ZIBELINE INTERNATIONAL™ PUBLISHING

ISSN: 2521-0890 (Print)
ISSN: 2521-0491 (Online)
CODEN: GBEEB6

Geological Behavior (GBR)

DOI: http://doi.org/10.26480/gbr.02.2024.130.135

RESEARCH ARTICLE

BIOSTRATIGRAPHY STUDY OF UQUO WELL 12, OML 13, OF UQUO FIELD, NIGER DELTA

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ARTICLE DETAILS

Article History:

Received 21 June 2024
Revised 24 May 2024
Accepted 27 July 2024
Available online 02 August 2024

ABSTRACT

Palynological analysis was carried out on twenty ditch cutting samples which were gotten from Uquo well 12 located at Uquo, Akwa Ibom state. The depth ranged from 1720ft to 2860ft. The aim of the study was to determine the age, depositional environment and paleoecology penetrated by the well. The palynological analysis yielded sufficient palynomorph (*pollen, spores, Acritach*). The most occurred palynomorphs recovered were Smooth monolete spore, *Verrucatosporite tenellis*, Foraminiferal test lining, *Polypodiaceiosporites sp*. The dominance of mangrove pollens; *Zonocostites ramonae* and *Psilatricolporites crassus,* this indicates that the sediments were likely deposited in a mangrove environment under a wet climate during the Pliocene. The age range penetrated by the well is late Miocene to Early Pliocene because of the co-occurrence of the index species of *Cyperaceopollis* spore, *Nympheapollis lotus* and *Stereisporites* spore seen at 1900ft and 2440ft. Since the study area is foreshore environment and the characteristics are: moderately low to moderately high coastal brackish water swamp community elements, moderately high hinterland fresh water swamp/forest elements, absence of sporadic of marine element therefore samples here has relatively few content.

KEYWORDS

Palynology, Palynomorphs, Hydrocarbon, Miocene, Biozones.

1. INTRODUCTION

Biostratigraphy is the branch of stratigraphy which focuses on correlating and assigning relative age of rocks strata by using the Fossil assemblages contained within them. Biozones are intervals of geological strata demarcated based on their typical fossil taxa found in them. These may be a single taxon or combination of taxa. The process of designating zone in stratigraphic unit is call biozonation. The main data of biostratigraphy analysis are: the occurrence or non-existence of a Fossil taxton in a geologic horizon; the first downhole occurrence (FDO)/last appearance Datum (LAD);the first appearance Datum (FAD)/last down hole occurrence (either local or global). Rock unit categorized by one or more taxa into biozone or zone. One way of reconstructing ancient environment decipher the conditions and timing under which sediments were deposited is by the application of palynological studies.

This involves the study of pollen and spore, particulate organic matter (POM) kerogen in sedimentary rock and certain minutes planktonic organisms in fossil and living form (Brooks and Summons 2003; Omorigieva, 2008). Palynomorphs; pollen and spores and certain other microscopic sized structures, either of plant or of uncertain origin. These other structure include acritarchs, dinoflagellates and their cysts (dinocysts), algal spores and fungal spores. The diameters of palynomorphs fall within the range of 5µm-500µm.

Biostratigraphy - correlation of rock sections. This aspect of palynology is the most important economically. Proper identification of indicative palynomorphs could lead to the discovery of oil, coal, and gas deposits. In fact, fossilized pollen was first discovered in a coal thin section. Because pollen and spores have the tendency of being dragged along with migrating petroleum through porous rocks - they are good indicators that petroleum isn't too far away. The small sizes of palynomorphs are ideal for drill core samples. The coloration and type of palynomorphs represents the thermal maturity and hydrocarbon potential of the area. This study is focus on using palynomorphs (pollens and spores) to interpret the age and environment of deposition of the well. To establish biostratigraphic zonation. To determine the age of the well (age dating) penetrated. To interpret and reconstruct the depositional environment. To develop a range chart.

