Data Acquisition For Forensic And Palynological Studies: A Case Study From Nigeria.

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Abstract: Palynological baseline data acquisition and analysis were carried out within longitude $6°3' - 9°4'$E and latitude $8°23' - 4°45'$N spanning the area from middle to southern Benue Trough for the purpose of forensic studies. A total of seventeen samples were collected from Northern to Southern town axis from Akunza Migili Lafia town to Ikot Ekpene road Abia state. A lithologic section was prepared using latitude from the northern to southern axis. The lithologic and palynological analysis based on field samples were tied up with the geologic formation based on published geologic maps. The rocks were compose of shale and sandstone, therefore found to traverse within middle Benue Trough (Akunza Migili Lafia Nasarawa State-Oturkpa Benue State), lower Benue Trough (Nkalagu- Enohia-Nkalu Afikpo Ebonyi State) and Niger Delta (Abia state boundary between Umuahia and Imo State-Ikot Ekpene road Abia State) from a geographic spread between longitude $6°3' - 9°4'$E and latitude $8°23' - 4°45'$N. Palynologic analysis yielded; *Echitricolpites spinosus, Fenetrites spinosus*; from middle Benue Trough, *Echimonocolpites rarispinosus, Cingulatisporites ornatus, Macrotyloma brevicaules, Tubistephanocolpites cylindricus, Hexaporotricolpites emelianova, Retidiporities magdalenensis, Retistephanoclpites gracillis, Elaeis guineensis*; from Nsukka Formation, *Multiarolites formosus, Echitricolpites spinosus, Nympheapollis clarus;* from Benin Formation. These data were used to generate palaeogeographical distribution of pollen, spore, fungal spore, dinoflagellate, acritarch, foram test wall lining and diatom. The palaeogeographical distribution charts were converted into percentage charts which shows the comparative occurrences of the different palynomorph groups. These are represented in step-like manner indicating the entrance of two to three new species marks a biozones. The occurrences of environmental diagnostic palynomorphs within a specific latitude range leads to the interpretation of the environment of deposition indicating sedimentation from alluvial plain to transitional/tidal zone and the diagnostic palynomorphs shows that the paleoecology consists of rainforest to mangrove.

Index Terms: Palynology, Benue Trough, Nigeria, Forensic, Baseline , Paleoenviroment.

1 INTRODUCTION

This research work document the data gathering effort in erecting a comprehensive data base for Benue Trough, Nigeria's Sedimentary Basin. The research work on forensic palynology has been carried out in the western world, notably U.S.A and New Zealand but has remained untried in Nigeria. The term forensic palynology is the application of pollen and spore in crime detection. This has been used in some countries extensively to control crime; this is the first time the research of this kind will be carried out in Nigeria, while palynology is the study of palynomorphs. Therefore, this study will serve as a frontier in forensic research work which will help in generating a data base for furher research work in forensic palynology.

1.1 Aims and objectives of the study

The aim of this study is to generate a comprehensive data baseline of pollen/spores and dinoflagellate within the study area, interprete Paleoenviromental of deposition of the study area using identified diagonistic palynomorphs.

1.2 Location and accessibility

The study area is located between latitudes $6^0$00'N and $6^0$30N of the equator and longitudes $7^0$20'E and $7^0$30E of the Greenwich meridian.

2.0 METHODOLOGY

This research work undertook both field work and laboratory study approach

2.1 Sample collection

A total number of seventeen samples were collected using the "pinch" method (Adams and Mehringer, 1975): 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.

2.2 Palynological preparation:

The pre-treatment of the samples with various acid combinations include removal of unwanted carbonate material by washing with 10ml diluted hydrochloric acid as well as further treating the residue with 40% hydrofluoric acid and boiling hydrochloric acid to dissolve all silicates and silicofluoride gel respectively.. Subsequently, three drops of safarin'o dye solution dropped into the residue to stain the palynomorphs and left for few minutes to allow for proper mixing and then pipette into a cover slip glass slide on top of the hot plate until dryness and was ready for palynological microscopic study using a microscope connected to computer in which snapshot were taken. (see list of Plate 1-4)

3.0 PRESENTATION OF RESULT

The results have been separated into Lithology, Percentage distribution of palynomorphs, Pollen assemblage zones, Paleoecology and Paleoenvironment (See figure 1).

