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Palynological Investigation of Campano-Maastrichtian Jamata Coal-Shale Member of Patti Formation, Southern Bida Basin. Central Nigeria

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Abstract

Palynological biostratigraphy of an exposed shale and coal member of the Patti Formation, southern Bida Basin, was undertaken to determine the age and depositional environment of the JMT succession. Age assessment integrated evolutionary occurrences, quantitative distributions, stratigraphic ranges, and associations of diagnostic pollen, spores, and organic-walled microplankton, compared with established palynological zonations and previous Nigerian and West African sedimentary basin studies. Recovered assemblages comprise predominantly miospores with variable dinoflagellate cyst occurrences. Diagnostic taxa include *Foveotriletes margaritae*, *Zlivisporites blanensis*, *Longapertites marginatus*, *Proxapertites cursus*, *Proteacidites sigali*, *Auriculiidites reticulatus*, *Periretisyncolpites giganteus*, *Ctenolophonidites costatius*, *Milfordia* spp., *Retidiporites magdalenensis*, and *Crototricolpites crotonoisculptus*. Organic-walled microplankton, including *Andalusiella polymorpha*, *Senegalinium* spp., *Deflandrea* sp., *Spinidium* sp., and *Selenopemphix nephroides*, support marginal to shallow-marine deposition. Assemblage composition and stratigraphic distribution place the succession within the *Foveotriletes margaritae* Assemblage Zone, indicating a Campanian–Maastrichtian age. Lower samples JMT1–JMT3 exhibit relatively low palynomorph abundance and diversity, whereas JMT4–JMT10 show marked increases, interpreted as a transgressive phase with progressive marine influence. A maximum flooding surface is inferred within the palynologically richest interval around JMT7–JMT8. The sandstone interval at JMT9 coincides with reduced palynomorph recovery and represents a regressive or highstand-related sedimentary pulse. Uppermost samples JMT12–JMT13 contain abundant peridinioid dinoflagellates and sparse Maastrichtian pollen and spores, suggesting continued shallow-marine deposition. These assemblages closely resemble previously documented Campanian–Maastrichtian assemblages from the Patti Formation elsewhere in the Bida Basin. The findings provide additional biostratigraphic evidence for a Campanian–Maastrichtian age assignment and support correlation of the JMT succession with the Patti Formation in the southern Bida Basin.

Keywords

Palynology;
Biostratigraphy;
Campanian–Maastrichtian;
Foveotriletes margaritae;
Patti Formation;
Jamata shale-coal member
Bida Basin; Nigeria.

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1 INTRODUCTION

The Bida Basin, also referred to as the Middle Niger Basin, is an intracratonic sedimentary basin in central Nigeria with a general northwest–southeast orientation. It extends from the Kontagora area in the north to Lokoja in the south and traverses' parts of Niger, Kwara, Nasarawa, and Kogi States, as well as the Federal Capital Territory. The basin is underlain by the Nigerian Precambrian Basement Complex, which has been extensively investigated to establish its sedimentological, stratigraphic, and mineralogical characteristics (Zaborski, 1998; Obaje *et al.*, 2004, 2011). The southern Bida Basin represents the southern depocenter of the larger Bida Basin and comprises a Campanian–Maastrichtian sedimentary succession whose stratigraphic nomenclature and lithostratigraphic relationships remain subjects of ongoing debate.

The studied outcrop, located along the Jamata axis at latitude **8° 03' 34.4" N** and longitude **6° 45' 38.9" E**, was selected for detailed investigation fig.2. This section was previously designated the **Jamata Member of the Patti Formation** by Ohiemi *et al.* (2026) fig1. The outcrop provides an important exposure for examining the lithological characteristics, stratigraphic relationships, and palaeoenvironmental significance of the Campanian–Maastrichtian succession in the southern Bida Basin.

GEOLOGICAL SETTING

The southern Bida Basin constitutes the southern sector of the Bida, or Middle Niger, Basin and forms an important component of Nigeria's inland sedimentary basins. It is an intracratonic sedimentary basin that extends from the Kontagora region in the north to the southeastern end of the basin around Lokoja. The basin generally trends in a northwest–southeast direction and is largely bounded by the Precambrian Basement Complex. It is structurally separated from adjoining sedimentary basins by basement highs and associated structural features. The southern Bida Basin has attracted considerable attention from sedimentological and stratigraphic studies due to the occurrence of sandstone, argillaceous sediments, coal, and ironstone within its Upper Cretaceous succession.

The succession of the southern Bida Basin is traditionally subdivided into three major lithostratigraphic units: the Lokoja Formation, Patti Formation, (Jamata and Ahoko members) and Agbaja Ironstone (Adeleye and Dessauvagie, 1972; Obaje *et al.*, 2011).

2 STRATIGRAPHY OF THE SOUTHERN BIDA BASIN

The southern Bida Basin unlike other sedimentary basins in Nigeria is characterized by
the notable absence of volcanic, carbonate, and Tertiary-aged rocks. The basin is broadly subdivided into three principal lithostratigraphic units: the Lokoja Formation, Patti Formation (Jamata and Ahoko members), and Agbaja Ironstone, each of which is distinguished by its characteristic lithological and stratigraphic features fig. 1.

Numerous investigations have been undertaken to establish the stratigraphy, sedimentology, and overall geological framework of the southern Bida Basin. These studies have contributed significantly to the understanding of the succession and distribution of its lithostratigraphic units. The stratigraphic framework of the Bida Basin has been examined and refined by several authors, including Adeleye (1973, 1974); Braide (1990, 1992); Idowu and Enu (1992), Whiteman (1982); Ladipo et al. (1994); Ojo and Akande (2003, 2008, 2009); Akande *et al.* (2005); Obaje *et al.* (2011, 2013); Rahaman *et al.* (2019); Ojo and Akande (2019).

