

Palynostratigraphy of the Exposed Section of Patti Formation Ahoko Quarry, Southeastern Bida Basin, Nigeria

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Abstract

Palynological investigation was carried out on thirteen samples obtained from the exposed section of Patti Formation of a quarry face at Ahoko area, southeastern, Bida basin, Nigeria. The samples were processed and analysed for their palynomorphs content. The samples were moderately rich in pollen, spores and dinoflagellates. Based on regular and abundant occurrences of some Maastrichtian restricted species like *Auriculiidites reticulatus*, *Longapertites marginatus*, *Foveotriletes marginatus*, and *Ephedripites ambonoide* and *Echitriporites trianguliformis*, Maastrichtian age was assigned to the section. Paleoenvironmental interpretation based on the recovered palynomorphs in the light of their ecological preferences revealed two depositional environments: the lower shallow marine section and upper freshwater section based on the occurrence of *Lygodium* sp, *Operculodium* sp, Dinocyst indeterminate and *Proteacidites longispinosus* and *Foveotriletes margaritae* respectively. The shallow marine environment goes to affirm the connection of the basin with the marine transgression of Tethy sea during the Maastrichtian time.

Keywords: Palynostratigraphy, Bida Basin, Patti Formation, Pollen and Spores, Ahoko,

1. Introduction

The exposed quarry section 49 km from Lokoja on the Abuja - Lokoja Express way is located in the southeastern portion of the Bida basin, Nigeria (Figure 1). Earliest geological studies of the basin were carried out by Falconer (1911) and Jones (1955,1958). However the first significant studies on the stratigraphy and sedimentology were that of Adeleye (1973, 1974, 1975, 1989) and Jan du Chene *et al.*, (1978) who reported the presence of upper Cretaceous palynomorphs in southern Bida basin.

Also Olugbemiro and Nwajide (1997) described some aspects of the sedimentological characteristics of the Lokoja Formation and Bida Sandstones which they interpreted to be mainly continental deposits. Akande *et al.*, 2005 interpreted the sedimentary successions in the southern Bida basin to range from continental to marginal marine and marsh deposits. They defined the Nupe group to consist of a basal unexposed conglomerates overlain by Bida Sandstones, the Sakpe Ironstones, Enagi Siltstone and Batati Ironstones respectively. Sedimentological evidences suggest that the group was derived from the basement complex of the southern Nigeria and laid down in fluvial and marine environments.

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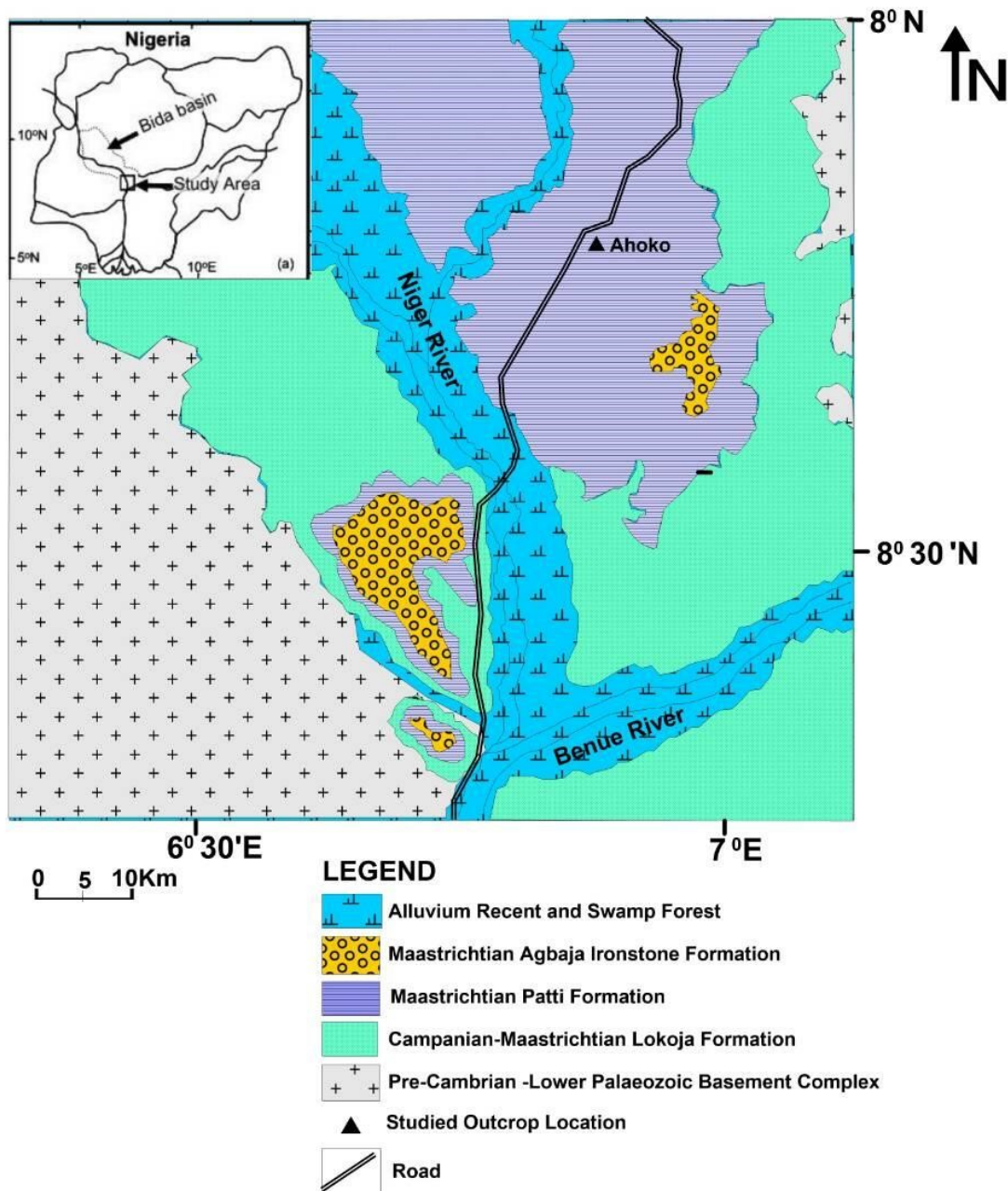