Due to co-occurrences of the Cyperaceopollis sp, Nympheapollis lotus and stereisporityes sp within the interval, the paleoenvironment ranges from Late Miocene- Early Pliocene. The Palynological P850zone identified which coincides with the base of the overlying P860 subzone include abundance of Zonocostites ramonae, rich occurrence of Stereisporitessp, Retibrevitricolporites obodoensis,and Psilatricolporitescrassus,scanty Nympheapollislotus, and Multiareolites formosus as well as the presence of Peregrinipollisnigericus which was used to characterize the age of the sediment as late Miocene (Otto et at., 2022).

2. DESCRIPTION OF STUDY LOCATION

Uquo in Esit Eket is located in the southern part of Akwa Ibom State. Esit Eket Local Government area administrative headquarter is in the Uquo town. The study area (Uquo) is located at 4° 39' 21.619" North and 7 56' 0.493" East, Village closer to Uquo are Ekepene Obo, Ikpa , Akpa Utong, Etebi, Odoro Nkot, Urua okok, Efoi, Eket e.t.c

Quick Response Code	Access this article online	
	Website: www.geologicalbehavior.com	**DOI:** 10.26480/gbr.02.2024.130.135

Cite The Article: Ifiok Ibanga, Abasiibiangake Etuk, Otto Augustina I (2024). Biostratigraphy Study of Uquo Well 12, Oml 13, of Uquo Field, Niger Delta, *Geological Behaviour 8(2): 130-135.*

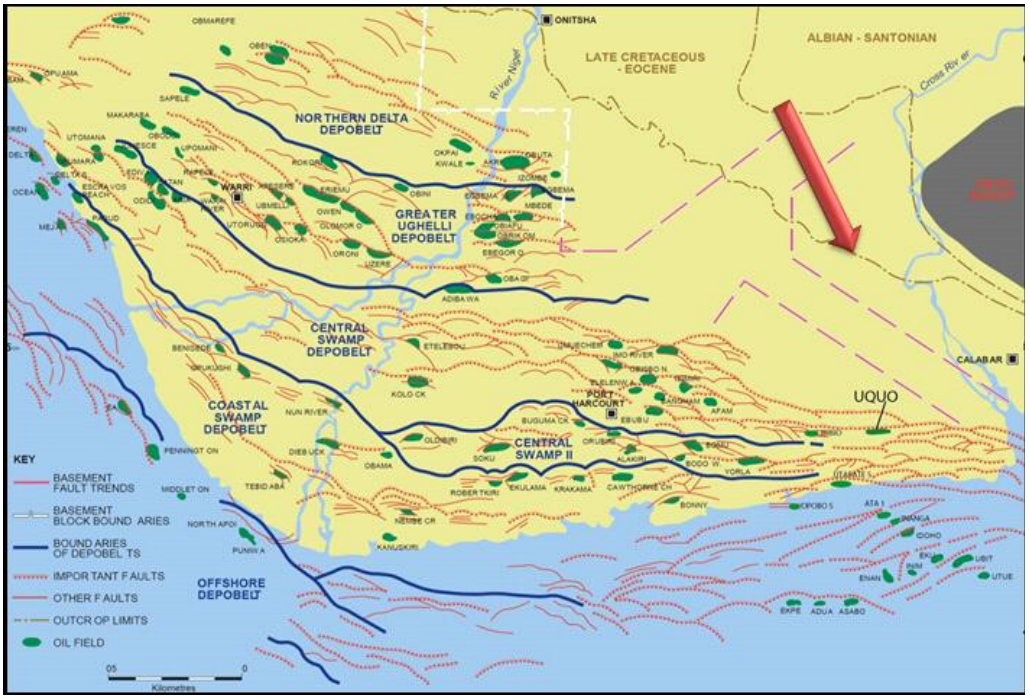

Figure 1: Map of Esit Eket Showing the study Area

The tidal variation ranges between 1.5m to 1.8m and defines the limits of partial saturation of the superficial soil, which is significantly influenced by the hydrology of the rivers and series of seasonal streams. The undulating lowland is characterized by extensive and irregular distribution of near shore course - fine grains permeable sands. These sands are subject to enormous seepage pressures, as they are often mined for local construction projects.

