global Positioning System (G.P.S), digital camera, marker, field notebook, pencil, eraser, masking tape, sample bags (used to collect samples from different locations). Hand auger and hand trowel was used to collect both surface and sub-surface samples (few metres deep). A total number of seventeen control samples were collected using the "pinch" method: collecting 10 pinches of soil throughout each sampled locations of about 50 to 100 square meters. These pinches were combined into a single, sterile, plastic bag and then sealed. Multiple pinches from each sample area were combined to prevent the possibility of over-representation of a single pollen type. The samples collected from different locations were well-labelled with sample and location number and then kept in a sample bag [5].

(b) palynological preparation: Samples were prepared for palynological studies. About 5 gram of each sample was placed in a labeled cup in which 100ml of 70% hydrofluoric acid (HF) was added with the aim of separating the

palynomorphs from the other rock debris by digesting the silica in sample. The samples were then washed and the slides prepared. A portion of the kerogen was mixed with 0.1% PVA solution, pipette onto a cover slip and allowed to dry. The remainder of the kerogen was sieved at 20µ. A portion of the sieved material was mixed with PVA solution pipette onto a cover slip and allowed to dry. The cover slips were mounted upon a microscope slide using norland adhesives. The slides were properly labeled and observed under research microscope through which snapshot was taken (see list of plate 1-4).

