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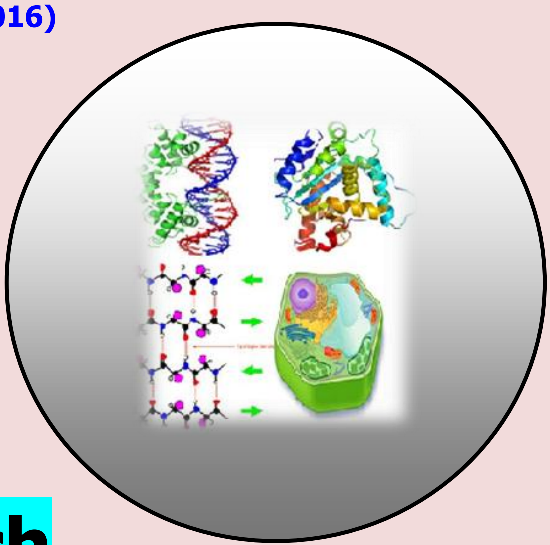

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RESEARCH PAPER

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Palynological age Dating of the Early-Middle Maastrichtian Mamu Formation of Well- B, Anambra Basin, Southeastern Nigeria

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ABSTRACT

Mamu Formation is very important in Anambra Basin, Nigeria because it contains adequate source rock and large deposits of coal measures. Its investigation is posited on the determination of relative geologic age and paleoenvironment of deposition of lithofacies different from typical Mamu lithofacies sequence. Sixty four ditch cutting samples were analyzed with microscope for lithologic units differentiation based on distinctive parameters such as colour, composition, grain size, sorting, roundness, fossil content, presence of authigenic minerals, calcite and diagenetic effects. Palynological analysis was carried out through laboratory processes such as digestion, sieving with 5µm mesh, debris floatation with 2.1g/ml heavy liquid, oxidation and mounting of the macerals on glass slides for quantitative count of pollen, spores dinoflagellates, algae, fungal spores and other important organic matter present.

The lithologic description yielded seven lithologic units which include siltstone, sandy gypsiferous shale, shaly gypsum, gypsum, shale, sandy shale and gypsiferous shale. The stratigraphic sequence encountered is different from typical Mamu Formation lithofacies sequence because it lacks coal units and it contains gypsum and its heterolith mixture with shale and sand particles. Two palynological zones were erected: 1. Foveotriletes margaritae assemblage zone 1, characterized by uphole continuous occurrence of Foveotriletes margaritae; restricted forms such as Retimonocolpites sp. 2, Trichotomosulcites sp.1, stephanocolporate pollen, Auriculiidites reticulatus, Monocolpopollenites sphaeroidites, Retitricolpites gigeometti. Other important forms present include Periretisyncolpites giganteus, Retidiporites magdalenensis, Proxapertites cursus, Syncolporites subtilis, Longapertites marginatus, Cingulatisporites ornatus, Zlivisporites blanensis, and Monocolpites marginatus; 2. Longapertites marginatus acme zone 2, marked by acme abundance of Longapertites marginatus within the interval, high frequency of Monocolpites marginatus, Periretisyncolpites sp., and Periretisyncolpites giganteus. The two zones show relatively moderate abundance of organic walled microplanktons such as Oligosphaeridium sp., Oligosphaeridium simples, Florentinia sp., Trichodinium delicatum, Andalusiella polymorpha, Andalusiella laevigata, Deflandrea, Isabelidinium sp., Cyclonephelium sp., Caningia sp., Phelodinum bolonienae, and Senegalinium spp. Peridinacean forms constitute the bulk of the dinoflagellate cysts recovered, thereby suggestive of marginal marine environment of deposition for sediments within the stratigraphic interval studied.
Keywords: Mamu, Lithologic sequence, Acme zone, Microplakton and Peridinacean forms.

INTRODUCTION

Anambra Basin is an intracratonic basin situated in the inland part of Nigeria. The basin is a matured basin capable of producing oil and gas. Due to its proliferation in fossil fuel such as oil, gas and coal its importance is immeasurable; as a result of this it continues to attract investigations in terms of hydrocarbon potential, sedimentological architecture and biostratigraphic relationships. It should be noted that due to the ambiguity nature of the sedimentary systems in the basin, it is very difficult to correlate facies across faults and also from one geographic location to another solely based on its facies characteristics.

The Mamu Formation is one of the important formations in the Anambra Basin that has attracted a lot of attention from the geologists based on its economic importance in terms of occurrence of coal interbeds and being a potential source rock for hydrocarbon generation within the basin.

The earliest published work on the Mamu Formation was that of Kogbe, (1989) and Obi, (2000) who described the formation as overlying the Nkporo Shale in the Early Maastrichtian. However, its Lithological composition was described to vary from siltstones, shales, coal seams and sandstones (Kogbe, 1989; Nton and Bankole, 2013). The age dating has been described to vary from Early to Middle Maastrichtian (Ogala *et al.,* 2009).

The crust of this investigation is based on lithological sequence that is not characterized by coal and other known facies that typify Mamu Formation but rather composed of facies that varies from shale, shaly gypsum, gypsiferous shale, siltstone and heterolithic facies of shale and sand. Since this is a distinctive sequence of lithofacies recovered in subsurface exploration well located out of the center of the basin, it becomes imperative to investigate and document its palynomorph contents and to compare its age relationship to the well established work of Ogala *et al.,* (2009) on shale and coal measures of Mamu Formation recovered from the center of the basin.

Geologic Setting

Sedimentation history of the Anambra Basin is related to the Lower Benue Trough evolution which is usually linked to the separation of the Gondwana during the Middle Cretaceous time (Nwachukwu, 1972). The evolutionary trend of Anambra Basin is patterned by east to west shifting of the depocenters (Akaegbobi, 2005). The initial area of active sedimentation was said to be located in the Abakaliki Trough from Aptian to Santonian. However, recent studies have shown that the active sedimentation was not restricted to the Abakaliki Trough alone but also took place within the graben of the faulted block segments of the Anambra Basin (Ola-Buraimo, 2012). Active sedimentation started in Albian and not restricted to Abakaliki Trough but rather distributed across the basin. This is demonstrated in the starigraphy of Asu River Group as the oldest sediment in Anambra Basin (Ola-Buraimo and Akaegbobi, 2013c). The other pre-Santonian formations are the Eze-Aku and Awgu Formations dated Late Cenomanian to Turonian and Coniacian ages respectively (Ola-Buraimo, 2013a, 2013b).