Collectively, these studies have enhanced the understanding of the spatial distribution of the basin's lithostratigraphic units, their stratigraphic relationships, lithological characteristics, and depositional history.

3 Methodology

Palynological age dating and paleoenvironmental deduction was carried out on twelve outcrop samples belonging to Shale, coal and ironstone of Jamata Member of Patti Formation. The outcropping section was measured, examined and samples were collected along about 2.5km from Jamata junction fig.1. The order of collection is from base to top coded JMT1

– JMT13 towards the top of the section fig. 2. Palynological sample preparation was undertaken on ten samples through different stages that involved digestion of the samples with Hydrofluoric acid (HF), followed by sieving with 5µm mesh. Separation of the macerals with heavy liquid was done using Zn2Br4, followed by final mounting of the residue on glass slides with DPX mountant. The preparation was followed by analysis of the prepared slides under the binocular microscope with the aim of identification and point counting of important palynomorphs such as pollen, spores, dinoflagellates, microforaminiferal wall lining, algae, and fungal spores present in the slides for stratigraphic study. Important palynomorph pictures the shales, coal and ironstone of Jamata Member are typically dark grey in color and fissile and light in nature. The shales largely at the base followed by coal facie and overlie again by shale followed by moderately hard sandstone and ironstone at the top. The studied section is composed of thick sequence of alternating carbonaceous shale (Figure 3).