3.1 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 five horizons on the basis of textural characteristics. These units from top to the base. 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 color (see figure 1)

3.2 Percentage distribution of palynomorphs

The distribution of palynomorphs varied considerably from one geographic location to another. 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 analyzed samples ranged from 1 to 158, with the lowest abundance at sample 23 and 24, while the highest abundance at 17**.**

3.3 Pollen Assemblage Zonation.

The pollen diagram shows (see fig.1 and 2) the most important taxa for different locations of the study area. These have been classified according to their paleoecological zone and thus consider being ecologically significant the species were not ubiquitous, but belonging to distinct ecological zones. Furthermore they have been identified to species level or to types identifiable with specie according to marked vegetation change reflected in the pollen diagram (fig. 1) pollen zone were recognized in the studied sections.

(i) Zone 1
Family: *Asteraceae* (compositae)
Echitricolporites spinosus

Subzone: Late Miocene-Pliocene
Location 3-15

Definition: species first appearing at the base of the zone; *Psilatricoporites sp, Echritricolporites Spinosus, Retitricolporites sp, Fenestries spinosus*.

Species first appearing at the top of the zone; *Psilamonocolpites sp, Striatricolpites catatumbus, Echiperiporites sp, Retidiporites sp.*

Species last occurring within the zone; *Echitricolporites spinosus.*

Species last occurring at the top of the zone;*Psilamonocolpites sp.*

Remark: Rich in palynomorphs assemblages, species are difficult to differentiate because this zone represents the top of the sampled location across the lateral geographic distribution. Although some of the genera which produce this pollen type a pantropical distribution. The occurrences in the Neogene appear to be restricted to the Caribbean area and Nigeria. It is possible that the extension of the range to the indo-malesian area took place relatively late Mio-Pliocene. Germeread, J.H., Hopping, C.A. and Muller, J. (1968). But not rich in pteridophyte spore toward the base of the zone.

(ii) Zone II
Family: *Arecaceae*
Elaeis guinensis

Subzone: Late Maastrichtian-Early Miocene
Location 15-26

Definition: Species first appearing at the base of the zone; *Peregrinipollis nigercus, Elaeis guineensis, Brevicolporites grunetti.*

Species first appearing at the top; *Zonocostites ramonea, Psilatricolporites sp, Echritricolporites spinosus, Retitricolporite sp, Fenestrites spinsus.*

Species last occurring within the zone. *Echitricolporites spinosus*.

Species last occurring at the top of the zone: *Zonocostites ramonae.*Remark: Rich in pteridophytes, it shows a slight increase in pteridophytes; the base marks a quantitative increase in *Elaeis guneensis*

(iii) Zone III Family:
Ctenolophonaceae Retistephanolcolpites grecillis

Subzone: Maastrichritian
Location 26-19

Definition: Species first appearing at the base of the zone; *Retistephanocolpite, gracillis, Psilastephanocolpite leavigatus, Auriculiidetes, sp, Ariadnaesporites sp, Psilatriporites sp, Acanthaceae sp, Fenestris spinosa, Monoporites annulatus,*

Species first appearing at the top of the zone; *Echipriporites sp, Nympheapollis clarus, peregrinipollis nigerics, Elaeis guineensis, Brevicolporites grunetti*.

Species last occurring at the top of the zone; *Echiperiporites sp*.

Remark: Rich in palynomrphs assemblage, at the base of the zone is the top of the pteridophyte spore minimum (ie, at an increase in abundance of pteridophyte spore. Presence of *Brevicolporites guinetti*, pollen in association with *Monoporites annulatus*.

4.0 DISCUSSION OF RESULT

(i) Zone 1: The high percentage occurrence of pollen and spore suggest a period of unstable environmental condition which might be cause on the one hand by variations in the extent and intensity of the alluvial plain fluctuations in the occurrence of Asteraceae (compositate) and widespread in the present day tropics, but are more common in open vegetation types, such as the savannah or higher montane vegetation than in the closed lowland rainforest (Germeraad, Hopping and Muller 1968). By extension to the coast as well as by drier conditions inland resulting in the presence of freshwater swamp/rain forest and extensive expansion of savanna southwards [20].

(ii) Zone II: The high percentage occurrence of pollen in this zone was an indication that lowland forest was well established during the period covered by this section. It also shows that there was an extent and intensity of alluvial plain resulting in fluctuations in the occurrence of *Elacies guneensis (*Arecaceae*)* this conclusion was further strengthened by the very low percentage occurrence of fungal spore and total absence of the pollen of other savanna elements in the zone. Other vegetation communities in existence during this period were fresh water swamp forest and lowland rain forest

suggesting wet and warm climate for this period.