MATERIALS AND METHODS

Lithologic description of sixty four (64) ditch cutting samples were carried out by taking into consideration parameters such as colour, grain size, roundness, sorting (related to western Atlas Core Laboratories) and other features such as presence of macrofossils, diagenetic effect and presence of calcite or authigenic minerals such as glauconiteor pyrite. However, twenty six samples out of the sixty four samples were selected at 27.4 m interval for palynological slide preparation. Indurated samples were crushed with mortar and pestle in order to enhance maximum recovery of pollen and spores. The crushed samples along with the friable ones were initially treated with dilute hydrochloric acid (HCL, 10 %) in order to eliminate carbonate substance present in them. They were later soaked in 60 % hydrofluoric acid (HF) for digestion. The samples were not oxidized in order to avoid corrosion; but they were sieved with 5µm mesh in order to maximize concentration of miospore grains and towards achieving clean slides for easy identification and photography of important microfossils. The retrieved sample residues were mildly oxidized with Nitric acid (HNO_3), neutralised with Potassium hydroxide (KOH), followed by heavy mineral liquid separation of the macerals using Zinc bromide ($ZnBr_2$) at 2.1g/ml. The collected residue was mounted on two glass slides per sample with DPX mountant. Quantitative absolute counts of encountered taxa were recorded while important types including both pollen and sporomorphs were photographed with Nikon Koolpix P6000 digital camera (Ola-Buraimo and Abdulganiyu, (2017).

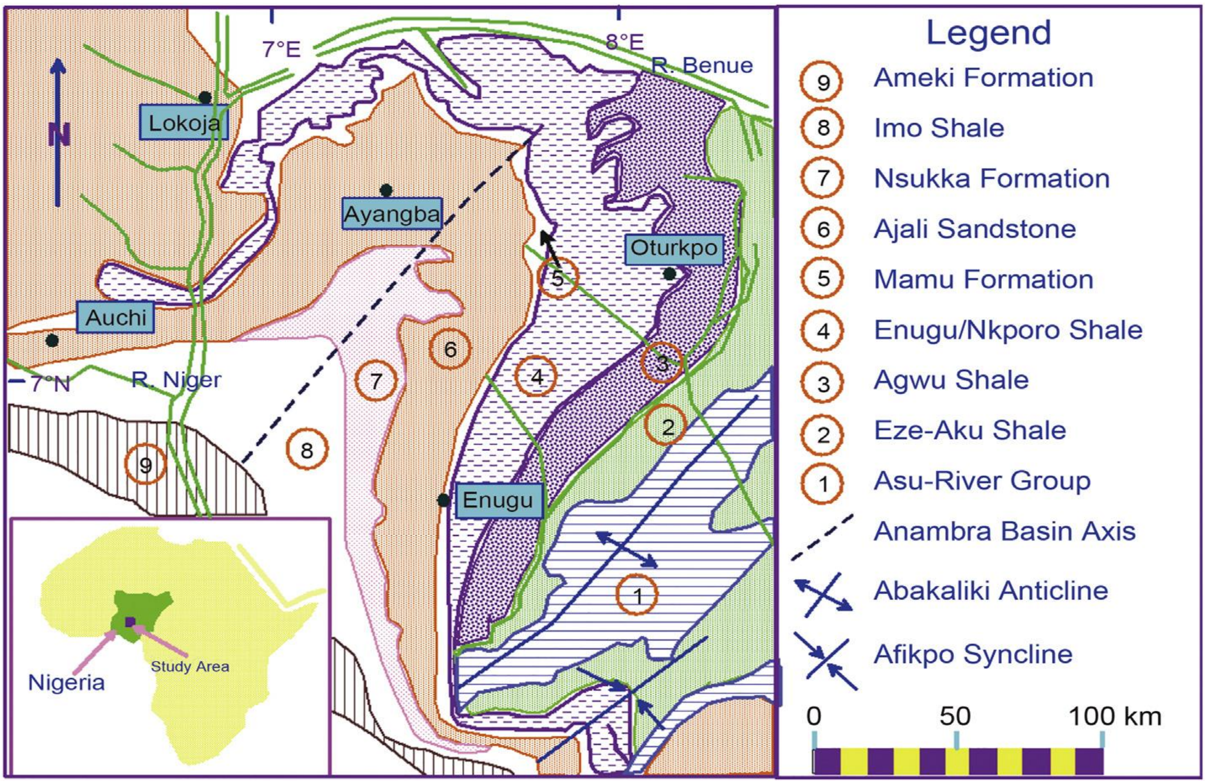

Fig. 1 Geological map of the Anambra Basin showing location of study area (From Nton and Bankole, 2013).

However, Reyment, (1965) indicated that the Anambra Basin became active after the Santonian tectonic event. Anambra Platform started prograding by depositing deltaic facies. The active regime of the Anambra Basin is characterized by the incursion of the marine which deposited mainly dark grey shale; dated Campanian to Early Maastrichtian based on the acme abundance of Milfordia spp and presence of typical Maastrichtian miospores such as *Buttinian andreevi, Foveotriletes margaritae, Cingulatisporites ornatus* and *Periretisyncolpites sp.* (Ola-Buraimo and Akaegbobi, 2012). This formation has been variously dated by early researchers as Campanian-Maastrichtian (Edet and Nyong, 1994) and simply Maastrichtian age (Oloto, 1987). The tectonic activity later subsides and an east-west prograding system developed. The deltaic system became aborted during the Maastrichtian by the commencement of major marine transgression (Akaegbobi, 2005). The Nkporo Shale and the overlying Lower Coal Measures of the Mamu Formation were deposited towards the center of the basin and the adjoining areas. However, the coal facies of the Mamu Formation is restricted and could not be found across the basin; it has been dated Middle–Upper Maastrichtian age (Ogala *et al.,* 2009). The deltaic system was aborted during the Maastichtian by the commencement of major marine transgression (Akaegbobi, 2005). The other younger formations include Nsukka Formation date Late Maastrichtian age (Bankole and Ola-Buraimo, 2017); others include Imo Shale (Paleocene); Ameki Formation (Eocene) and Ogwashi Formation dated Late Miocene-Pliocene (Ola-Buraimo and Akaegbobi, 2012); this was finally capped by Benin Formation (Nwajide, 1990; See Table 1).

RESULT AND DISCUSSION

Palynological Zones

The twenty five samples analyzed for both quantitative and qualitative data collection yielded fairly high abundance and diversity of pollen and spores; while the organic walled microplanktons are moderately distributed within the stratigraphic interval considered for this research. The interpretation of the analyzed samples was based on occurrence of marker palynomorphs, association of important fossils and relative quantitative appearance of key fossils. One formal zone of *Foveotriletes margaritae* assemblage zone belonging to Germeraad et al. (1968) and *Longapertites marginatus* acme zone after *Ogala et al.,* (2009) were established.

