Palynological Zonation of Oligocene to Early Miocene Sediments of Greater Ughelli Depobelt, Niger Delta Basin

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ABSTRACT: Palynological zonation of Oligocene to Early Miocene sediments of Greater Ughelli Depobelt Niger Delta Basin was carried out using One hundred and ninety (190) ditch cutting samples ranging from 20ft.-11,820ft. (6.09m-3603.7m), by identifying the different species of palynomorphs present as well as using stratigraphic significant diagnostic palynomorphs to age date and zone the well section, Nine hundred and sixty four (964) species of palynomorps were recovered.Nine hundred and fifty four (954) were miospores(pollen and spore) and ten(10) were Dinocysts.The presence of diagnostic palynomorphs such as *Praedapollis africanus, Peregrinipollis nigericus, Retibrevitricolporites obodoensis* aided in the establishment of the age and three P-zones in the well. The age of the well section range from Oligocene to Early Miocene.The P-zones established are *P560, P580 and P620* zones. P620 and P580 Zones were lumped together and was established based on the occurrence of Top *Pradapollis africanus* at 4500ft and quantitative base of *Peregrinipollis nigericus* at 7620ft.This zone were lumped together because Top/FDO *Cicatricosisporites dorogenesis* (30)/*Gemmatriporites sp* (573) which represents the base of P620 zone and top of P580 zone were undefined.P560 Zone was defined by the appearance of quantitative base *Peregrinipollis nigericus* at 7620ft and increase *Retibrevitricolporites obodoensis* at 11580ft.

The Niger Delta is the most significant hydrocarbon province on the West African continental margin. It lies mainly in the Gulf of Guinea to the southwest of the Benue – Trough and constitutes the most important Cenozoic deltaic construction in the south Atlantic. Because of its petroliferous nature, the economy of Nigeria depends largely on the oil and gas derived from it. The Cenozoic Niger Delta is situated at the intersection of the Benue Trough and the South Atlantic Ocean where a triple junction developed during the separation of South America and Africa in the Late Jurassic (Whiteman, 1982). Geologically it is found in the Tertiary period in the geologic column. The combination of source rock, lithologic types, structures and thermal history of the basin are favorable for the generation, accumulation and retention of hydrocarbons (Whiteman, 1982; Stacher, 1995). The use of lithofacie and palynology as tools and components in evaluating sedimentary pile and basin analysis has become increasingly important in recent times as seen in works by (Germeraad *et al.*, 1968;Oloto, 1994;Chiaghanam *et al.*, 2013; Lucas, 2017).

Biostratigraphy is an essential tool for dating rocks and identifying the biotic record through time and is necessary for establishing temporal correlation, reconstructing paleogeography as well as recognition of oil and gas deposits and intervals. It is essential to the petroleum industry as a tool for defining geologic constraints on prediction of exploration risk and modeling reservoir simulation.(Allmon, 1993) stated that paleontology is still a necessary geologic tool because the geologic time scale is based on fossils, fossils are still the primary tool for dating sedimentary rocks and fossils records the history of life and environmental changes.

This study is aimed at establishing a palynological zonation framework of sedimentary succession penetrated by the drill.
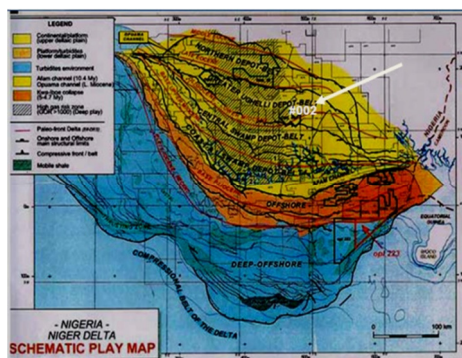

Fig. 1: Depo belts of Niger delta Nwozor*et al.,(*2013)

MATERIALS AND METHOD
Fifty (50)selected ditch cutting samples were collected from the well ranging from 20ft. (6.09m) to 11,820ft. (3603.7m) were utilized for palynological slide

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preparation. The slides were analyzed under the microscope for palynological content.

Palynological Sample Preparation: The sample preparation was carried out following the international standards given below:

10g of sample was crushed between aluminum pie dishes, collected and tested for limestone ($CaCO_3$) using HCl, while effervescence occurred, the limestone was eliminated by further addition treatment with concentrated HCl.

After two or three hours, the sample was decanted and the waste solution transferred to one special waste container bottle. The broken down mineral material and fossils were removed and centrifuged for about 1-2 minutes and decanted repeatedly until a neutral reaction was reached. Concentrated HNO_3 was used for oxidization and heated over bunsen burner. KOH of 10% solution was added to the sample and transferred to styrofoam cups and HF added and let to stand overnight. The sample was then washed with water until a neutral reaction was reached and decanted. Sodium hypochlorite (Purex) as well as some drops of HCl was added, agitated and let for about 15 minutes. Two drops of Ammonium Hydroxide concentrate was added and diluted with water. At this stage, separation of the organic matter from the inorganic material (silica) was done by floatation using diluted zinc bromide (ZnBr). The samples were transferred to a flexible plastic tubes, already prepared (cut and mount immersed into warm water); such plastic tubes are set into centrifuge tubes with water around them. Zinc bromide has a specific gravity of 2.2 thus, everything with a specific gravity of more than 2.2 will settle down. The process of centrifugation using zinc bromide took about 15 minutes. A small portion of the supernatant liquid was observed under the microscope. Then, a clip across the flexible plastic tube was inserted so that the supernatant liquid would be easy to take out by pipette decantation or eye dropper.