Figure 1: Location of the Ahoko quarry section investigated, Southeastern, Bida basin, Nigeria (Modified After Akande *et al.*, 2005).

The present study is to describe the palynostratigraphic characteristics of the Patti Formation from the exposed section of a quarry site at Ahoko area, Southeastern Bida Basin, Nigeria to determine the geologic age and the paleoenvironments of the Patti Formation.

2. Stratigraphic Framework

Stratigraphy of the Bida basin has been described by several workers. Falconer (1911) described the upper Cretaceous sedimentary rocks in the southern Bida basin as Lokoja series, Russ (1930) used the term Nupe Group to collectively refer to the stratigraphic successions in both Northern and Southern Bida subbasins. Jones (1958) described the sedimentary successions in the southern Bida basin to consist of Campanian-Maastrichtian Lokoja and Patti Formation. Stratigraphically, the Lokoja Series constitute Agbaja Oolitic Ironstone Formation, Patti Formation and Lokoja Formation. The stratigraphic succession of the Bida Basin is as shown in Figure 2.

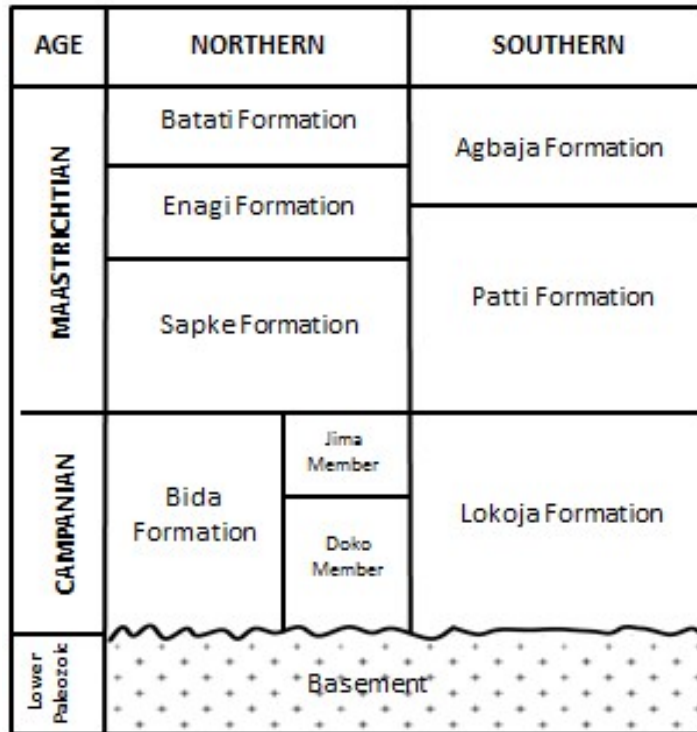


Figure 2: Stratigraphic succession of Bida Basin (Modified After Akande *et al.*, 2005)

2.1 Lokoja Formation

The Lokoja Formation is composed of pebbly clay grits and sandstones as well as a few thin oolitic ironstones. The basal conglomerates which consist of well rounded quartz pebble in a matrix of white clay is rarely exposed. A typical locality of the Lokoja Formation is seen around Igbaja Plateau. Desauvagie (1974) assigned a Maastrichtian age to it and considered the Lokoja sandstone as equivalent of Nupe sandstones.