Table 1. Correlation Chart for Early Cretaceous-Tertiary strata in southeastern Nigeria (After Nwajide, 1990).

AGE	ABAKALIKI-ANAMBRA BASIN		AFIKPO BASIN
30M.Y	**Oligocne**	Ogwashi-Asaba Formation	Ogwashi-Asaba Formation
54.9	**Eocene**	Ameki/Nanka Formation Nsuegbe Sandstone (Ameki Group)	Ameki Formation
65	Paleocene	Imo Formation Nsukka Formation	Imo Formation Nsukka Formation
73	Maastrichtian	Ajali Formation Mamu Formation	Ajali Formation Mamu Formation
83	Campanian	Nkporo Oweli Formation/Enugu Shale	Nkporo Shale/Afikpo Sandstone
87.5	Santonian	Non-deposition/erosional	Non-deposition/erosion
88.5	Coniacian	Agbani Sandstone/Awgu Shale	Non-deposition/erosion
93	Turonian	Eze Aku Group	Eze Aku Group (include Amasiri Sandstone)
100	Cenonian-Albian	Asu River Group	Asu River Group
119	Aptian Berremian Hauterivian	Unnamed Group	
PRECAMBRIAM		BASEMENT COMPLEX	

The established zones have been compared with the work of Van HoekenKlinkenberg (1964), Jardine and Magloire (1965) on the palynology of Senegal and Cote d Voire sediments, Lawal (1982) on Benue Trough sediments in Nigeria, Lawal and Moullade (1986) on Lower Benue Trough palynological zonation, Edet and Nyong (1994) on the Nkporo Formation, Anambra Basin, Nigeria, Ogala *et al.,* (2009) on the coal measures of Mamu Formation, Anambra Basin, Nigeria, Ola-Buraimo (2012) on the palynology of Bornu Basin, northeastern Nigeria, Ola-Buraimo and Akaegbobi (2013b) on the Asata /Nporo Shale sequence in Anambra Basin, southeastern Nigeria. The definition of the biozones established and the bioevents that characterize them are succinctly detailed below.

Zone 1: *Foveotriletes margaritae* Assemblage Zone
Interval: 1844 – 2215m
Age: Early Maastrichtian
Characteristics: The base of the zone is marked by the extinction of *MIlfordia spp., Cupanieidites reticulates* and other older forms such as *Ulmoideipites sp., Cicatricosisporites sp., Retitricolpites gigeometii* which do not exist beyond the limit of the underlying Milfordia spp. acme zone in this well (Ola-Buraimo and Akaegbobi, 2013b). However, at the near base where this biozone commences is characterized by the appearance of *Monosulcites sp. 1, Sycolporites subtilis, Monocolpites sp.3, Monocolpopollenites sphaeroidites, Auriculiidites reticularis, Retimonocolpites sp. 2, Ephedripites sp.,* and *Retimonocolpites sp*. Marker forms such as *Trichotomosulcites sp. 1* (Lawal 1982; Lawal and Moullade 1986) and co-occurrence of *Monocolpopollenites sphaeroidites* and *Stephanocolporites* sp (Jardine and Magloire 1965) show top-hole appearance. These three forms are restricted within this interval and then significantly characterize the Zone 1 (see Figure 1, Table 2).

The near base of this zone is further characterized by the occurrence of *Zlivisporites blanensis* and increase in frequency of *Retidiporites magdalenensis* (2188m). There is continuous presence of strongly important Maastrichtian pollen grains such as *Monocolpites marginatus*, *Syncolporites subtilis*, *Foveotriletes margaritae* (Germeraad *et al.*, 1968), *Monosulcites sp. 1, Longapertites marginatus* and *Inaperturopollenites sp.*

The top of the zone is marked by the final appearance of *Trichotomosulcites sp. 1* (Figure 1, Table2). It is further characterized by relative increase in *Monocolpites marginatus*. Other miospores present are *Cingulatisporites ornatus*, *Retidiporites magdalenensis, Longapertites marginatus, Periretisyncolpites sp.*, and *Leiotriletes sp.*

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At the near top is the increased in abundance of *Periretisyncolpites sp.*, last appearance of *Trichotomosulcites sp.1*; other forms present are the stephanocolporate pollen, *Zlivisporites blanensis, Proxapertites cursus, Monocolpites marginatus, Longapertites marginatus* and *Tricolporopollenites sp*. (Figure 1, Tables 2-3). The interval is further marked by the assemblages *of Longapertites marginatus, Monocolpites sp, Proxapertites cursus,* relative quantitative high occurrence of *Retidiporites magdalenensis; others are Leoitriletes sp, Inaperturopollenites sp,* and *Laevigatosporites sp*.
The assemblages of pollen and spores encountered in the well interval (1844-2215m) are partly similar to those described by Van Hoekenklinkenberg (1964), Jardine and Magloire (1965), Germeraad *et al.*, (1968), Lawal (1982), Lawal and Magloire (1986), Edet and Nyong (1994), all of them dated the assemblage broadly as Maastrichtian age. However, to a higher degree the assemblages of palynomorphs recovered in this interval are similar to those described by Ogala *et al.,* (2009) on Mamu Formation, Anambra Basin, Nigeria and Ola-Buraimo and Akaegbobi, (2013) on upper part of Nkporo Shale, Anambra Basin, Nigeria dated Early Maastrichtian age.