Three depositional cycles and lithostratigraphic subdivision of upper sandy continental Benin formation, intervening unit of alternating sandstone and shale (Agbada formation) and lower shaly Akata formation have been identified in the Niger Delta area (Short and Stauble, 1967; Avbovbo, 1978, etc). The structural geology, sedimentology and petroleum geochemistry of the Niger Delta have been published by several workers (Tuttle, et al., 1999; Weber and Daukoru, 1975, etc.). The accumulation and retention of hydrocarbons was published by (Whiteman, 1982; Stacher, 1995; Ekweozor, 1980). Palynological studies in Nigeria in the past four and a half decades were primarily based on the needs of the oil industries and information on them has remained confidential.

Most of the studies were largely concerned with systematic descriptions of pollen and spores, palynological zonations and biostratigraphy. Apart from the published works of the Late Quaternary Eastern Niger Delta. It will serve as a contribution to the knowledge of the Niger Delta environmental changes as reflected by vegetation particularly at Miocene/Pliocene periods where there is a dearth of published information. A Late Miocene Late-Pliocene age belonging to P850, P860, P860, P870, P880 and P920 zones of a group researcher were established for the interval under study (Evamy et al., 1978).

3. Methodology

3.1 Materials

Sample bags, Slides, Cover slips, Norland optical adhesive, vial, Price tags. Medicated spirit, Beakers, watch glass, Soap (optional), was used.

3.2 Method

This method includes; Desk study, Field study and Laboratory text.

3.3 Desk Study

Geographic maps, Topographic maps, online publications and previous work of area were studied.

3.4 Field Study

Ditch cutting samples from OML-13 were collected. The studied section ranged from 1720ft-2860ft with a total of twenty samples selected for palynology analysis at 60ft intervals.

3.5 Laboratory Study

Samples were labeled and described to avoid contamination, the prepared sample is washed in 0.5mircon sieve, sample analysis/taxonomy was carried out, then Charting and Report writing.

3.5.1 Sample Preparation

POM (particulate organic material) is made-up of Carbonate (HCL), Silicate (HF) and Organic material Sample preparation has three (3) sub-disciplines which are, palynology, foraminifera, calcareous Nano-fossil. Due to the hazardous and expensive nature of HCL, HF and HNO_3, Sodium Hexametaphosphate is using to loosen Clay matrix, this is because Sodium Hexametaphosphate keeps the organic material and mineral walls intact.

3.5.2 Procedure

- Labelled sample is carefully place in a beaker
- The prepared sample is soaked in water and a spoonful of sodium Hexametaphosphate is added
- The sample is washed after 12hours in a sieve of 0.5microns then turned into a watch glass (Swirl the watch glass gently for the residue to settle)
- Supernatant (floated particles) Is turned gently into a vial
- A cover slip is placed on a hot plate then at moderate heat, the supernatant is spotted on the cover slip using a pipette, the spotted side (supernatant) is allowed to dry (avoid bubbles)
- Then three drops of Norland optical adhesive is dropped on the cover slip (spotted side) and Placed on the slide, then the slide is expose to sunlight, the slide is clean with a medicate spirit.
- The slide is mounted on a microscope and viewed.

4. Results and Discussion

4.1 Palynology

The recovery of pollen and spores from sediments has proven useful in providing information about the stratigraphy and depositional environments of geologic formations, hence, they have become valuable tools in the understanding of environments characterized by different lithofacies sequences (Evans and Sunday, 2018). The sample at intervals 1720ft -2860ft analyzed palynologically yielded a fairly to moderately amount of palynomorphs, at most depths they were practically no palynomorphs (PNP).