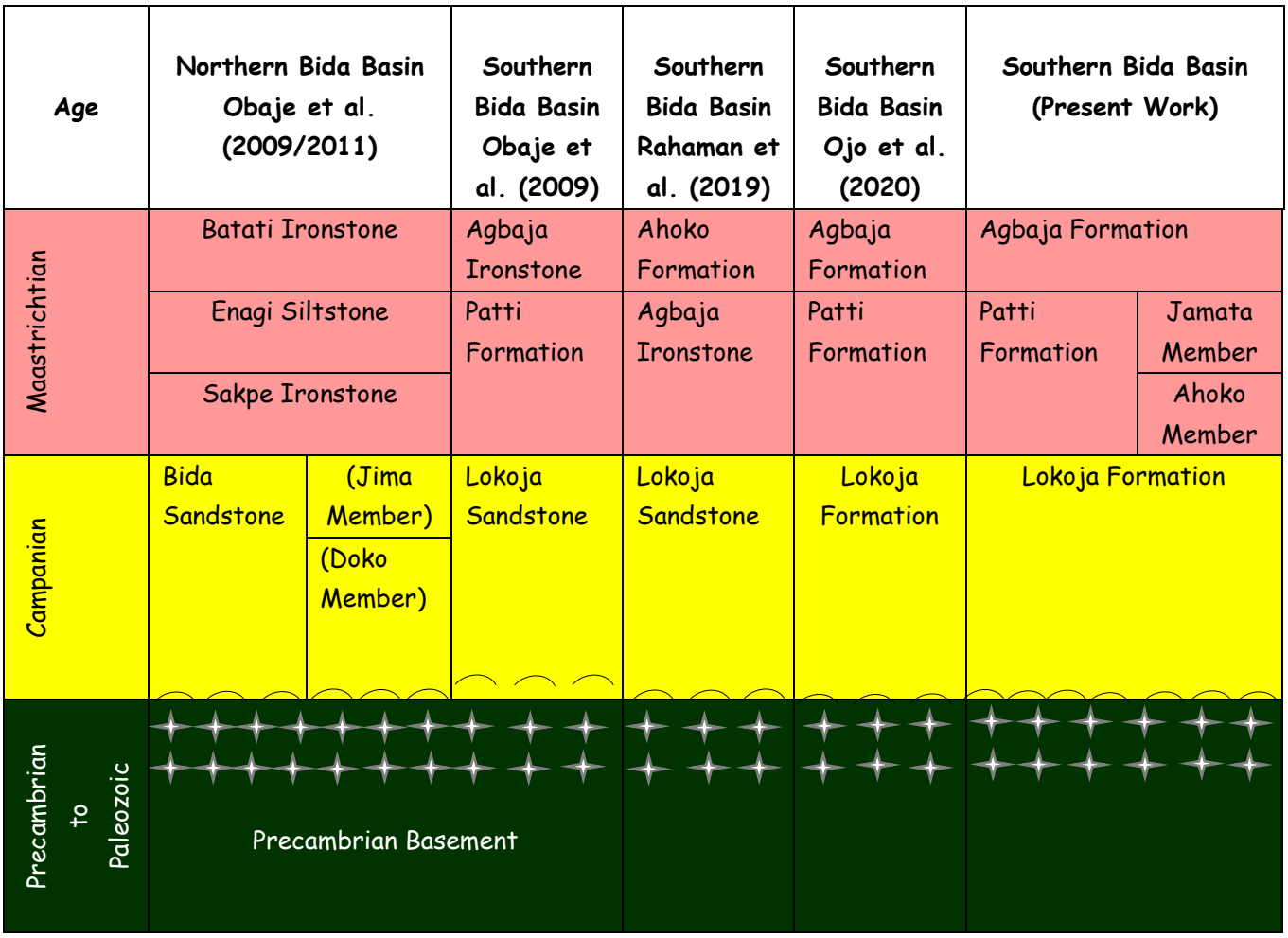


Fig.1 Stratigraphic succession in the Bida Basin

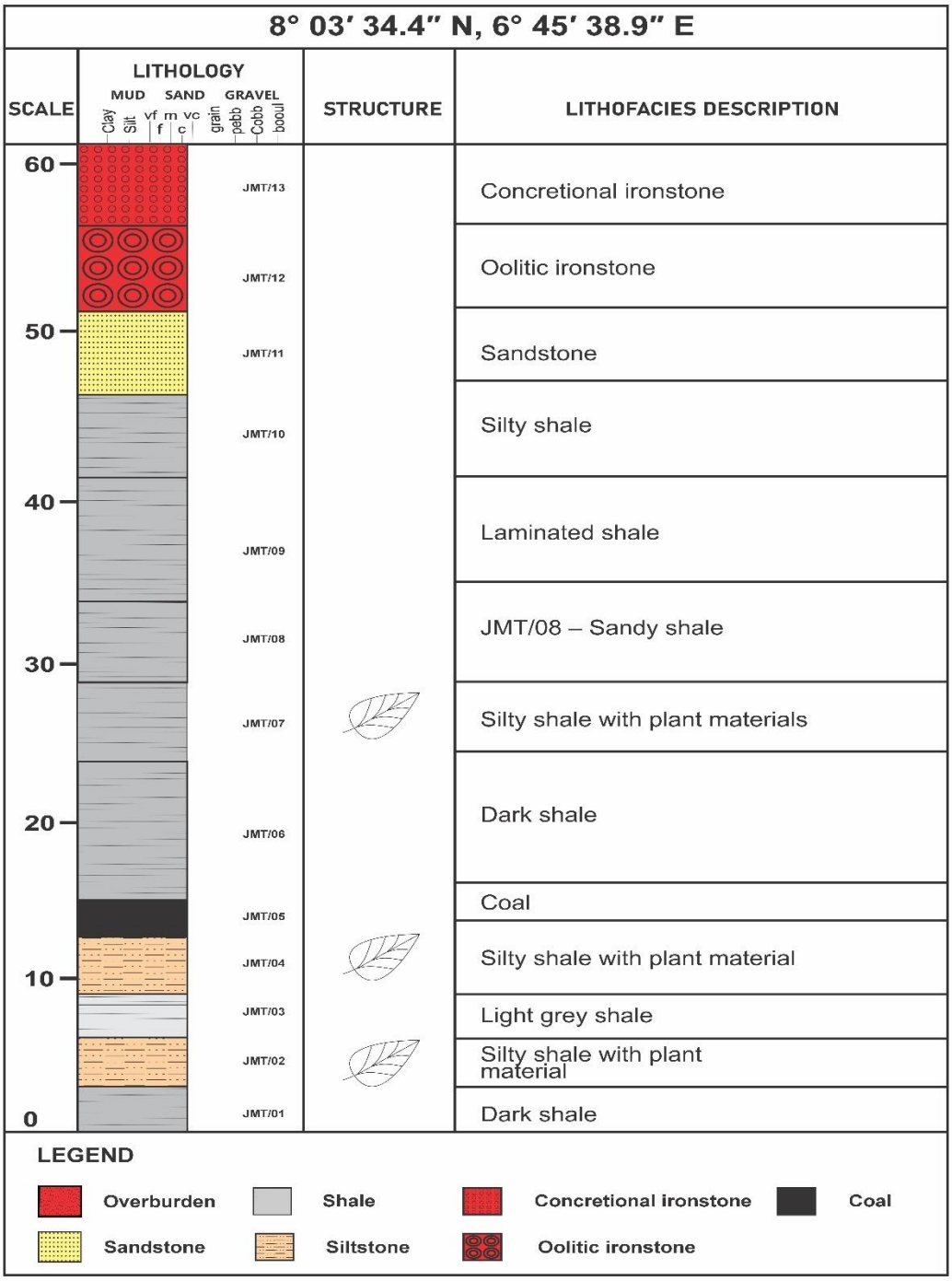


Fig.2 Lithologic section of Jamata exposure



Plate I: Exposed section of the Patti Formation (showing shale, coal, sandstone facies) and the Agbaja Ironstone capping the entire succession at Jamata (8° 03' 34.4"N and 6°45'38.9"E).

Results

The palynological result of outcrops of Patti Formation of JMT samples for Jamata area ranges from JMT1-JMT13; consisting of twelve samples. The samples lithology is mainly shale with a few claystone samples and coal. The characterization of the samples for biostratigraphic age dating was on the premise of the evolution of the forms, their quantitative occurrence and association with stratigraphically important forms. The fossil assemblages were compared with some well-established age dating works from different sedimentary basins in Nigeria and West African sedimentary deposits. The obtained results were in particular compared with works of Germeraad *et al.*, 1968; Evamy *et al.*, 1978; lawal, 1982; Edet and Nyong, 1994; Ola-Buraimo, 2012, 2013; Ola-Buraimo and Akaegbobi, 2013; Ola-Buraimo, 2020.

The result of the analysed Samples JMT13 -1 were presented below in terms of palynomorph abundance and diversity. The results were listed from the topmost sample (JMT13) to the deepest sample at the base of the outcrop (Sample JMT1).

Sample Number: JMT 13

Palynomorph	**Abundance**
1 Dinoflagellate cyst	1
2 Phelodinium bolonienae	2
3 Proteacidites sp.	1
4 Senegalinium sp.	1
5 Andalusiella polymorpha	1

Sample Number: JMT 12

Palynomorph	**Abundance**
1 Wetzeliella sp.	2
2 Auriculiidites reticulatus	1
3 Hystrichosphaeridium sp.	2
4 Indeterminate	1

Sample Number: JMT 10

Palynomorph	**Abundance**
1 Batiacasphaera sp.	1
2 Fofeotriletes margaritae	2
3 Selenope,mphix nephroides	1
4 Leiotriletes sp.	3
5 Longapertites marginatus	2
6 Tetradites sp.	1
7 Fungal spore	1
8 Milfordia sp.	2
9 Wetzeliella linceidentata	2
10 Indeterminate	2
11 Periretisyncolpites magnosagenatus	1
12 Monosulcites sp.	2
13 Dinoflagellate sp.	2

Sample Number: JMT 9

Palynomorph	**Abundance**
1 Leiotriletes sp.	7
2 Longapertites marginatus	1
3 Indeterminate	10
4 Cyathidites sp.	2
5 Selenopemphix nephroides	1
6 Senegalinium sp.	1
7 Monosulcites sp.	1
8 Dinoflagellate sp.	1