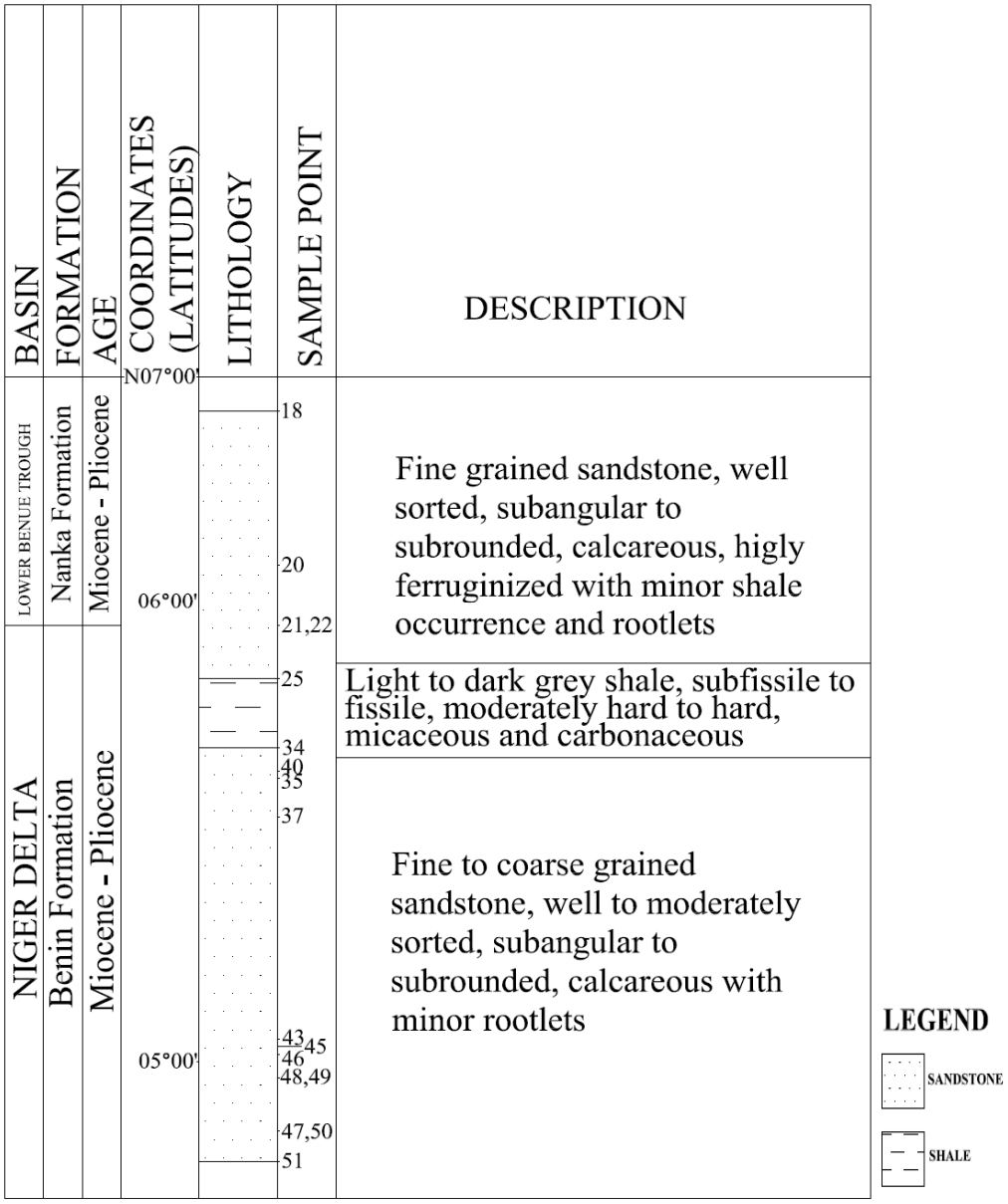

Figure 2: Lithology of the Studied Samples

PRESENTATION OF RESULT

The results have been separated into Lithology, Percentage distribution of palynomorphs, Pollen assemblage zones, Paleoecology and Paleoenviroment.

(A) Lithology The lithological and textural characteristics were derived by washing the samples under running water using the 90µm, and 53µm mesh size set of sieves to remove the mud. The samples were dried on a hot plate, examined and described with the aid of a Leitz-Wetzlar binocular microscope. The samples were divided into three horizons (A-C) on the basis of textural characteristics. These units from top to the base are shown in Fig. 2. It was characterized by sandstone and shale with the sand grains exhibiting fine to coarse grained size. They were well to moderately sorted with abundant calcareous, minor rootlets, ferruginous materials and minor shale occurrence at the upper unit. The sand grains sub-angular to sub-rounded and light to dark grey in colour. The shale in unit B was sub-

fissile to fissile, moderately hard to hard with micaceous and carbonaceous detritus. The colour of the shale was light to dark grey.

(B) Percentage distribution of palynomorphs The distribution of palynomorphs varied considerably from one geographic location to another (see figure 3). The sampling points of the samples were arranged using their coordinates (latitudes) in a descending order, starting with the locations that have the highest latitude from north to south. Pollen and spores preservation was good in most of the samples and the microflora was rich and well-diversified. The total number of palynomorphs counted per gram of the analysed samples ranged from 3 to 221,with the lowest abundance at sample 25 and the highest abundance at samples 21 and 22

(C) Pollen Assemblage zones The evolution of organisms through time provides the framework for a system of zonation by which discrete units of time represented by accumulation of sediments can be recognized [1,6]. A segment of a stratigraphic record that is characterized by particular species of index fossils may be formally recognized as a zone. Some zones are defined by the presence of single specie while others are distinguished by the presence of two or more species. A zone is generally named for a species that characterizes it. It receives its name from one or more of these fossils. The basis for recognizing assemblage zones include; variations in the fossil taxa, abundance of specimens or both. The assemblage zone may indicate ecologic facies, age or both. The recognized assemblage zones are discussed under previously recognized major zones [7,10].

(i) Zone I: *Zonocostites ramonae*
Subzone: Miocene – Pliocene
Locations 18 – 20

Definition: Species first appearing at the base of the zone – *Zonocostites ramonae, Psilatriporites sp, Brevicolporites guinetii, Retimonocolpites sp, Fenestrites spinosus, Cyperaceapollis sp, Echitriporites formosus, Multiareolites formosus.* Species first appearing at the top of the zone – *Striatricolpites catatumbus, Retitricolporites sp, Nympheapollis clarus, Elaeis guineensis, Psilastephanocolporites sp.* Species last occurring within the zone – *Cyperaceapollis sp*. Species last occurrence at the top of the zone – *Striatricolpites catatumbus.*

Remark: Species having their first appearance are difficult to differentiate because this zone represents the top of the sampled locations across the lateral geographic distribution. Base of the zone is marked by abundance of *Zonocostites ramonae.* Increase in abundance of mangrove pollen (*Zonocostites ramonae*) within the zone. Rich in Pteridophyte spores towards base of the zone and presence of *Elaeis guineensis* pollen.