Table 1: Shows Palynomorphs recovered at each depth

Depth(ft)	Palynomorphs	Occurrence
1720-1780	Verrucatosporite tenellus	**1**
	Acritarch sp	**1**
	Fungal spore	**1**
1780-1840	Dinocyst interminate	**1**
	Fungal spore	**1**
	Pluricellaesporite psilatus	**2**
1840-1900	Fungal spore	1
	Psilatricolporite crassus	4
	Smooth tralete spore	2
	Smooth monolete	1
	Polypodiaceisporite sp	2
	Acritarch spore	1
	Psilastephanocolporite laevigatus	1
	Psilatriporites spore	1
1900-1960	Fungal spore	5
	Foraminiferal lining	4
	Verrucatosporites alienus	2
	Smooth monolete spore	10
	Dinocyst interminate	3
	Acritarch spore	3
	Monoporites annulatus	2
	Smooth trilete spore	7
	Verrucatosporite tenellis	1
	Botryoccocus braurim	2
	Psilatricelporites crassus	1
	Pachydermites diederixi	5
	Psilastephanocelporites laevigalus	1
	Polypodiaceiosporite sp	2
	Retitricolporites amazoerisus	1
	Leiosphaeridia spore	2
	Stereisporite spore	1
	Aletesporite spore	1
	Zonocoslites ramonae	1
1960-2020	Botryoccous braunii	3
	Smooth monolete spore	3
	Retitricolporite irregularise	2
	Foraminiferal lining	7
	Psilastephanocolporite laevigatus	1
	Pachydermites diederxil	2
	Echistephanoporites echinatus	1
	Echiperiporite estaleae	3
	Polypodiacuosporite sp	1
	Nympheapollis lotus	1
	Dino intermidate	1
	Zonocostites ramonae	3
	Aletesporite spore	1
	Fungal spore	2
	Verrucatosporites alienus	1
	Acritarch spore	2
	Brevicelporite guinettii	1
	Fungal hyphae	1
	Polypodiacelosporite retirugatus	1
	Polyadopollerites spore	1
	Smooth trilete spore	2
2020-2080	Acritarch	2
	Fungal spore	2
	Smooth monolete	3
	Foraminiferal lining	3
	Echistephanoporites echinatus	2
	Zonocostites ramonae	1
	Psilatricolporites crassus	1
2080-2140	Zonocostites ramonae	1
	Botryoccocus brauim	1
	Verrucatosporite alienus	1
	Pediastrum spore	1
	Smooth tralete spore	1
2140-2200	Dinocyst intermidate	1
	Fungal spore	1
	Smooth monolete spore	1
	Foraminiferal lining	2
	Brevicolporite guinettii	2
	Monoporite aunnulatus	1
	Smooth tralete spore	1
	Acritarch	1
2200-2260	Foraminiferal lining	1
	Smooth monolete spore	1
	Smooth tralete spore	1

Table 1 (Continue): Shows Palynomorphs recovered at each depth		
	Verrucatosporite tenellus	1
2260-2320	Smooth monolete spore Fungal spore Foraminifera lining Aletesporites spore Rugulatisporite caperatus Verrucatosporites alienus Cyperaceopollis spore	1 1 3 1 2 2 1
2320-2380	Smooth monolete spore Psilatrocelporite crassus Cyperaceopollis spore Foraminiferal lining Verrucatosporites alienus Smooth tralete spore Verrucatosporites tenellus Fungal spore Verrucosisporites Psilatricelporite spore Echiperiporite estalae	1 2 1 1 1 2 1 1 1 1 1
2380-2440	Psilatrocelporite crassus Smooth tralete spore Cyperacopollis spore Smooth monolete spore Psilatricolporite spore	2 1 1 2 1
2440-2500	Foraminifera lining Smooth tralete spore	1 1
2500-2560	PNP	
2560-2620	Pachydermites diederixii Smooth trilete spore	1 2
2620-2680	Foraminifera lining Fungal spore Smooth trilete spore	1 1 1
2680-2740	PNP	
2740-2800	Dinocyst intermidate Smooth monolete spore	1 1
2800-2860	Acritarch Verrucatosporite tenellus Verrucatosporite alienus	1 1 1

5. Data Interpretation

In the study area, the distribution of palynomorphs taxa were used as a tool for the interpretation of the paleoenvironmental condition under which the sediments were deposited (palynomorphs were identified).

Interpretation:

(**1720-1780):** The spore assemblage gotten here was verrucatosporites tenellis, while fungal was found and Acritarchs sp and there were of same occurrences.

1780-1840: Here fungi was found which was pluricellaesporites psilatus and had the occurrence of (2) as the abundance in this depth and fungi spore was included and Dinocyst indeterminate was found.

1840-1900: Pollen assemblage gotten here was psilatricolporites crassus which was more abundant. The spore recovered here includes; smooth trilete spore, smooth monolete, polypodiaceisporite sp, psuilatriporites sp, and psilastephanocolporite laeuigatus which is found the fresh water/forest and acritarch spore and fungi spore.