(iii) Zone III: The period covered by this zone can be suggested to be a period of rapid and unstable climatic conditions culminating in rapid sea-level change (rise and fall), this may account for the rapid changes noticed in the pollen assemblages in this zone particularly, Riparian. However, the non-occurrence of montane forest vegetation typified by *Podocarpus Miliajanus* in this zone indicates that the climate was probably more open. Furthermore, it can be suggested that during the lowering of the sea level, there was an extensive development of savanna vegetation indicated by the highest percentage occurrence of Acritarch and fungal spore in this zone. This unstable wet/dry period may have accounted for the extensive development of the savanna as Germeraad et al, (1968) have reported that a drier climate with marked rainy season favors the development of extensive grass areas. Prevalence of wet conditions during this period was corroborated by the existence of fresh water rainforest [21].

4.1 Paleoenvironment and Paleoecology

Pollen and spores are generally dominant throughout the whole section Pollen and fungal spore show a high values, and aquatic elements (freshwater and marine togetherr) are only important within certain locations (pollen) in the percentage diagram a clearer definition can be seen than using only presence/ absence data. Dominant and less abundant show little variation across the section although pollen and spore is slightly more abundant in the location 3 to location 25, 16, and 26 (*Elaeis guinensis – Echitricloporites spinosus* zone*)*. Within location 23 and 24 were non deposit of pollen and spore palynormorph but with abundant of fungal spore and acritarch which shows a clear distinctive characteristic of freshwater/rain forest (*Retistephanocolpites gracillis*) characteristic of the Benin formation are the mangrove elements, *Zonocostites ramonae* and *Psilatricolporites sp*, the marine representative (foraminiferal test livings, dinoflagellate, acritarchs and diatom), indicating sedimentation in coastal and shallow marine environments, close to mangrove vegetation, although more typical of freshwater environment, can also occur in slightly brackish water, due to its tolerance to salinity (Rull, 1997b). The main palynomorph that characterize theNsukka Formation and member of the Maastrichtian are (*Aletepollenites sp, Multiareolites formosus, Magneperiporities spinosus, Psilatricolporites sp, Echitricolporties spinosus, Retitricolporites sp, Fenestries spinosus, Elaeis guinnesis, Monoporites annuilatus, Retidiporites magdalenensis, Constructripollenites ineffectus, Echimonocolpites rarispinosus*. This is consistent with the presence of alluvial plain environments flooded by freshwater. From the vegetation point of view, the Benin formation with age Miocene–Pliocene, it is considered to be a mangrove assemblage which show a high numerical count of *Zonocostites ramonae* which is compose of palynomorph of vegetation flooded by fresh low salinity water and is characterize by transitional / tidal zone environmental conditions. But fungal spores represent another type of coastal swamps (palm/ fern swamps common in the Neotropics) in the freshwater swamp/rain forest of alluvial plain beyond the limit of tidal influence. Therefore, this assemblage is thought to represent the more inland vegetation required in this research work the pollen from mangroves was believed to have substantially increase to a very high grains, probably transported landward by wind: the first zone which is *Echitricolporites spinosus*; therefore, the significant could be due in part to environment and evolutionally factors, considering that (1) it could have originated in these environments, (2) the major transport agents for playnomorphs in alluvial plain are wind and (3) were deposited in more distal environments freshwater swamp/rain forest, this can be explained by an increased of wind capacity. Current paleogeographic reconstructions support these points. Therefore in the study area more work is needed to establish or infer a better formational history. Similar numbers of this pollen occur only inland, in freshwater environment, most probably due to wind transport (Muller, 1959; ten Broek and Nijssen, 1971).

5.0 CONCLUSION

This study of the palynological baseline data acquisition from middle to south Benue Trough for forensic studies has characterized the environment and biological change that have taken place in the past. The goal of these works is to understand the event of the past, present and future behavior of the earth system using palynological tools. Accordingly, the most primary aim of this research work is to generate a baseline data of palynomorphs within the study area for forensic investigations in Nigeria. The outcome result will serve as reference point or “baseline” for which further forensic studies could be carried out. It also shows that palynologic record and the environment have a direct relationship with respect to vegetation and climate. The study identified six pollen zones on which the palaeoenvironment and paleoecology were inferred; with the palaeoenvironment ranging from alluvial plain to transitional/tidal zone while the paleoecology is within the freshwater swamp/rain forest to mangrove vegetation respectively. Further research will be required to identify and include the younger deposit identified with the presence of *Echitricolporties spinosus* in zone I, of the stratigraphy of the middle Benne Trough Nigeria.