(ii) Zone II: *Echitricolporites spinosus*
Subzone: Miocene – Pliocene
Locations 20 – 22

Definition: Species first appearing at the base of the zone – *Retitriporites amazoensis, Retitriporites heterobrochati, Aletepollenites sp, Retistephanocolporites williamsi, Acanthacea sp, Cyperapollis sp, Monoporites annulatus, Multiporopollenite sp, Cretacaeiporites mulleri, Retistephanocolpites gracillis, Echitricolporites spinosus.* Species last occurring within the zone – *Brevicolporites guinetii, Retimonocolpites sp, Retitriporites amazoensis, Retitriporites heterobrochati, Retistephanocolporites williamsi, Cyperapollis sp, Monoporites annulatus, Multiporopollenites sp, Cretacaeiporites mulleri.* Species last occurring at the top of the zone – *Cyperaceapollis sp.*

Remark: Rich palynomorph assemblages. Base of the zone is marked by decrease inabundance of *Zonocostites ramonae* and increased representation of *Brevicolporites guinetii* (Palm pollen), *Echitricolporites spinous* and *Psilastephanocolporites sp.* Increase of the alga *Concentricyst circulus* from top to base of the zone.

(iii) Zone III: *Echiperiporites sp*
Subzone: Miocene – Pliocene
Locations 21 – 34

Definition: Species first appearing at the base of the zone – *Magnaperiporites spinosus, Echiperiporites sp, Psilamonocolpites sp, Psilaperiporites minimus, Ctenolophonidites costatus.* Species last occurring within the zone – *Magnaperiporites spinosus, Psilamonocolpites sp, Psilaperiporites minimus, Ctenolophonidites costatus.* Species last occurring at the top of the zone – *Brevicolporites guinetii, Retimonocolpites sp, Retitriporites amazoensis, Retitriporites heterobrochati, Retistephanocolporites williamsi, Cyperapollis sp, Monoporites annulatus, Multiporopollenites sp, Cretacaeiporites mulleri.*

Remark: This zone is characterized by the presence of *Echiperiporites sp* and a slight increase in *Multiareolites formosus.* It is relatively low in pteridophyte spores.