1900-1960: Spores recovered were smooth monolete spore which was abundant smooth trilete spore which was next in adundant, polypodianceiosporite sp, verrucatosporites alienus, stereisporite spore, aletesporite spore, leiosphaeridia spore. The pollen assemblages gotten include; Zonocostites ramonae, retitricolporites amazorisus. Others were fungi spore, Botroyoccocus braurim, pachyderites diederixi and foram test lining were also present and Acritarch spore.

1960-2020: Spore recovered were; Smooth monolete spore, polypodiacuosporite, smooth trilete spore, polyadopollerites spore, Nympherapollislotus which is a marker was found, Echiperiporites estelae, Acritarch spore, Botryoccous braunii, Retitricolporite irregularise, Pachydermites diederixil, Echstephanoporites echnatus, Breuicelporite gunitetti, fungal hyphae and here foram test lining was abundant.

2020-2080: Spore recovered were; smooth monolete spore, fungal spore, Acritarch, Psilatricolporites crassus, Echistephanoporites, foram test lining were seen also in the sample.

2080-2140: Zonocostites ramonae, Botryoccocus brauim, verrucatosporite alienus (spore) Pediastrum spore, and smooth tralete spore were found

2140-2200: Here mostly smooth monolete spore, smooth trilete spore, monolete annulatus, fungal spore, also Breucolporite guinetti, Acritarch and Dinocyst intermidate were found.

2200-2260: A few of smooth monolete spore, smooth trilete spore, Verrucatosporite tenellus which are all spores were found ,foram test lining was also found.

2260-2320: Foram test lining was abundant, here with (3) occurrence, smooth monolete, Verrucatosporites alienus, Aletesporite spore, Rugulaatisporites caperatus, cyperaceopollis spore (which is a marker) and Foram test lining was found.

2320-2380: Spore recovered were; Smooth monolete spore, Verrucatosporites alienus, smooth trilete spore, Verrucatosporites tenellus, Pollen assemblage were; Psilatricelporite spore, A maker Cyperaceopollis spore was found Psilatrocelporite crassus, fungal spore, Foram test lining was found and Echiperiporite estale.

2380-2440: Here there were mainly spore recovered which include psilatrocelporite crassus, smooth trilete spore, cyperacopollis spore (marker), smooth monolete spore and psilatricolporite spore.

2400-2500: Few spores were found; smooth trilete spore and Foraminifera lining.

2500-2560: Partically no Palenomoprphy

2560-2620: Spore recovered was smooth trilete spore and Pachydermites diedeixii.

2620-2680: Smooth trilete spore, fungal spore, foram test lining was found.

2680-2740: Partically no palenomorphy.

2740-2800: Smooth monolete spore and Dinocyst intermidate

2800-2860: Few species of spores were found Verrucatosporites tenellus, Verrucatosporite alienus and Acritarch were found.