2.2 Patti Formation

Jones (1958) described Patti Formation as consisting of fine to medium grained, grey and white sandstones, carbonaceous silts, shale and Oolitic ironstones. Thin coal beds have been recorded and white massive gritty clay is present. The maximum exposed thickness of the formation is 70 m and to the north it thins out. The only fossils found are freshwater plant remains and seeds in

carbonaceous beds. The Patti Formation is a lateral equivalent of the Enagi Siltstone Formation around Bida and Mamu Formation to the east of the Niger-Benue confluence Adeleye (1975).

2.3 Agbaja Formation

The Plateau around Lokoja are all capped by the Ironstones of the Agbaja Formation which is about 7-14 m thick. The coarse grain subfacies of the Edozhigi member is dominant Adeleye (1975). The Oolites are usually sub-spheroidal closely packed red and brown goethitic Oolitic rocks. The Ooids are about 1-5 mm average size, blackish lustrous goethitic pisolitic (3-7 m) size are abundant in the top areas and rarely in the basal parts Adeleye (1975).

3. Materials and Methods

The samples were collected by carefully scraping the beds in order to prevent present-day pollen contamination and immediately isolating the samples in plastic bags. Thirteen samples mainly of shales, siltstones and claystones were processed according to standard palynological procedures. Palynomorphs assemblages were studied in these samples from interval 0 -19 m of the exposed quarry section at Ahoko area, 49 km to Lokoja, Abuja- Lokoja express way.

10 g of the crushed rock samples were diluted in 37 % HCl and treated with 37 % HF to digest the carbonate and silicate content respectively. To break up the amorphous organic matter obscuring the palynomorphs, the sample was oxidized with 67 % HNO₃ and neutralized in KOH. Each residue were sieved through 10 μ mesh and wash using ultrasonic cleaning in order to achieve a better dispersion of the residue. Palynomorphs were counted up to 47 determinable specimen. For qualitative and quantitative study of the samples, sample slides were prepared for each and examined using olympus light CX21FSI microscope equipped with digital camera. Identification of the palynomorphs was in accordance with Williams *et al.*, 1998.

4. Results and Discussion

4.1 Lithological Description of the Ahoko Quarry

Lithological characteristics of the sediments at Ahoko quarry showed the argillaceous units of the Patti Formation. The 19 m thick sequence consist of shales, siltstones and claystones which are interbedded with concretionary to massive bioturbated ironstones Figure 3. The basal unit consist of a dark to light grey carbonaceous shale of about 3.5 m thick. Overlying the basal unit are vertically fractured shale units filled with ferruginised siltstones, the concretionary ironstones interbedded with shales were not fractured, this may be because fracturing preceded the formation of ironstone beds. At the upper section of the sequence the silty shale and siltstones intercalating with the ironstones become prominent.

4.2 Age Determination

The age synthesis of the exposed Ahoko quarry face was based on the distribution of the recovered palynoflora (Figure 3). A non fossiliferous but dateable upper section representing part of the Maastrichtian. The studied section is characterised by the occurrence of pollen and spores with

very few dinoflagellates. The taxa recovered include stratigraphic significant forms such as *Auriculiidites reticulatus*, *Epherdripites ambonoides*, *Longapertites marginatus* and *Foveotriteles marginatus*. These species have been reported by several workers from Maastrichtian sediments from other basins in West Africa, North Africa and other parts of the world (Germeraad *et al.*, 1968; Herngreen *et al.*, 1998; Atta Petters and Salami, 2004, 2006). The occurrences of these taxa from the studied section of Patti Formation effectively assigned Maastrichtian age to the interval.