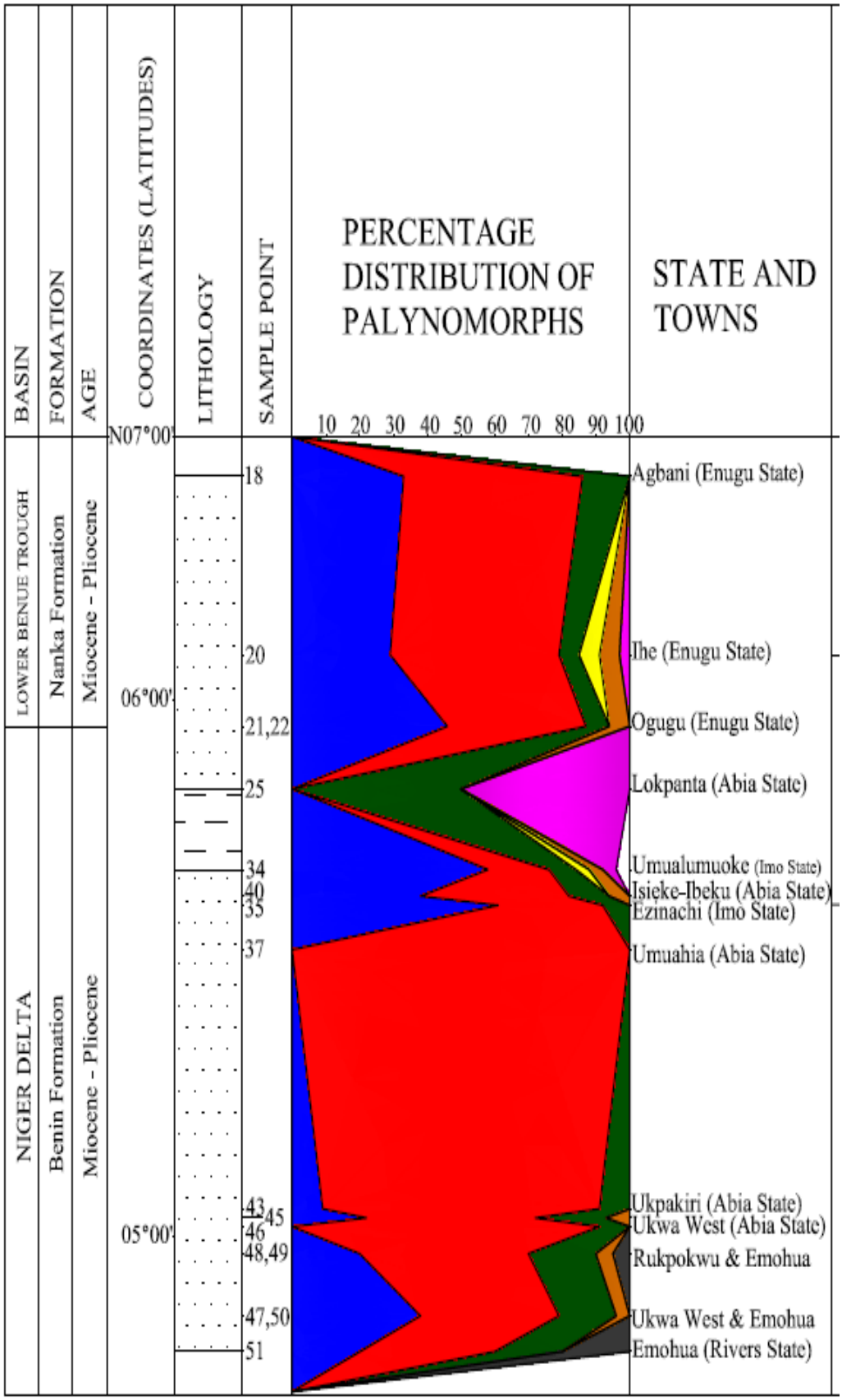

Figure 3: Percentage distribution of palynomorphs across the sampled locations, showing variations from north to south latitude

RESULTS AND DISCUSSION

Paleoenvironment/paleoecology Pollen and pteridophyte spores are generally dominant throughout the locations [4,8]. Fungal spores show lower values and aquatic elements (freshwater and marine together) are only important in the Nanka Formation (between zones I – II). Characteristics of the Nanka Formation are the mangrove elements (*Zonocostites ramonae* and *Psilatricolporites sp*), the marine representatives (dinoflagellates, acritarchs, foram test lining and diatom) and the fresh water alga *Concentricyst circulus*, indicating sedimentation in coastal and shallow marine environments close to mangrove vegetation. *Concentricyst circulus* are more typical of freshwater environments but can also occur in slightly brackish water due to its tolerance to salinity [12]. The main elements that characterize the Benin Formation are pollen and spores (*Selaginella myosurus, Psilatricolporites sp, Zonocostites ramonae, Retitricolpites sp*). Fungal spores, dinoflagellates, acritarchs, diatoms and foram test lining are also represented and the fresh water algae *Concentricyst circulus* which are consistent with the presence of alluvial environments characterized by fresh water swamp.

(i) ZONE I The high percentages occurrence of *Zonocostites ramonae* in this zone was an indication that mangrove swamp vegetation was well established during the period covered by the location, thus conforms with the transitional paleoenvironment. It also shows that there was a rise in sea level with the coast predominantly taken over by *Zonocostites ramonae*. As far as the *Rhizophora* pollen type is unique and cannot be confused with pollen from other taxa [14]. This conclusion was further strengthened by the very low percentage occurrence of *Elaeis guineensis* pollen of fresh water elements in the zone. Other vegetation community in existence during this period is the presence of *Fenestrites spinosus*, *Multiareolites formosus* that represent the savanna elements. The increased occurrence of fungal spores in this zone supports the suggestion that conditions were adverse during this period. Fungal spores are a means of surviving unfavourable environmental conditions.

(ii) ZONE II The predominant vegetation during the period covered by this zone was fresh water as indicated by the predominance of *Echitricolporites spinosus, Brevicolporites guinetii.* Furthermore, a reduced representation of mangrove vegetation confirmed the zone to be of fresh water vegetation. The minor alteration of *Monoporites annulatus* (grass pollen) further inland with the ground covered by pteridophytes probably reflects the shifting boundary between forest and savannah in the lowlands. This zone thus marks the beginning of the alluvial plain paleoenvironment across the lateral geographic distribution in the locations.

(iii) ZONE III There was an appreciable occurrence of *Multiareolites formosus* and *Echiperiporites sp* indicating fresh water swamp forest. This period is significant of a relatively low occurrence of *Zonocostites ramonae* and a predominant cover of grasses was well established probably in the coastal areas. It is well known from the present vegetation complexes in the tropics, an abundance of grasses in the tropics is typical of more open vegetation such as the savanna or in river valleys [4]. This is typical with the characteristics of an alluvial plain environment with a fall in mangrove vegetation, noteable presence of fresh water swamp forest with an expansion of the savanna representative.