Sample Number: JMT 8

Palynomorph	**Abundance**
1 Cingulatispotites ornatus	1
2 Leiotriletes sp.	9

3 Tricolporites sp.	3	
4 Retimonocolpites sp. 2	1	Lawal, 1982
5 Indeterminate	6	
6 Crototricolpites crotonoisculptus	3	
7 Monocolpites marginatus	1	
8 Monosulcites sp.	6	
9 SEnegalinium sp.	1	
10 Selenopemphix nephroides	2	
11 Milfordia sp.	4	
12 Longapertites marginatus	1	
13 Cyathidites sp.	2	
14 Triporites sp.	1	
15 Oligosphaeridium	1	
16 Rugulatisporites caperatus	1	
17 Dinoflagellate sp.	1	
18 Syncolporites sp.	1	
19 Proteacidites sp.	1	

Sample Number: JMT 7

Palynomorph	**Abundance**
1 Milfordia sp.	3
2 Senegalinium sp.	1
3 Cyathidites sp.	3
4 Dyad pollen	1
5 Triporites sp.	1
6 Andalusiella polymorpha	2
7 Leiotriletes sp.	6
8 Fungal spore	1
9 Cingulatisporites ornatus	1
10 Indeterminate	5
11 Foveotriletes margaritae	2
12 Retidiporites magdalenensis	1
13 Longapertites marginatus	1
14 Periretisyncolpites sp.	1
15 Auriculiidites reticulatus	1
16 Retimonocolpites sp. 2	1
17 Zlivisporites blanensis	1
18 Dinofllagellate sp.	1
19 Proxapertites cursus	1
20 Verrusisporites sp.	1
21 Milfordiamjardinei	1
22 Retistephanocolpites sp.	1
23 Proteacidites sp.	1
24 Monosulcites sp.	1
25 Botryococcus braunii	1

Sample Number: JMT 6

Palynomorph	**Abundance**
1 Retimonocolpites sp	1
2 Monosulcites sp.	2
3 Dinoflagellate sp.	3
4 Retitricolporites sp.	1
5 Leiotrilets sp.	5
6 Bacutriporites orluensis	1
7 Milfordia sp.	2
8 Cyathidites sp.	4
9 Retimonocolpites sp. 2	3 Lawal, 1982
10 Fungal spore	1
11 Longapertites marginatus	1
12 Verrucosisporites sp.	2
13 Monocolpopollenites sphaeroidites	2
14 Botryococcus braunii	1
15 Syncolporites sp.	1
16 Indeterminate	1
17 Selenopemphix nephroides	1
18 Monocolpites marginatus	1
19 Foveotriletes margaritae	4
20 Triporites sp.	1
21 Tetradites sp.	1

Sample Number: JMT 5

Palynomorph	**Abundance**
1 Monosulcites sp.	5
2 Retidiporites magdalenensis	1
3 Deflandrea sp.	1
4 Indeterminate	10
5 Monocolpopollenites sphaeroidites	5
6 Tricolporopollenites sp. S. 152	3
7 Milfordia sp.	2
8 Longapertites marginatus	4
9 Foveotriletes margaritae	2
10 Fungal spore	11
11 Auriculiidites reticulatus	2
12 Leiotriletes sp.	5
13 Senegalinium sp. 5	1
14 Inaperturopollenites sp.	1
15 Dinoflagellates sp.	2
16 Syncolporites marginatus	1
17 Proxapertites cursus	2
18 Constructipollenites ineffectus	2
19 Syncolporites sp.	1

20 Monocolpites marginatus	1

Sample Number: JMT 4

Palynomorph	**Abundance**
1 Triporites sp.	1
2 Leiotriletes sp.	7
3 Fungal spore	1
4 Longapertites marginatus	2
5 Foveotriletes margaritae	1
6 Indeterminate	6
7 Monosulcites sp.	2
8 Cyathidites sp.	4
9 Tricoporpollenites sp. S. 152	1
10 Echitriporites triangu;iformis	2
11 Retidiporites magdalenensis	1
12 Syncolporites reymentii	1
13 Triorites sp.	1
14 Milfordia sp.	2
15 Monocolpopollenites sphaeroidites	1
16 Batiacasphaera sp.	1
17 Spinidinium sp.	1

Sample Number: JMT 3

Palynomorph	**Abundance**
1 Indeterminate	6
2 Longapertites microfoveolatus	1
3 Syncolporites sp.	2
4 Senegalinium sp.	1
5 Deflandrea sp.	1
6 Spinidinium sp.	1
7 Monocolpites sp.	1