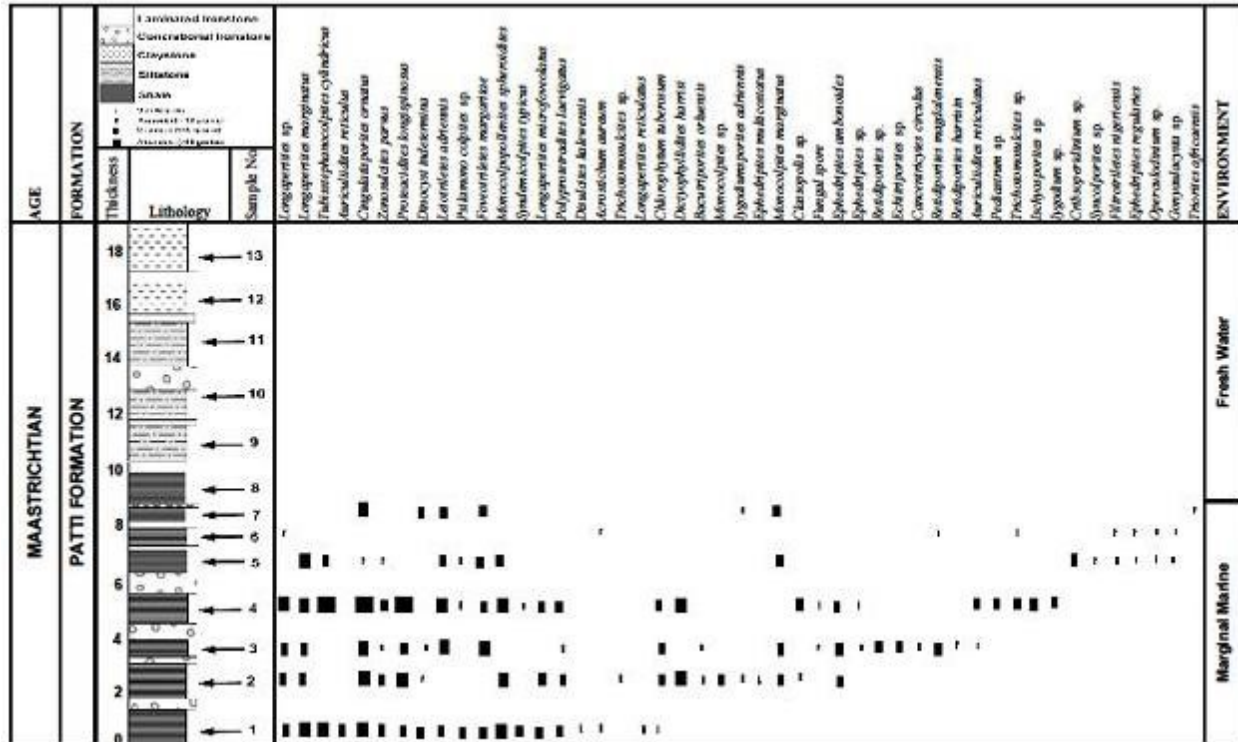


Figure 3: The lithology and Palynomorphs ranges of the quarry section, Ahoko area, Southeastern Bida basin, Nigeria.

4.3 Paleoenvironments and Paleoecology

The Cretaceous microfungal provinces discussed by Herngreen and Chlonova (1981) showed that the West African province is situated within the late Cretaceous Palmae Province. This is affirmed by the occurrence of *longapertites* suggesting a tropical climate. Also the presence of *Retidiporites spinizonocolpites* and *Echimonocolpites* belonging to the semi mangrove swamps Germeraad *et al.*, (1968), Jan du Chene (1978) suggested a mangrove environment in the Maastrichtian of Nigeria on the basis of the occurrence of *Spinizonocolpites baculatus*.

The significant occurrence of the palmae pollen of *Echitripores* and *Longapertites* and Pteridophytes point to a vegetation developed under a predominant humid climate during the Maastrichtian time in the basin. The occurrence of *Lygodium* sp, *Cribsoperidium*, *Operculodium* which generally do not exceed 5 m from the base serve to delineate the marine section of the

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sequence while the upper section is generally barren of the fossil but the the presence of the land derived miospores such as *Proteacidites longispinosus*, *Foveotriletes margaritae*, *Longapertites marginatus*, *Pediastrum* sp suggest freshwater environment condition.