CONCLUSION

Forensic palynology is still in its infancy. It remains untried in many regions of the world and could be used in crime investigation. The primary aim of this research work is to generate palynological baseline data for forensic studies in Nigeria. The result of this work indicate that a total number of 17 samples which were collected across a geographic spread from north to south which yielded a range of palynomorphs assemblage data. The distribution of palynomorphs varied considerably from one geographic location to another. Pollen and spores preservation was good in most of the samples and the microflora was rich and well diversified. The total number of palynomorphs counted per sample ranged from 3 to 221 with the lowest abundance at sample 25 and the highest abundance at samples 21 and 22. The percentage composition was calculated thus: numerical count of each palynomorph group in a sample divided by the total count, multiplied by 100.

The pollen and spores were gradually increasing from the north to south across the latitudinal geographic spread with a negligible number of marine representatives, indicating sedimentation in terrestrial environment. Five biozones were drawn from the results which indicate alluvial to transition paleoenvironment and the paleoecology infers fresh water to mangrove swamp vegetation. Zones I and IV are marked by an abundance of mangrove pollen (*Zonocostites ramonae* and *Psilatricolporites sp* respectively) with an increased occurrence of fungal spores in the zones. Hence, a transistional paleoenvironment is inferred to these zones. In zones II, III, IV, there is abundance in *Echitricolporites spinosus*, *Echiperiporites sp* and *Retitricolpites sp* respectively. Zone III shows a relatively low percentage of pollen and spores assemblage, but a higher percentage of fungal spore and foram test lining

throughout the study area. These zones are therefore confined to the fresh water swamp paleoecology in an alluvial plain paleoenvironment

Plates showing Palynomorphs

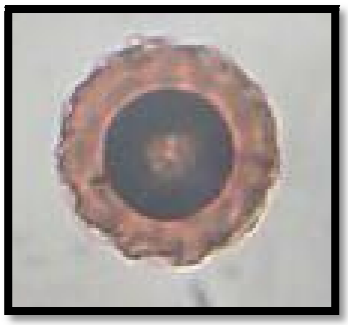

Plate 1. ***Cingulatisporites sp***

Plate2. ***Leiotriletes sp***

Plate 3. ***Fungal spore***

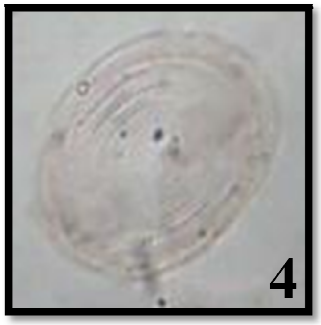

Plate 4. ***Zonocostites ramonae***

REFERENCES

[1] D.P, Adams,and P.J., Mehringer,. *Jour. of Research of the United States Geol. Surv.*,**1975**,3,733-736.
[2] J.R.L, Allen,. Sedimentation in the modern Delta of the River Niger, West Africa Proc. 6th Internal coaf. Sedimentologist,**1965**, 26-34.
[3] L.C Amajor.,. *Sedimentary Geol*. **1976**, 49,1-20.
[4] A.A, Avbovbo, *Am. Assoc. Petrol. Geol. Bull*., **1978**, 62, 295-306.
[5] J.M Benkhelil,. *Bull Centres Research Explor. And Prod.* Elf Aquitaine, **1988**, 12.
[6] V.M, Bryant, J., Jones, and D. Mildenhall,. *Palynology*,**1990**, 14, 193-208.
[7] K.C, Burke, *African Geology*., Nigeria.**1972**, 187 – 218.
[8] K.C Burke,. *American Assoc. of Petro. Geol.*, **1972**, 56, 1975-1983.
[9] H. Doust,, and E. Omatsola,.. *Amer. Assoc. Pet. Geol*, **1990**, 48, 201-238.
[10] C.M, Ekweozor, and N.V, Okoye,. *Amer. Assoc. Petrol Geol.*,**1980**, 20, 1251-1258.
[11] G. Erdtman., Handbook of Palynology; Hatner Publishing Co., New York, **1969**, 486.
[12] B.D Evamy,.,J.Haremboure,. *Amer. Associ. of Petrol. Geol.*, **1978**, 62,1-39.
[13] K.,Faegri, P.E Kaland.,. Textbook of pollen analysis, by Faegri K and Iversen J; 4th edition, John Wiley and Sons, New York,**1989**, 328.
[14] E.J Frankl,, and E.A.,Cordry,. The Niger Delta oil province – recent developments onshore and offshore: Mexico City, 7th World Petroleum Congress Proceedings, **1967**, 1b, 195-209.