Sample Number: JMT 2

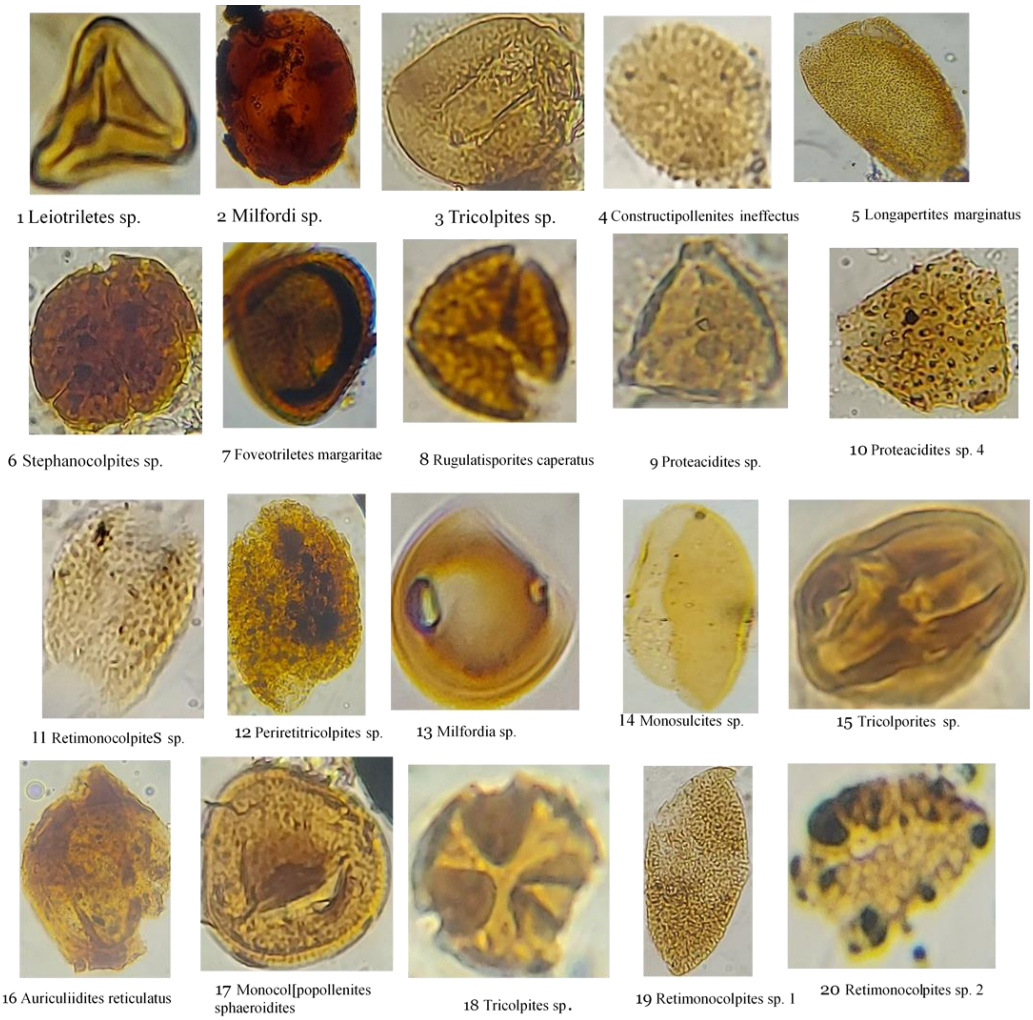
Palynomorph	**Abundance**
1 Fungal spore	3
2 Ctenolophodites costatus	1
3 Periretisyncolpites sp.	1
4 Dinoflagellate sp.	1
5 Indeterminate	19
6 Zlivisporites blanensis	1

Sample Number: JMT 1

Palynomorph	**Abundance**
1 Fungal spore	2
2 Monosulcites sp.	2
3 Proxapertites cursus	1
4 Monocolpites sp.	2

5 Cingulatisporites ornatus	1
6 Tricolporopollenites sp. S. 215	1 Jardine & Magloire, 1965
7 Longapertites microfoveolatus	1
8 Dinoflagellate sp.	1
9 Proteacidites sp.	1
10 Tricolporites sp.	1
11 Indeterminate	9
12 Zlivisporites blanensis	2
13 Inaperturopollenites sp.	1
14 Periretisyncolpites giganteus	2
15 Andalusiella polymorpha	2
16 Botryococcus braunii	1
17 Auriculiidites reticulatus	1
18 Proteacidites sigali	1
19 Proxapertites cursus	1
20 Cyathidites sp.	1
21 Leiotriletes sp	1
22 Milfordia sp.	2
23 Longapertites marginatus	1