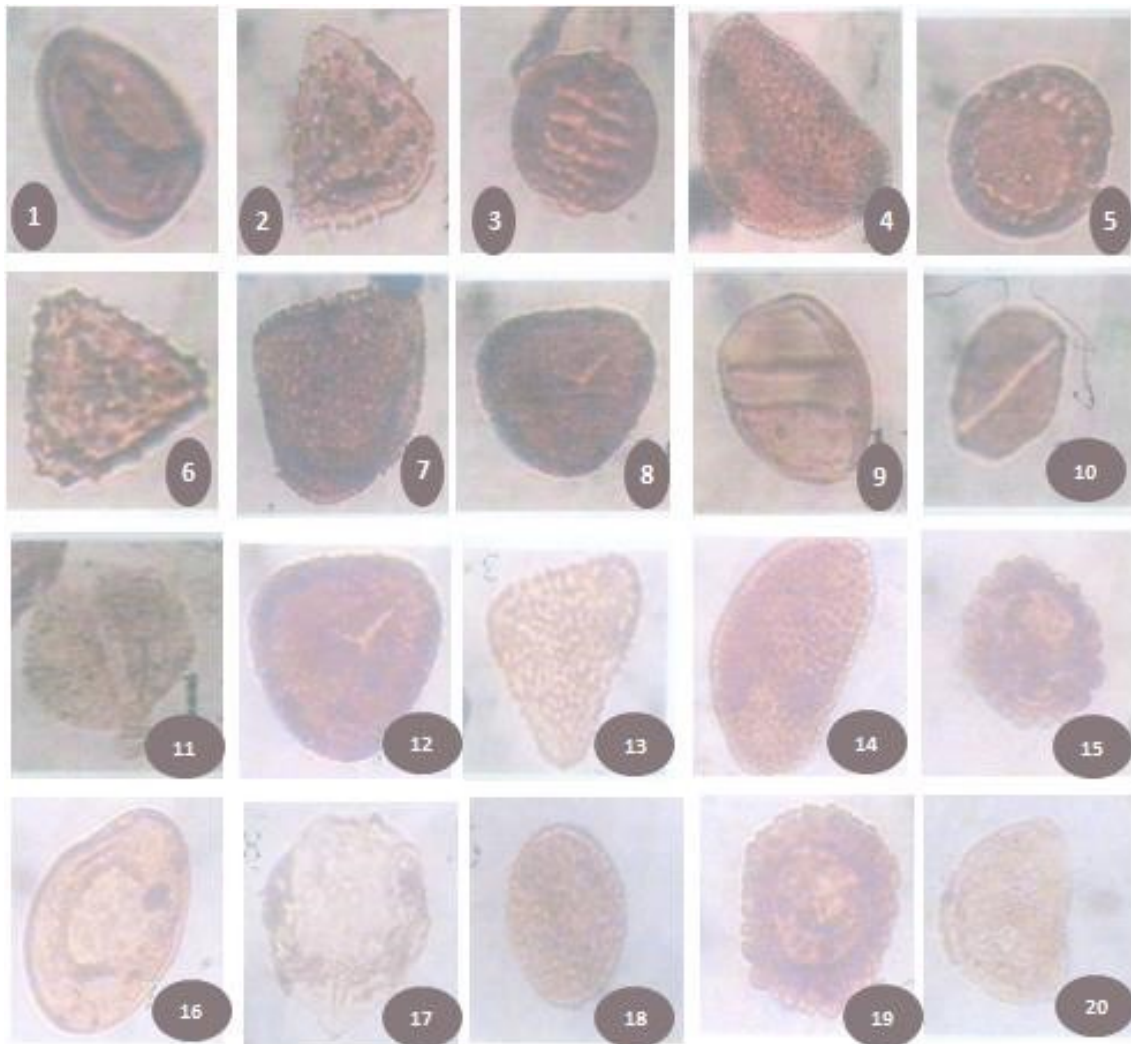


Plate I: Photomicrograph of some characteristic palynomorphs (x 400).

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|----|---|----|-----------------------------------|
| 1 | <i>Ephedripites ambonoides</i> | 11 | <i>Auricullidites reticulatus</i> |
| 2 | <i>Proteacidites longispinosus</i> | 12 | <i>Foveotriletes margaritae</i> |
| 3 | <i>Tubistephanocolpites cylindricus</i> | 13 | <i>Trichotomosulcites sp</i> |
| 4 | <i>Longapertites microfoveolatus</i> | 14 | <i>Retidiporites sp</i> |
| 5 | <i>Tubistephanocolpites cylindricus</i> | 15 | <i>Cingulatisporites ornatus</i> |
| 6 | <i>Proteacidites longispinosus</i> | 16 | <i>Chlorophytum tuberosum</i> |
| 7 | <i>Longapertites sp</i> | 17 | <i>Cribsoperdinium sp</i> |
| 8 | <i>Ischyoporites sp</i> | 18 | <i>Ischyosporites sp</i> |
| 9 | <i>Monocolpopollenites spheroidites</i> | 19 | <i>Cingulatisporites ornatus</i> |
| 10 | <i>Auricullidites reticulatus</i> | 20 | <i>Longapertites marginatus</i> |