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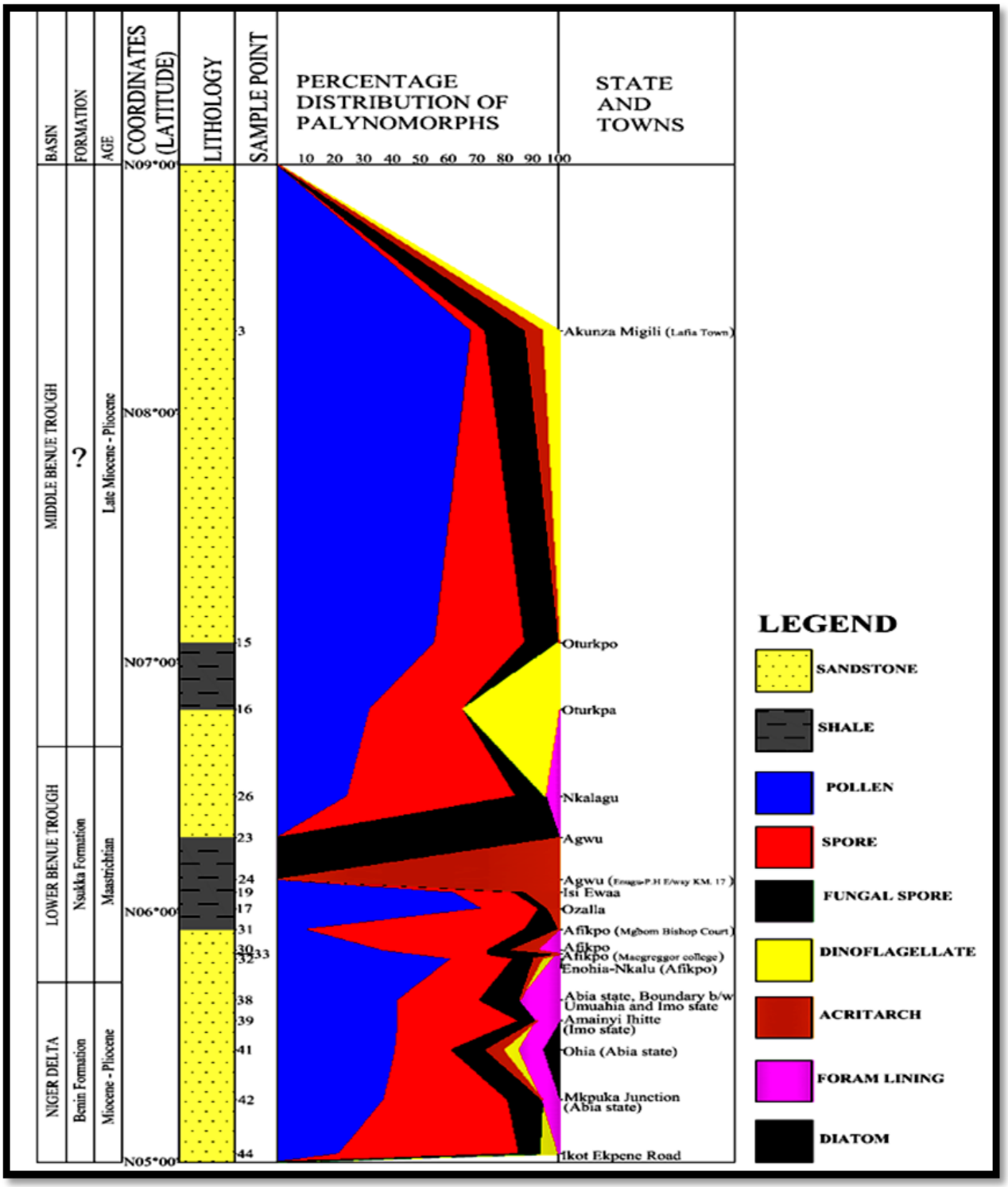
Figure 1: Percentage distribution of Palynomorphs