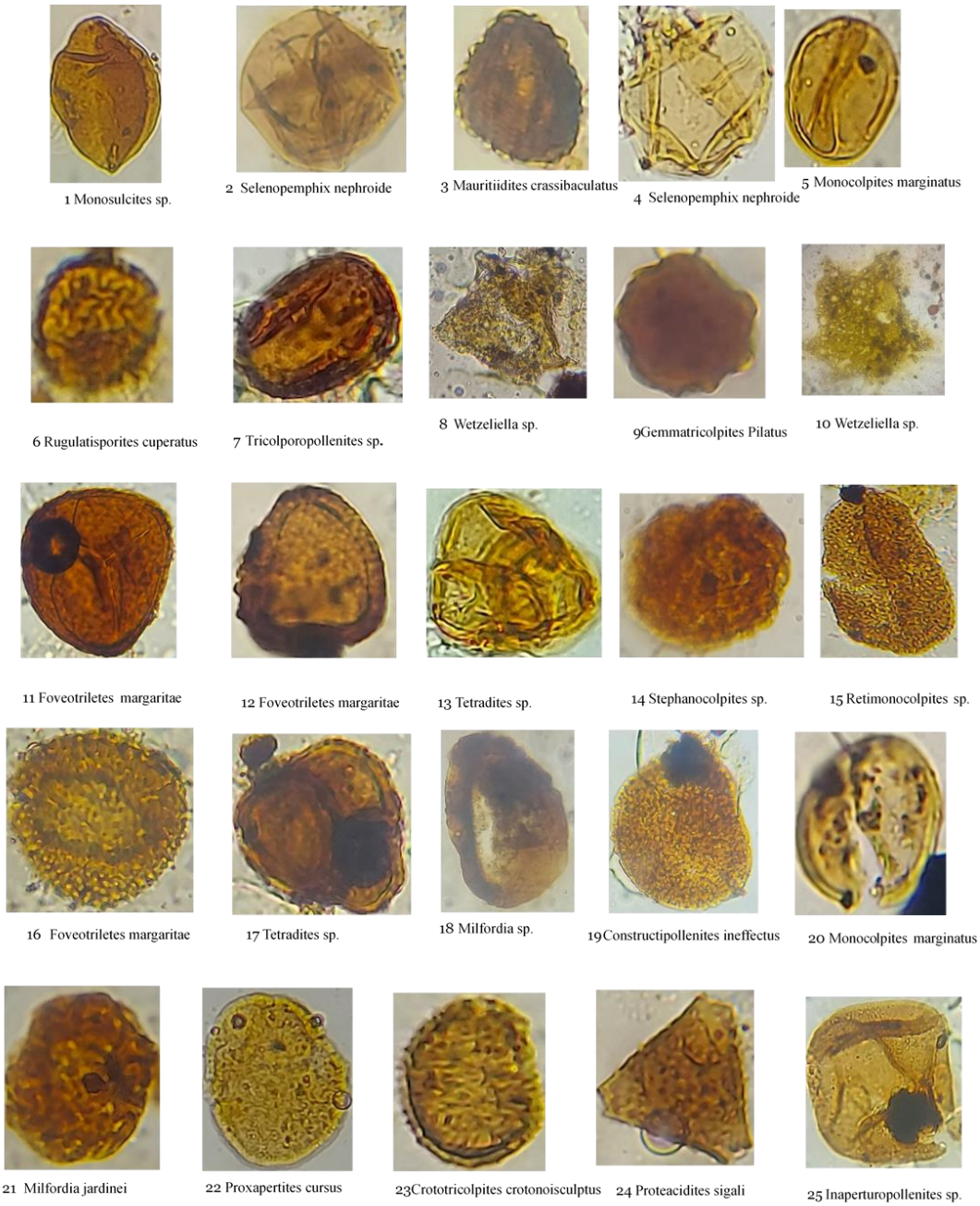
Plate II. Photomicrographs X400



Photomicrograph interpretation

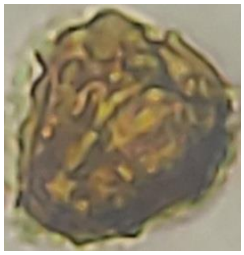
1 Leiotriletes sp.
2 Milfordi sp.
3 Tricolpites sp.
4 Constructipollenites ineffectus
5 Longapertites marginatus
6 Stephanocolpites sp.
7 Foveotriletes margaritae
8 Rugulatisporites caperatus
9 Proteacidites sp.
10 Proteacidites sp. 4
11 Retimonocolpites sp.
12 Periretitricolpites sp.
13 Milfordia sp.
14 Monosulcites sp.
15 Tricolporites sp.
16 Auriculiidites reticulatus
17 Monocol[popollenites sphaeroidites
18 Tricolpites sp.
19 Retimonocolpites sp. 1
20 Retimonocolpites sp. 2

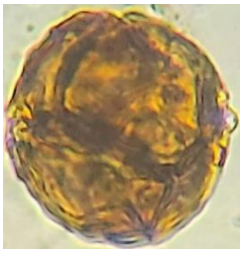
Plate III. Photomicrograph X400



Photomicrograph interpretation
1 Monosulcites sp.
2,4 Selenopemphix nephroides
3 Mauritiidites crassibaculatus
5 Monocolpites marginatus
6 Rugulatisporites cuperatus
7 Tricolporopollenites sp.
8, 10 Wetzeliella sp.
9 Gemmatricolpites Pilatus
11,12,16 Foveotriletes margaritae
13 Tetradites sp.
14 Stephanocolpites sp.
15 Retimonocolpites sp.
17 Tetradites sp.
18 Milfordia sp.
19 Constructipollenites ineffectus
20 Monocolpites marginatus
21Milfordia jardinei
22 Proxapertites cursus
23 Crototricolpites crotonoisculptus
24 Proteacidites sigali
25 Inaperturopollenites sp.

Plate IV. Photomicrograph X400


1 Gemmatricolpites sp.

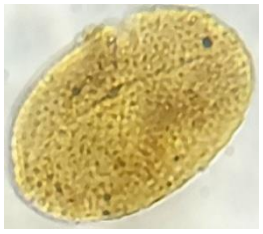

2 Ulmoideipites krempii

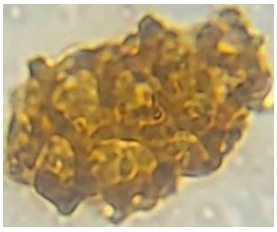

3 Crototricolpites

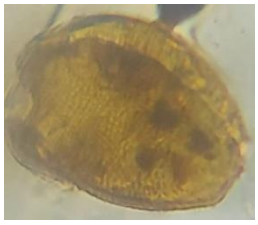

4 Dyad pollen

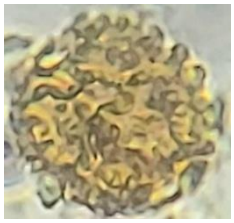

5 Milfordia jardinei

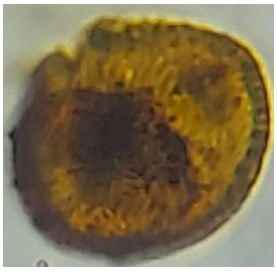

6 Retimonocolpites sp.


7 Retimonocolpites sp.


8 Periretisyncolpites sp.


9 Longapertites Sp.


10 Proxapertites faceius


11 Proxapertites cursus

Photomicrograph interpretation
1 Gemmatricolpites sp.
2 Ulmoideipites krempii
3 Crototricolpites crotonoisculptus
4 Dyad pollen
5 Milfordia jardinei
6,7 Retimonocolpites sp.
8 Periretisyncolpites sp.
9 Longapertites sp.
10 Proxapertites faceius
12 Proxapertites cursus