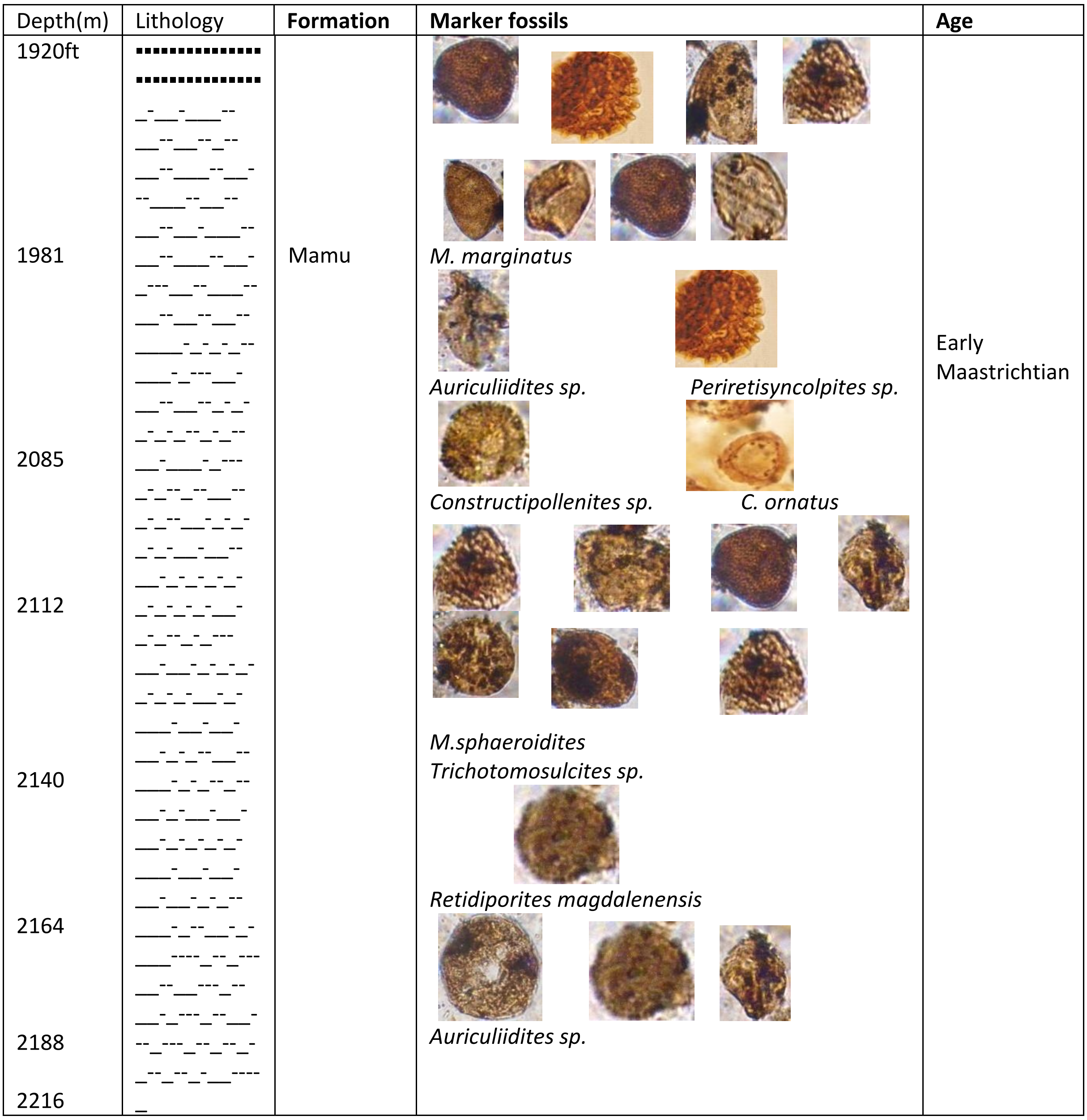

Figure 2. Marker fossil appearances with depth in interval 1923-2216m.

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The dinocyst assemblages include *Isabelidinium sp. 6, (Lawal, 1982); Deflandre sp, Cyclonephelium distinctum, Andalusiella sp., Criproperidium sp. 2, Caningia sp., Senegalinium bicavatum, Pheodinium belonienea* (Schrank, 1984); *Andalusiella polymorpha, Batiachasphaera sp., Senegalinium sp., unidentified dinoflagellate cysts, dinoflagellate peridinoide Forma A. and ?Gouyaulacysta sp*. The presence of the peridinaceans suggests a marginal marine deposit (Schrank, 1984) and their continuous and top stratigraphic presence in this interval may suggest Maastrichtian age for the sediments (Jain, 1972; Schrank, 1984 Oloto, 1987; Edet and Nyong 1994; Ogala *et al.*, 2009).

Therefore, *Foveotirletes margaritae* Assemblage Zone 1 is assigned Early Maastrichtian age based on the continuous occurrence of *Foveotriletes margaritae* as well as the distinctive assemblages of *Trichotomosulcites sp. 1, Monocolpites sphaeroidites, Cingulatisporites ornatus;* lower frequencies of *Monocolpites marginatus, Periretisyncolpites giganteus*, *Longapertites marginatus, Monosulcites sp.*, and *Cyathidites sp.* (Table 2, Figure 1)

Zone 2: *Longapertites marginatus* Acme Zone

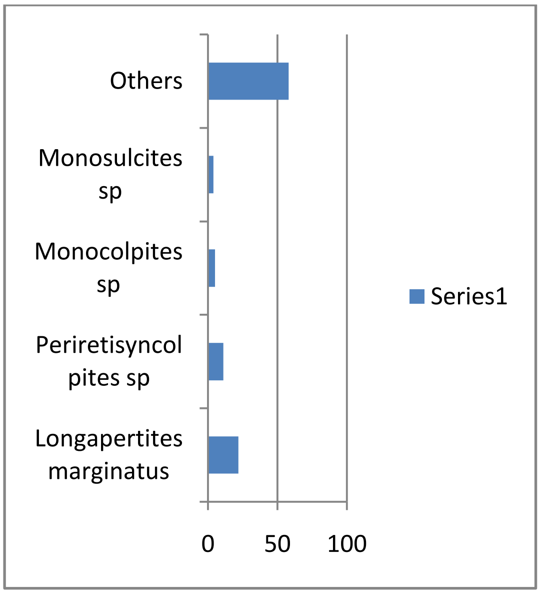
Interval: 1372 – 1844 m

Age: Middle Maastrichtian

Characteristics: The base of the zone is characterized by steady increase in the frequency of *Longapertites marginatus*, *Constructipillenites ineffectus, Tricolpites sp., Retidiporites magdalenensis, Monocolpites marginatus, Foveotriletes margaritae, Proxapertites cursus, Ehitricolporites trangulatus, Periretisyncolpites giganteus, Zlivisporites blanensis* and *Periretisyncolpites sp.* At depth 1817 m *Longapertites margintus* shows maximum development with about 22% of floral content along with other forms that show increase in frequency such as *Periretisyncolpites giganteus* 11%, *Monocolpites sp*. 5%, *Monosulcites sp.* 4%, and *Cyathidites sp.* (Figures 2 and 3).

Among the four taxa the percentage relationship as depicted by the pie and bar charts are as follows: *Longapertites marginatus* 52%, *Retiperisyncolpites sp.* 20%, *Monocolpites sp*. 12% and *Monosulcites sp.* 10% (Figures 4 and 5). This stratigraphic horizon is further marked by the maximum development of *Constructipollenites ineffectus*, and first appearance of *Echitriporites trianguliformis* (Van Hoeken Klinkenberg 1964). The maximum development of these forms may be due to favourable ecological and climatic conditions.