5. Conclusion

The exposed section of Ahoko quarry was assigned Maastrichtian age based on the Maastrichtian restricted forms such as *Auriculiidites reticulatus* and *Ephedripites ambonoides*. Paleoenvironmental interpretation of the section delineated the sequence into two: the lower marine section (0- 5 m) and the upper freshwater interval (5-19 m). The former is characterized by the occurrence of marine dinocyst and scanty presence of terrestrially derived palynomorphs represented by *Lygodium* sp, *Cribsoperidium* sp and *Operculodium* sp while the latter section (5-19 m) is unfossiliferous and is characterised by the absence of marine dinocyst and presence of terrestrially derived palynomorphs. The presence of palmae type pollen suggest the prevalence of tropical humid climate during Maastrichtian time.

References

- Adeleye, D. R. (1973). Origin of ironstones, an example from the Middle Niger valley, Nigeria. *Journal of Sedimentary Petrology*, 43, 709-727.
- Adeleye, D. R. (1974). Sedimentology of the fluvial Bida Sandstones (Cretaceous) Nigeria. *Sedimentary Geology*, 12, 1-24.
- Adeleye, D. R. (1975). Nigerian late Cretaceous stratigraphy and paleogeography. *AAPG Bull* 59:2302–2313.
- Adeleye D. R. (1989). The geology of the Mid-Niger Basin. In: Kogbe CA (ed) *Geology of Nigeria*, 2nd edn. Elizabethan Publishing Co., Lagos, pp 283-287.
- Akande, S. O., Ojo, O. J. and Erdtmann, B. D., (2005). Paleoenvironments, Organic Petrology and Rock Eval studies on source rock facies of the Campanian to Maastrichtian Patti Formation, southern Bida basin, Nigeria. *Journal of African Earth Sciences*, 41, 394 - 406.
- Atta-Peters, D. and Salami, M. B. (2004). Late Cretaceous to early Tertiary Pollen Grains from Offshore Tano Basin, Southwestern Ghana *Revista Española de Micropaleontología*, 36(3), pp. 451-465.
- Atta-Peters, D. and Salami, M. B. (2006). Aptian–Maastrichtian palynomorphs from the offshore Tano Basin, Western Ghana *Journal of African Earth Sciences* Volume 46, Issue 4, 379-394.
- Falconer, J. D. (1911). The geology and geography of northern Nigeria. Macmillan, London, 29
- Germeraad, J. J., Hoppings, C. A. and Muller J. (1968). Palynology of Tertiary sediment from Tropical areas. *Review of Paleobotany and Palynology*. (3/4). pp. 187-348.
- Jan du Chêne, R., Onyike, M. S. and Sowumi, M. A. (1978). Some New Eocene Pollen of the Ogwashi-Asaba Formation, Southeastern Nigeria. *Revista De Espanol Micrpaleontologie*, Vol. 10, pp. 285-322.
- Herngreen, G. F. W. and Chlonova, A. F. (1981). Cretaceous microfloral provinces. *Pollen et Spores*, 23, 441-555.
- Herngreen, G. F. W. (1998). Cretaceous sporomorph provinces and events in the equatorial region. *Zentralblatt fur Geologie und Paläontologie*, 1, 1996 (11/12), 1313 - 1323.
- Jones, H. A. (1955). The oolitic ironstone of Agbaja Plateau, Kabba Province. *Record of Geological Survey Nigeria*, (printed in 1958), 20-43.

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- Jones, H. A. (1958). The oolitic ironstone of Agbaja Plateau, Kabba Province. Record of the Geological survey of Nigeria, pp.20 – 43.
- Olugbemi, R. and Nwajide, C. S., (1997). Grain size distribution and particle morphogenesis as signatures of depositional environments of Cretaceous (non ferruginous) facies in the Bida Basin, Nigeria. Journal of Mining and Geology, 33, 89-101.
- Russ, W. (1930). The Minna- Birnin Gwari belts. Reports of the survey of Nigeria. P 10-14.
- Williams, G. L., Lentin, J. K., and Fensome, R. A. (1998). The Lentin and Williams Index of Fossil Dinoflagellate Cysts (1998 ed.). Am. Assoc. Stratigr. Palynol., Contrib. Ser., Vol.