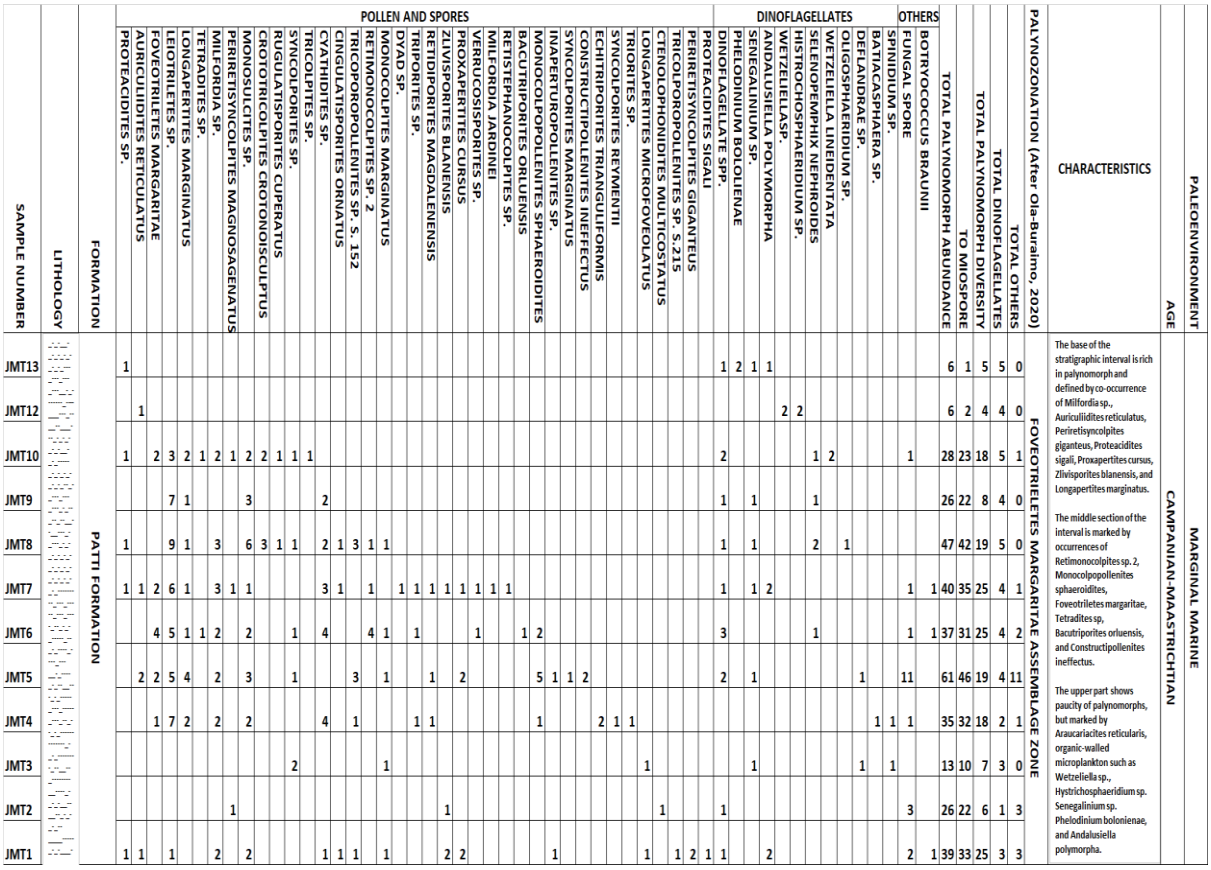


Fig.3 Palynomorph distribution chart, Formation, Age, and Paleoenvironment of JM outcrop

Discussion

The analysis of the palynological data from the various intervals in Jamata named JMT with the sample interval JMt1-JMT13 revealed distinct characteristics indicative of the Foveotriletes margaritae Assemblage Zone and of Campanian-Maastrichtian in age

The base of the stratigraphic interval of investigation (JMT1) is quantitatively rich in pollen, spores, and dinoflagellates (Figs. 3). The interval is marked by the occurrence of key forms in association with stratigraphically important miospores. The marker fossil at the base is the rare appearance of *Milfordia* sp. in association with *Zlivisporites blanensis*, *Longapertites marginatus*, *Proxapertites cursus*, *Proteacidites sigali*, *Auriculiidites reticulatus*, and *periretisyncolpites giganteus*. Other forms present are *Inaperturopollenites* sp. *Proteacidites* sp., *Longapertites microfoveolatus*, *Tricolporopollenites* sp., *Cingulatisporites ornatus*, *Leiotriletes* sp., and *Monosulcites* sp (Fig. 3; Plates II-IV).

The miospore assemblage present in Sample JMT1 is indicative of Campanian-Maastrichtian age similar to the work of Edet and Nyong, 1994, and in particular with the work of Oladimeji and Ola-Buraimo (2022) for the Patti Formation in Bida Basin, Nigeria. Organic-walled microplankton present are *Andalusiella polymorpha*, undifferentiated dinoflagellates of peridinoidae type, indicative of marginal marine deposits (Ola-Buraimo and Ehinola, 2021).

The overlying intervals JMT2 and JMT3 are contemporaneously and genetically related in terms of miospore recovery that is low. They are suggested to have been deposited during the fall in sea level, possibly in a lowstand systems tract by a progradational process, involved in active sedimentation during this regime. Nevertheless, the sediments were deposited in typical marine environment characterized by the occurrence of dinoflagellate cysts, *Senegalinium* sp., *Deflandrea* sp., and *Spinidium* sp.

The sediment at the base with Sample JMT2 suggests a fining upward sequence of low diversity of

pollen and spores. The few forms present in the samples JMT2-JMT3 are the first up-hole appearance of *Ctenolophonidites costatius*, continuous occurrence of *Periretisyncolpites* sp. and *Longapertites microfoveolatus*. Stratigraphic position of the intervals indicates Campanian-Maastrichtian age (Plates II-IV).

Overlying intervals JMT4-JMT10 show a sharp quantitative increase in palynomorph abundance and diversity compared with the underlying intervals JMT2 and JMT3. The elevated increase depicts a change in sea level from fall to high level; suggestive of retrogradational sediment deposition, associated sediment starvation. The interval represents a thick shale deposit with a thin sandstone intervening at the top, represented by Sample JMT9. The sequence is a combined Transgressive/Highstand Systems Tracts. The maximum flooding surface (MFS) is placed at interval JMT8, characterized by high palynomoph abundant and diversity.