Other miospores present in this zone are the typical Maastrichtian floral which are present in the underlying Zone 1 but continue in appearance into Zone 2- *Longapertites marginatus* Acme Zone; such forms are *Foveotriletes margaritae, Monosulcites sp., Monocolpites marginatus, Cingulatisporites ornatus, Retidiporites magdalenensis, Longapertites microfoveolatus*, and *Proteacidites sp. 5* (Lawal 1982).



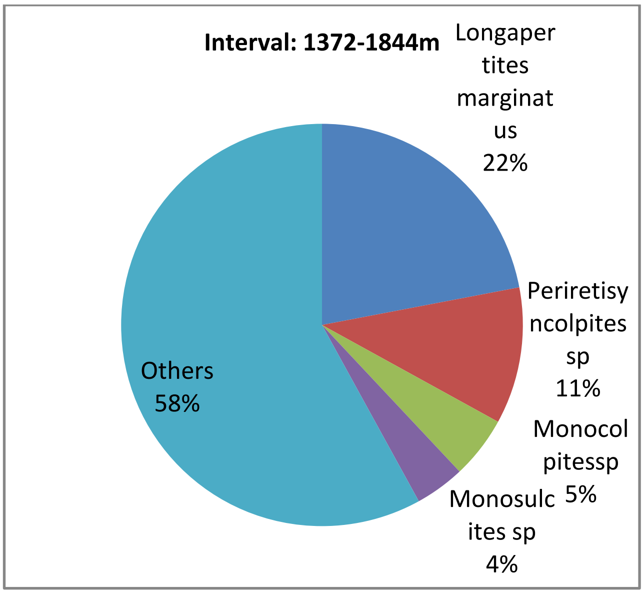
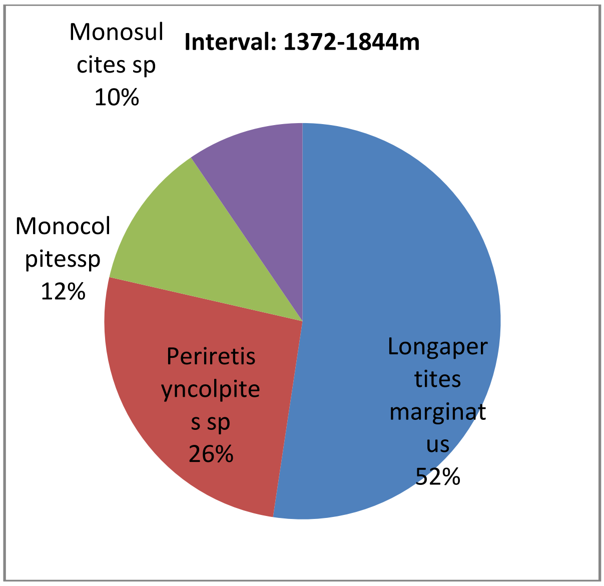


Fig. 2 Frequency of Longapertites marginatus, other forms.

Fig. 3. Percetage of Longapertites marginatus, other Palynomorphs present forms, palynomorphs present.



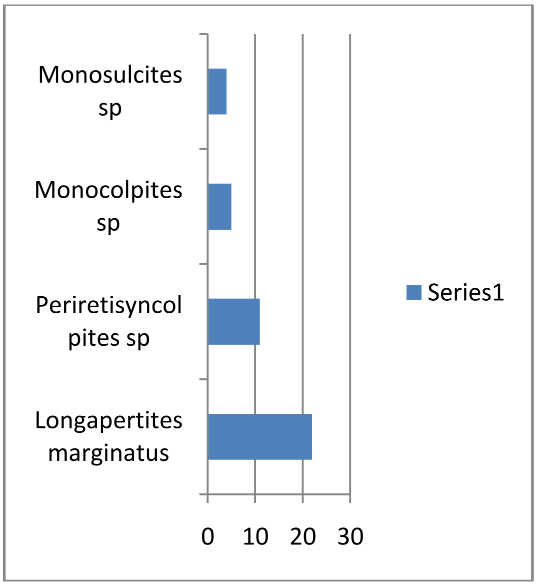
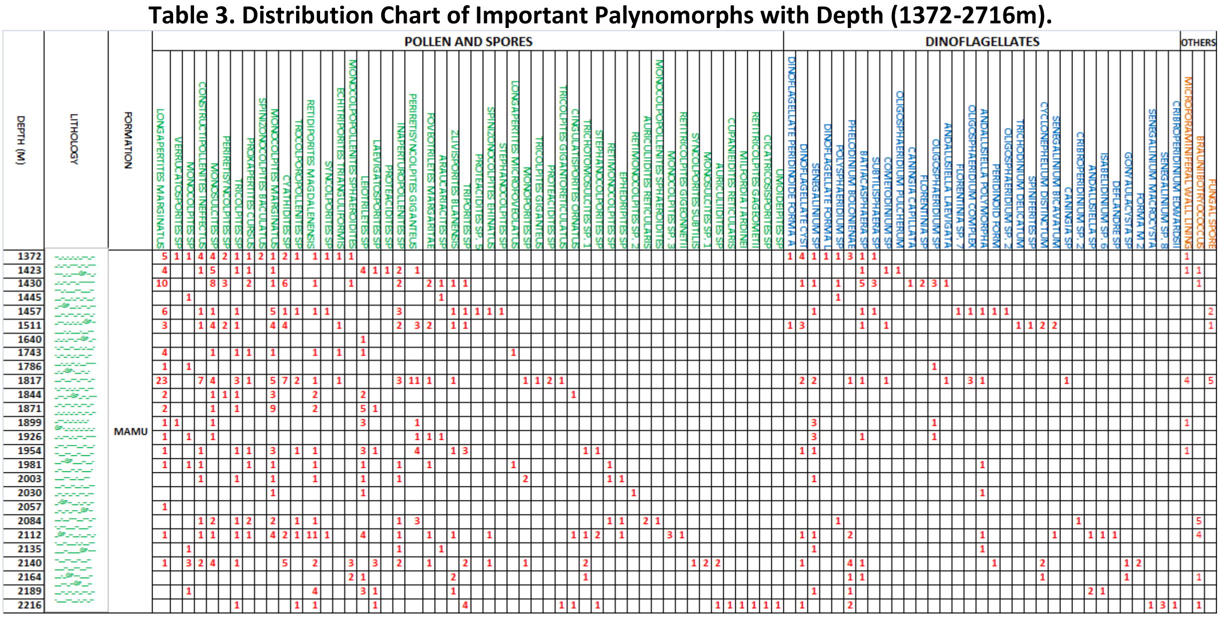


Fig. 4. Relative percentage of Longapertites marginatus to other important forms present.
Fig. 5. Relative quantity of Longapertites marginat to other important forms present.