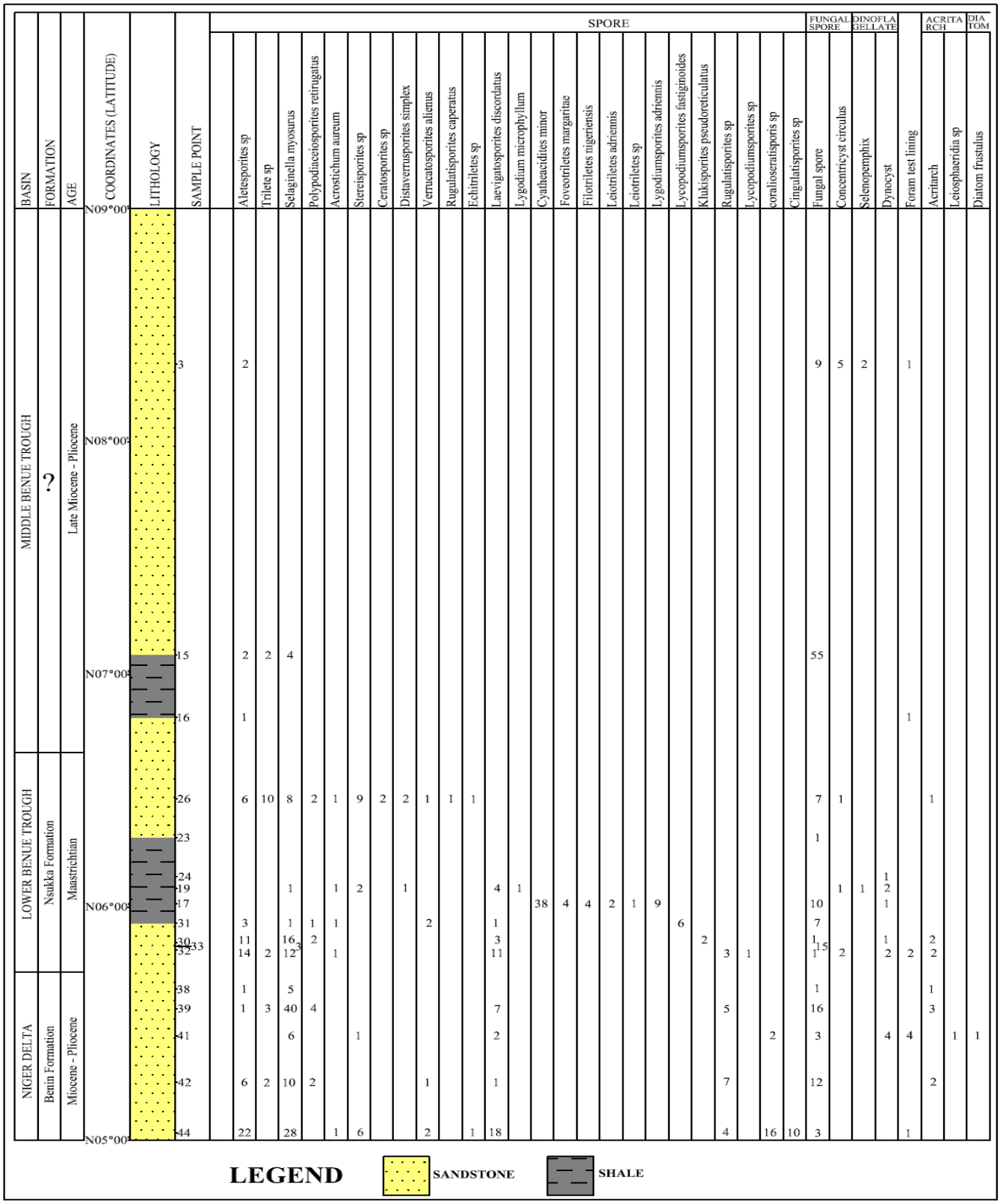


Figure 2: A section of Paleogeographical distribution of Pollen from North to South Latitude

LIST OF PLATES SHOWING PALYNOMORPHS IN THE STUDY AREA

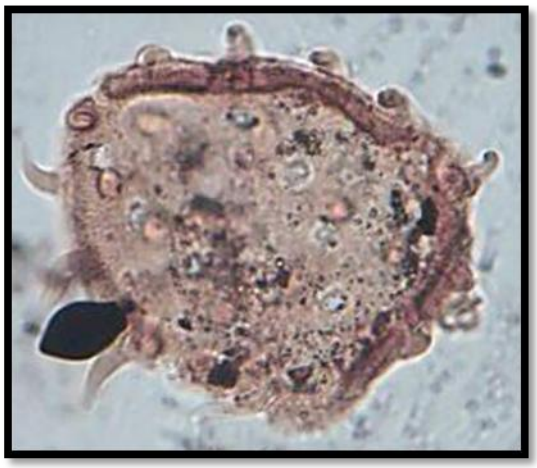


Plate 1 Polyadopollenite sp

PLATE 2 Trilete sp

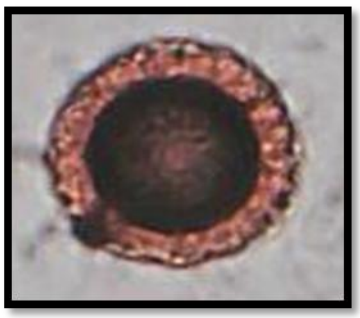


Plate 3 Cycadopite sp

Plate 4 Fungal Spore