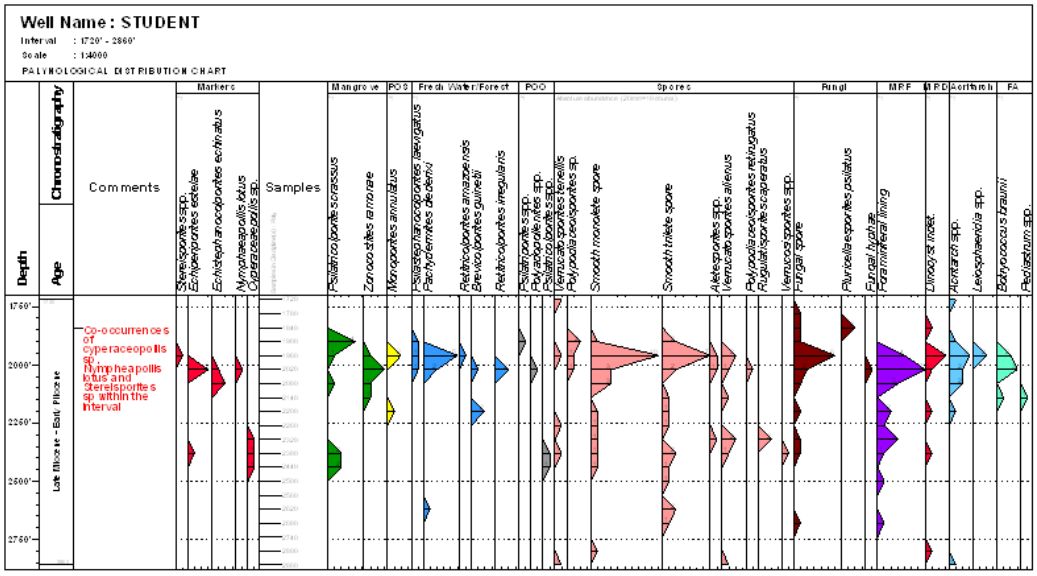

Figure 2: Showing the depositional environment and palynomorphs of UQ – 12 well

6. Age Determination

Due to co-occurrences of the Cyperaceopollis sp, Nympheapollis lotus and stereisporityes sp within the interval, the paleoenvironment ranges from Late Miocene- Early Pliocene.

Table 2: Shows species name, types and environment of deposition

Species Name	Type of Polynomorphs	Environment of deposition
Zonocostites ramonae	Pollen	Mangrove
Verrucatosporites alienus	Spore	Low forest
Fungal spore	Spore	Lagoon
Pachydermites diederixii	Pollen	Fresh water/forest
Nympheapollis clarus	Pollen	Lowland rainforest
Botryococcus braunii	Algae	Fresh water
Aletesporite spore	Spore	
Psilatricolporites Crassus	Spore	Mangrove

7. Paleo-Environment Interpretation

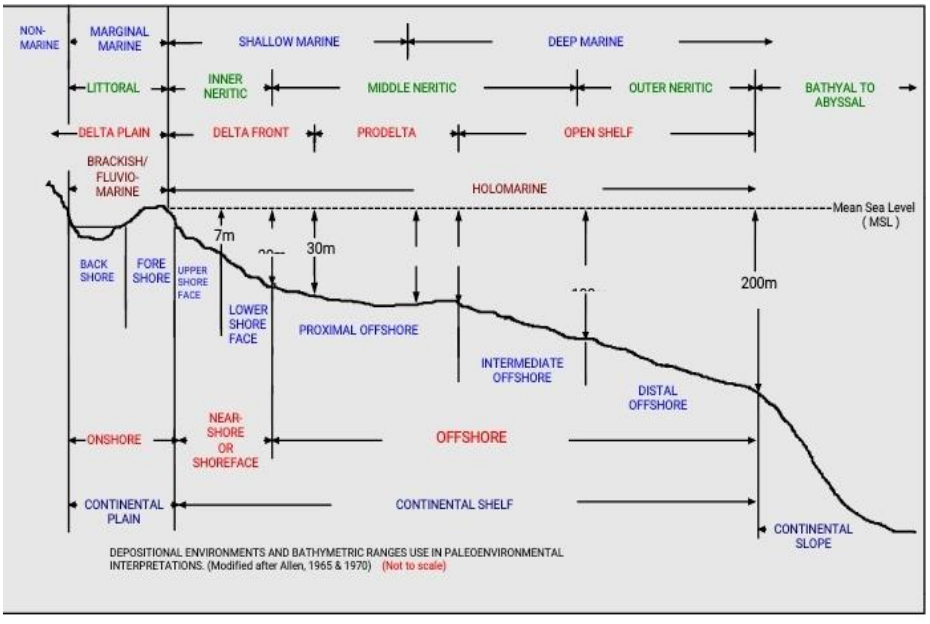

Figure 3: Showing the depositional environment and Bathymetric range use in paleo-environment

7.1 The Characteristics of the Foreshore Environment Are:

- Moderately low to moderately high(21-60%) coastal brackish water swamp community element
- Moderately high(31-60%) hinterland fresh water swamp/forest elements
- Very low to moderately low (6-30%) savanna element
- Extremely low (2-5%) concentration of montane elements Absence of sporadic marine elements (<2%).

8. Conclusion

The study area is a foreshore environment and the characteristics are: moderately low to moderately high coastal brackish water swamp community elements, moderately high hinterland fresh water swamp/forest elements, absence of sporadic of marine element therefore

samples here has relatively few contents.

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