Table 3. Distribution Chart of Important Palynomorphs with Depth (1372-2716m).



The top of the zone is defined by the relative decrease in frequency of *Longapertites marginatus* and other associated forms such as *Leiotriletes sp, Monosulcites sp., Periretisyncolpites giganteus*, *Monocolpites marginatus*), and *Constructipollenites ineffectus*. The top of the zone is also marked by con-current appearances of *Spinizonocolpites baculatus*, *Verrucatosporites sp.,, Longapertiyes marginatus, Tricolpites sp., Proxapertites cursus, Monocolpites marginatus, Tricolporopollenites sp., Retidiporites magdalenensis, Syncolporites sp. and Monocolpopolleinites sp.*

The assemblages of Zone 2- Longapertites marginatus Acme Zone are similar to the same zone established by Ogala *et al.,* (2009) for the Coal Seam Measures in Mamu Formation. The interval is further characterized by the occurrence of phytoplanktons such as *Oligosphaeridium sp., Oligosphaeridium simplex, Florentinia sp., Trichodinium delicathum*, *Andalusiella polymorpha*, *A. laevigata* , and microforaminiferal wall linings . The presence of these forms is indicative of marine influx in a shallow marine environment (Table 4).

Some of the dinocysts mentioned above especially the peridinacean forms have been described to be associated with Maastrichtian age sediments, though some of the evolved earlier than Maastrichtian (Jain 1977; Schrank 1984; Oloto 1987; Edet and Nyong 1994; Ogala *et al.,* 2009; Ola-Buraimo and Akaegbbi, 2012).
Therefore, the Longapertites marginatus Acme Zone in well-B is here dated Middle Maastrichtian age on the basis of maximum development of *Longapertites marginatus* and occurrence of some associated forms, such as *Periretisyncolpites giganteus, Monocolpites marginatus, Monosulcites sp. Constructipollenites ineffectus* and *Cyathidites sp.* The age assignment is also based on the stratigraphic position of the interval that contained distinctively different assemblages of fossils in term of abundance and diversity compared with the bounding stratigraphic intervals.

Table 4. Summary of biodata showing abundance, diversity, palynological zone, age and paleoenvironment of deposition.

Depth (m)	Forma-tion	Abun-dance	Diver-sity	Biozone	Characteristic	Age	Paleo-envi-ron-ment
1372	MAMU	47	29	Longapertites marginatus acme Zone	Interval marked by acme abundance of Longapertites marginatus, high frequency of Monocolpites marginatus, Periretisyncolpites sp, Periretisyncolpites giganteus	MIDDLE MAASTRICHTIAN	MARGINAL MARINE
1423		28	17				
1430		58	25				
1445		3	3				
1457		43	27				
1511		47	26				
1640		2	2				
1743		12	9				
1786		3	3				
1817		101	33				
1844		13	8	Foveotriletes margaritae Assemblage zone	Interval defined by continuous occurrence of Foveotriletes margaritae and forms restricted to the zone such as Retimonocolpite sp. 2, Trichotomosulcites sp. 1, Stephanocolporate pollen, Auriculiidites reticulatus, Monocolpopollenites sphaeroidites, Retitricolpites gigeometii	EARLY MAASTRICHTIAN	
1871		23	9				
1899		10	6				
1926		12	10				
1954		32	19				
1981		12	12				
2003		11	10				
2030		5	5				
2057		2	2				
2084		53	23				
2112		53	30				
2135		6	6				
2140		50	28				
2164		11	9				
2189		15	9				
2216		33	27				