The palynomorph content from Sample JMT4 shows a continuous occurrence of *Foveotriletes margaritae* with a spike frequency in Sample JMT6, followed by *Auriculiidites reticulatus*, *Proxapertites cursus*, and *Longapertites marginatus*. However, new forms with first appearance at this level are *Monocolpopollenites sphaeroidites*, *Retidiporites magdalenensis*, *Monocolpites marginatus*, and *Syncolporites* sp. In sample JMT6, index fossils with up-hole appearance are *Retimonocolpites* sp. 2, *Bacutriporites orluensis*, *Tetradites* sp., *Triporites* sp., and *Verrucosisporites* sp (Fig. 3). All the aforementioned pollen and spores are indicative of Campanian to Maastrichtian age deposits. *Selenopemphix nephroides, Senegalinium* sp.5, and *Deflandrea* sp. are organic-walled microplankton that indicate marginal marine environment of deposition.

Interval JMT7, JMT8, and JMT10 are quantitatively rich in palynomorphs, with highest organic recovery and diversity placed in Sample JMT7. The maximum Flooding Surface (MFS) is also placed at JMT7. Some of the diagnostic forms represented in the underlying intervals are continuously present here. A few new forms that appeared in Samples JMT7 and JMT8 are *Milfordia jardinei*, *Retistephanocolpites* sp., Dyad pollen, *Crototricolpites crotonoisculptus*, and *Rugulatisporites cuperatus*. These forms established a Campanian-Maastrichtian age for the sedimentary interval (Edet and Nyong, 1994; Ola-Buraimo, 2020). Important forms with quantitative occurrence in the intervals are *Leiotriletes* sp., *Monosulcites* sp., and a flash amount of *Milfordia* sp.

Sample JMT9 represents the intervening sand spike within the underlying and overlying sediment packages as a result of its paucity in palynomorph abundance and diversity, compared to the adjacent intervals. Therefore, the top of the HST was placed at JMT10, characterized by relatively moderate to high abundant frequency and diversity of palynomorphs.

Some of the marker forms that are present in the underlying intervals that defined Campanian-Maastrichtian age have continuous appearance here. They include *Foveotriletes margaritae, Longapertites marginatus, Milfordia* sp., *Periretisyncolpites* sp., *Proteacidites* sp., *Crototricolpites crotonoisculptus, Syncolporites* sp., and *Rugulatisporites cuperatus*. Their presence in the interval further substantiates the age of the intervals.

Samples JMT12 and JMT13 are the topmost samples retrieved from the JMT outcrop. The pollen and spores' recovery are poor with dominant presence of organic-walled microplanktons such as *Phelodinium bolonienae, Histrichsphaeridium* sp., undifferentiated dinoflagellates, *Senegalinium* sp., and *Andalusiella polymorpha* (Fig3). They are peridinoid forms that indicate a shallow marine sediment deposit (Fig.3). Rare pollen present are *Araucariacites reticularis* and *Proteacidites* sp. which are suggestive of Maastrichtian age.

The JMT sediment palynomorph assemblages are strongly correlatable with some of the forms established in Patti Formation of the Bida Basin in the north-central part of Nigeria, dated Campanian-Maastrichtian age (Oladimeji and Ola-Buraimo, 2022).

Conclusion

The palynological investigation of the Jamata Member of the Patti Formation establishes the succession as **Campanian–Maastrichtian in age**, based on the occurrence, abundance, and stratigraphic distribution of diagnostic pollen, spores, and organic-walled dinoflagellate cysts. The assemblage is particularly characterized by *Foveotriletes margaritae*, together with other significant taxa such as *Longapertites marginatus, Proxapertites cursus, Proteacidites sigali, Auriculiidites reticulatus, Periretisyncolpites* sp., *Milfordia* sp., *Crototricolpites crotonoisculptus*, and *Rugulatisporites cuperatus*. The assemblage closely corresponds to the ***Foveotriletes margaritae*** Assemblage Zone and correlates well with previously established Campanian–Maastrichtian palynological assemblages of the Patti Formation and other Upper Cretaceous successions in Nigeria.

The vertical variation in palynomorph abundance and diversity reflects changes in depositional conditions and relative sea level. The basal interval (JMT1) contains abundant and diverse terrestrial palynomorphs together with dinoflagellate cysts, indicating marginal-marine conditions. The low recovery in JMT2–JMT3, accompanied by marine dinoflagellates, suggests reduced terrestrial input and a possible sea-level fall associated with progradational sedimentation. In contrast, the pronounced increase in palynomorph abundance and diversity from JMT4 to JMT10 indicates increasing marine influence and a major transgressive phase. The highest abundance and diversity, particularly around JMT7–JMT8, mark the maximum flooding interval.

The occurrence of peridinioid dinoflagellate cysts, including *Andalusiella polymorpha, Senegalinium* spp., *Deflandrea* sp., *Selenopemphix nephroides*, and *Phelodinium bolonienae*, further indicates deposition within a shallow to marginal-marine environment. The coexistence of terrestrial pollen and spores with marine microplankton reflects continued interaction between continental vegetation and marginal-marine depositional systems. The upper intervals, JMT12–JMT13, are dominated by dinoflagellate cysts, suggesting increased marine influence during the Maastrichtian.

Generally, the palynological evidence indicates that the Jamata Member represents a Campanian–Maastrichtian shallow to marginal-marine succession deposited under fluctuating relative sea-level conditions. The close similarity of its palynological assemblages with those documented from the Patti Formation elsewhere in the Bida Basin provides strong support for regional correlation and confirms the stratigraphic assignment of the Jamata succession to the Patti Formation. The study therefore provides important biostratigraphic and palaeoenvironmental evidence for refining the Upper Cretaceous stratigraphic framework of the southern Bida Basin.

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