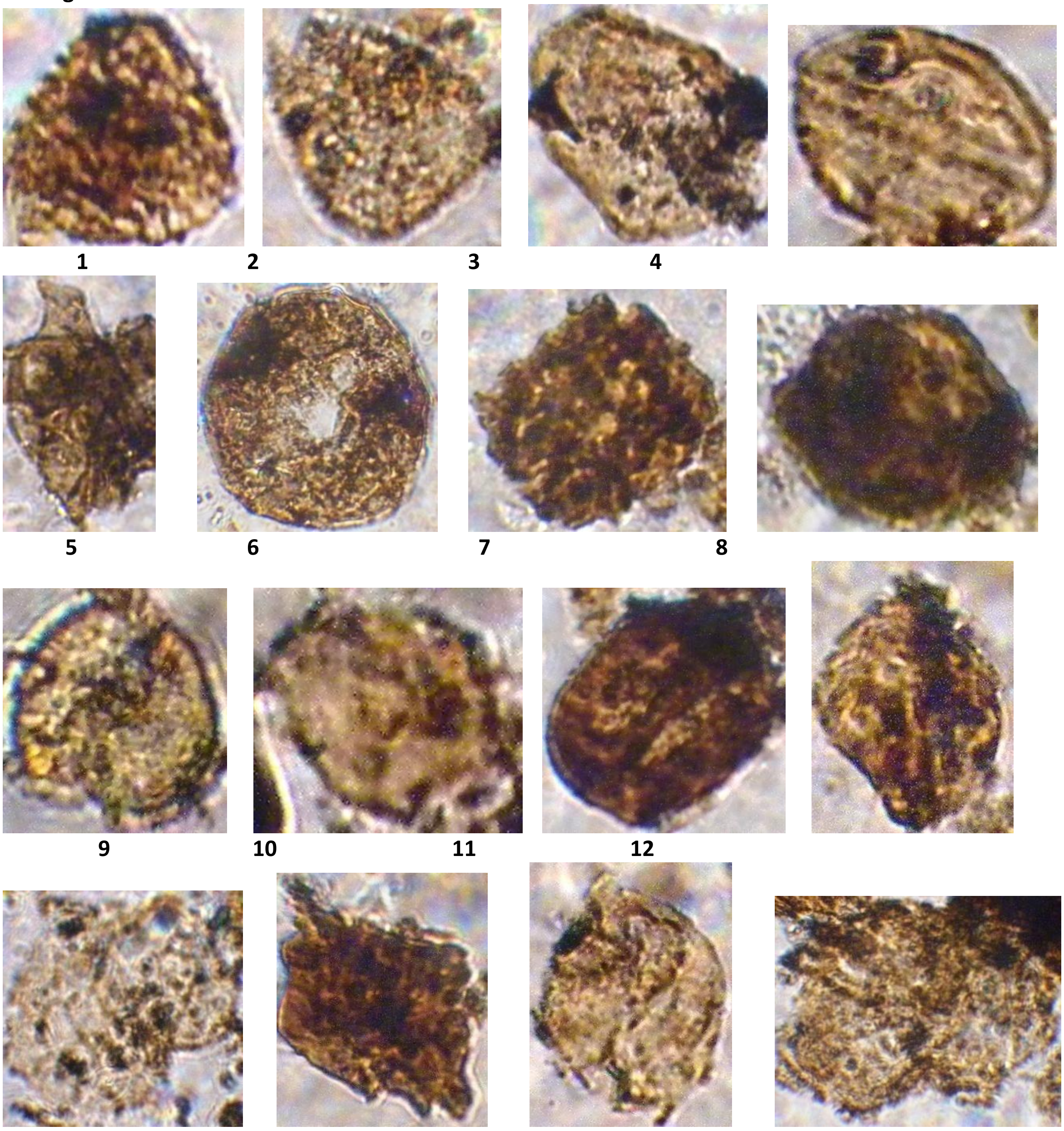
CONCLUSIONS

Stratigraphic lithologic sequence of the analyzed section (1372-2215 m) contains seven lithofacies units such as siltstone, sandy gypsiferous shale, shaly gypsum, gypsum, shale, sandy shale, and gypsiferous shale. The lithofacies encountered is different from typical Mamu Formation characterized by coal measures and the interval also contains lithofacies such as gypsum and its heterolithic mixture with shale and sand.
Two palynological zones were erected: 1. *Foveotriletes margaritae* assemblage zone 1 marked by uphole continuous occurrence of *Foveotriletes margaritae*, also associated with stratigraphically restricted forms such as *Trichotomosulcites sp. 1*, *Retimonocolpites sp. 2,* stephanocolporate pollen, *Auriculiidites reticulatus, Monocolpopollenites sphaeroidites,* and *Proxapertites cursus*; 2. *Longapertites marginatus* acme zone 2 is characterized by very high abundance of *Longapertites marginatus* within the interval (1372-1844 m), high frequency of *Monocolpites marginatus*, and *Periretisyncolpites spp.*

Paleoenvironment of deposition of the sediments deposited within the analyzed section is suggested to be marginal marine setting based on the preponderance of peridinacean dinoflagellates such as *Florentinia sp., Deflandrea sp., Andalusiella polymorpha, A. Laevigata, Isabelidinium sp., Phelodinium bolonienae* and *Senegalidinium spp.*

PLATE 1

All magnification at X400



1 *Trichotomosulcites sp.* 1 **Lawal, 1982.**
2 *Trichotomosulcites sp. 2*
3 *Auriculiidites sp.*
4 *Monocolpites marginatus* **Jardine & Magloire, 1965.**
5 Indeterminate dinocyst
6 *Milfordia jardinei* **Hochuli, 1979.**
7 *Ulmoideipites krempii* **(Anderson, 1960) Elsik, 1968.**
8 *Phelodinium bolonienae* **Riegel, 1974.**
9 *Proxapertites cursus* **Germeraad *et al.* , 1968.**

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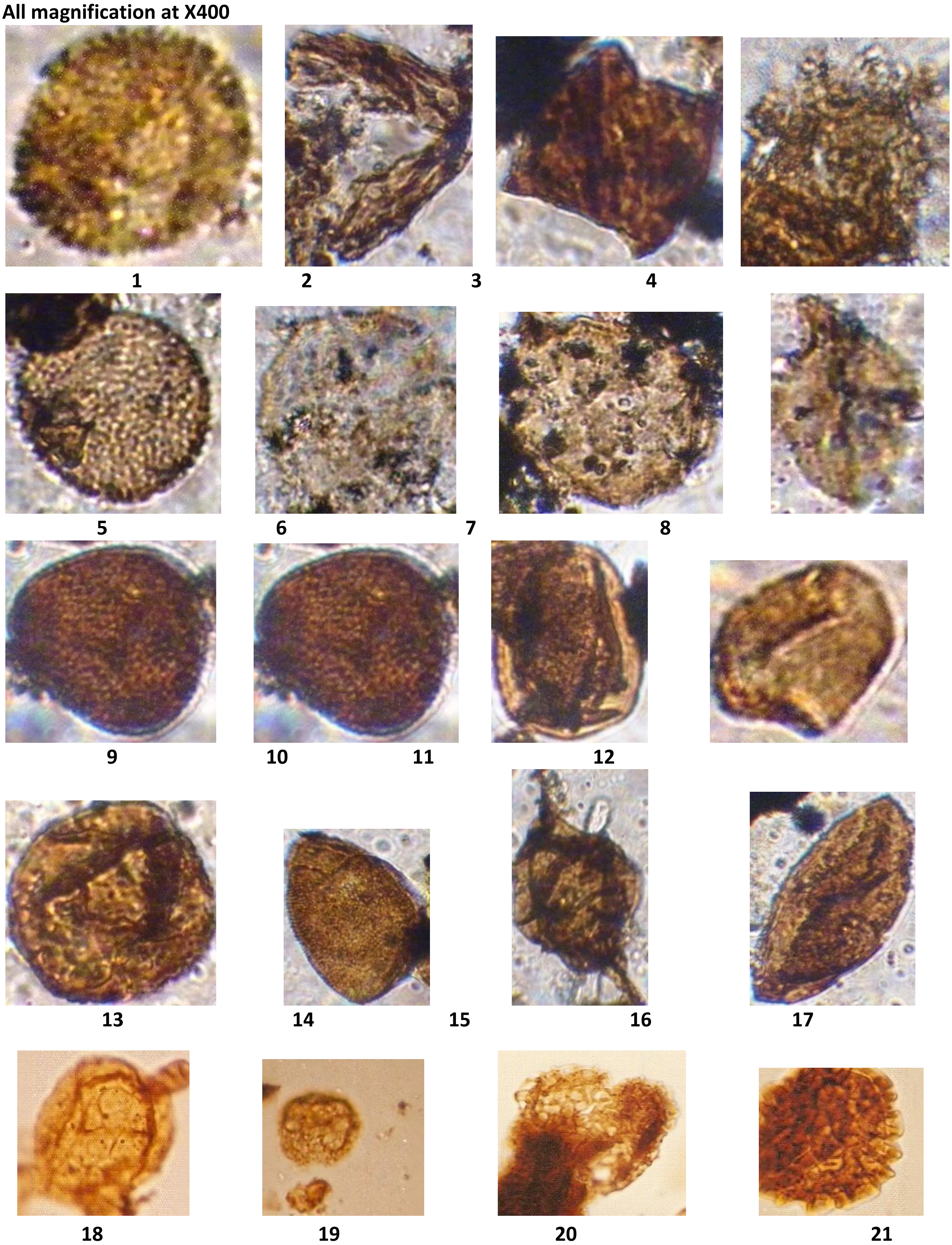
10 *Retidiporites magdalenensis* **Van der Hammen & Garcia, 1965.**
11 *Tricolpites sp.*
12,14 *Auriculiidites sp*. **Lawal, 1982.**
13 *Senegalinium sp.*
15 *Cribroperidium sp. 2* **Lawal, 1982.**
16 *Senagalinium sp.*

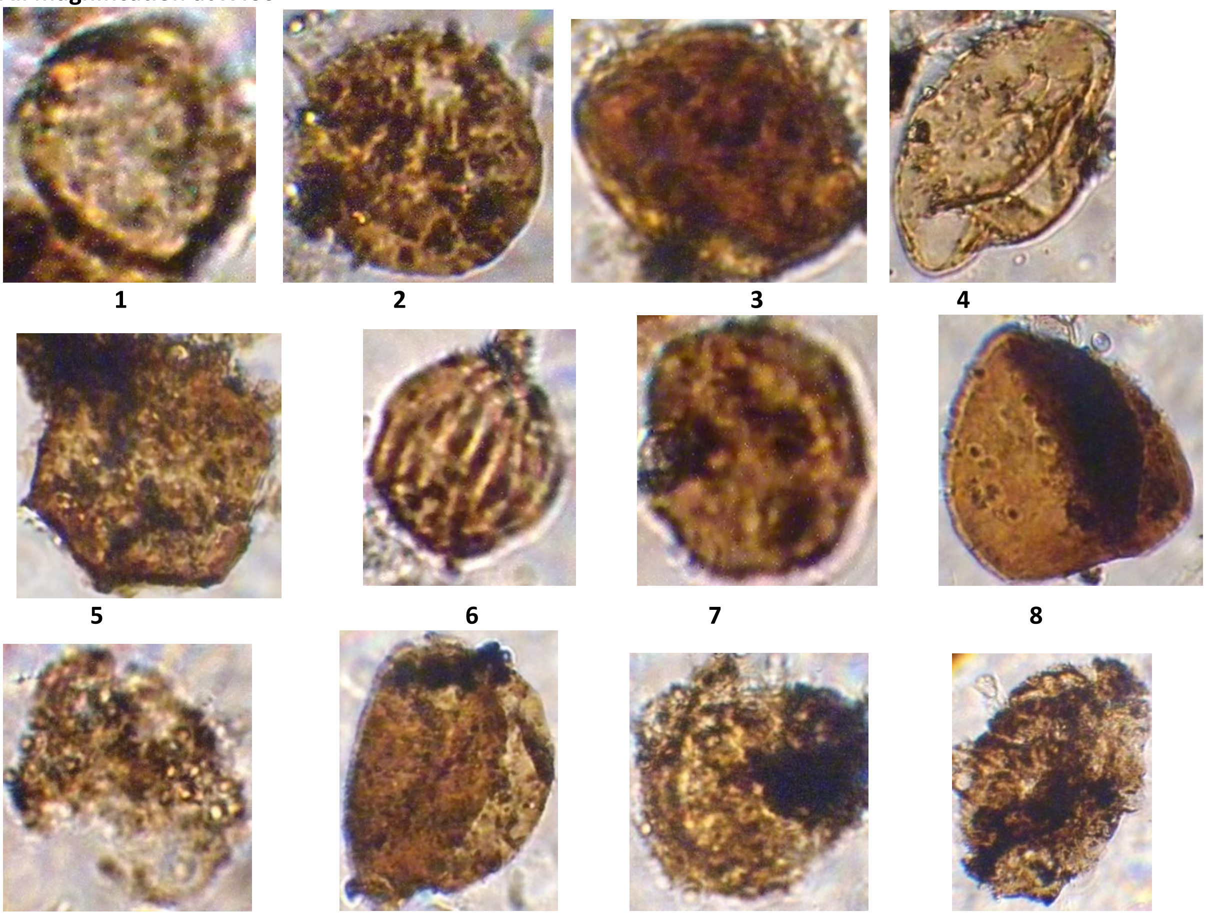
PLATE 2

All magnification at X400



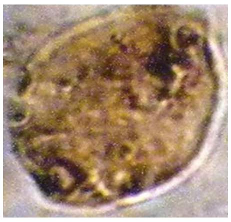
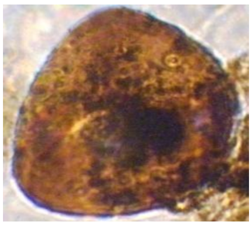
1 *Constructipollenites ineffectus* **Van Hoeken Klinkenberg, 1964.**
2 *Ephedripites sp.*
3 *Senegalinium bicavatum*
4 *Oligosphaeridium sp.*
5 *Proxapertites cursus* **Germeraad et al. 1968.**
6 Dinoflagellate peridinoid Forma A
7 Indeterminate dinocyst
8 *Auriculiidites sp.* **Lawal, 1982.**
9, 10 *Foveolatus margaritae* **(Van der Hammen) Germeraad et al, 1968.**
11 *Psilatricolpites sp.*
12 *Retidiporites sp.*
13 *Araucariacites australis* **Cookson, 1947.**
14 *Longapertites microfoveolatus*
15 *Andalusiella polymorpha* **Malloy, 1972.**
16 *Monosulcites sp.*
17,18 *Zlivisporites blanensis* **Pacltova, 1961; in Boltenhagen, 1967.**
19,20 *Periretisyncolpites sp.* **Lawal, 1982**

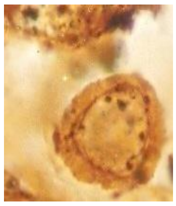
PLATE 3
All magnification at X400



1 **2** **3** **4** **5** **6** **7** **8** **9** **10** **11** **12**

Indexed, Abstracted and Cited in Indexed Copernicus International and 20 other databases of National and International repute



13 **14** **15** **16**


17 **18**

1	Syncolporites subtilis Boltenhagen, 1976.
2	Spinizonocolpites baculatus
3	Longapertites sp.
4	?Monocolpites sp.
5	Senegalinium sp.
5	Ephedripites sp. A Azema & Boltenhagen, 1974
7	Cingulatisporites ornatus Van Hoeken Klinkenberg, 1964
8	Foveotriletes margaritae Germeraad et al, 1968
9	Phelodiniun sp.
10	Monosulcites sp.
11	Trichodinium cf. castanum (Deflandre) Clark and verdier, 1967
12	Retidiporites magdalenensis Van der Hammen & Garcia, 1965
13	Retitricolpites sp.
14	Foveotriletes margaritae Germeraad, Hopping and Muller, 1968
15,16	Cingulatisporites ornatus Van Hoeken Klinkenberg, 1964
17,18	Tricolporopollenites sp. Jardine and Magloire, 1965

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