Palynomorphs Distribution Chart: A palynomorph distribution chart was established based on the first appearance datum (last downhole occurrence) and last appearance datum (first downhole occurrence) of each palynomorph identified in the well section. The recovered Miospores are as follows:

Miospores recovered are:Polypediaceisporites, Verrucatosporites usmensis, Dichtyphidiles harassi, Crototricolpites crotonoisculptus, Echiperiporites estelae, Smooth trilate spore cf. Acrostichun aureum,

Pradapollis africanus, Retibrevitricolporites obodoensis, Laevigatosporites smooth monolete spore, Classopollis, Retitricolporites irregularis, Proxapertites operculatus , Praedapollis flexibilis, Psilatricolporites crassus, Sapotaceae pollenites , Pachydemites diederixi , Psilamonocolpites marginatus , Arecipites exilimuratus, Striatmonocolpites rectostriatus, Striatricolpites catatumbus, Monoporites annulatus, Numulipollis neogenicus, Verrucatosporites usmensis, Stereisporites , Zonocostites ramonae , Spirosincoporites brunnii , Polygalaceae , Cinctiperiporites mulleri, Racemonocolpites hians, Grimsdalea baculatus , Magnastriatites , Cyperoceapollis sp , Retimonocolpites obaensis, Magnastriatites hawardi , Racemonocolpites rarispinosus, Psilaheterecolpites, Pediastrum,Belskipollis elegans, Polyadopollenites vancampori , Bombacacidites , Echitricolpolrites spinosus , Ericipites .

Recovered Palynomorphs that were stratigraphically significant and environmentally necessary were plotted in order to interpret the P-zones and zonal age dating of the well See plate 1 and tables 2.

Microscopic view of the supernatant liquid decided how to clean, run acetolysis or stain. Add acetic anhydride and three of four drops of H_2SO_4 to take out the water, then immerse test tube in boiling water for about ten minutes. The sample was properly washed at each stage. Here, it was ready for cleaning and mounting; during this stage several views under the microscope accomplished with some attempt to get mainly fossil material was done. The palynomorph counting and logging were done by straight transects across each slide and coordinates. The recovered palynomorphs species were identified with the aid of Shell palynological photo album, other relevant publications and manuals such as web-based albums. Morphological characters of the pollens and spores such as the size, exine, structure, shape, sculpture and aperture type provided the basis for the identification of the forms. Species name and their abundance were recorded in the analysis data sheets.

RESULT AND DISCUSSION

Palynomorphs that were stratigraphically significant and environmentally necessary were recovered in the analyzed samples and were plotted in order to interpret the Palynostratigraphy/P-zones and age of the well section. The pollen and spores recovered are relatively moderate in abundance.

*Palynological Count:*From the analyzed palynological slides, Nine hundred and sixty four (964)palynomorphs species were identified.Nine hundred and fiftyfour (954) were Miospore (pollen and spore) and ten

(10)were Dinocysts. The palynomorph distribution with   depth is shown in table 1.

.**Table 1:** Occurrence and distribution of Palynomorphs

S/N	DEPTH (ft.)	DEPTH (m)	POLLEN	SPORES	MIOSPORES	DINOCYSTS	TOTAL PALYNOMORPHS
1.	1640	500	0	8	8	2	10
2.	1760	536	2	0	2	0	2
3.	1940	591	0	5	5	3	8
4.	4500	1372	7	5	12	3	15
5.	4560	1390	10	1	11	0	11
6.	4620	1408	8	3	11	0	11
7.	4680	1426	6	1	7	0	7
8.	4820	1469	14	5	19	0	19
9.	5040	1536	3	7	10	0	10
10.	5100	1554	12	9	21	0	21
11.	5340	1628	6	20	26	0	26
12.	5400	1646	32	20	52	0	52
13.	5460	1664	18	7	25	0	25
14.	5580	1701	6	13	19	0	19
15.	5700	1737	8	19	27	0	27
16.	5820	1774	4	8	13	0	13
17.	5980	1823	10	8	18	0	18
18.	6100	1859	7	11	18	0	18
19.	6220	1896	8	10	18	0	18
20.	6340	1932	4	7	11	0	11
21.	6400	1951	11	14	25	1	26
22.	6520	1987	8	15	23	0	23
23.	6580	2006	9	8	17	0	17
24.	6700	2042	14	16	30	0	30
25.	6940	2115	12	18	30	0	30
26.	7060	2152	10	13	23	0	23
27.	7180	2188	2	6	8	0	8
28.	7300	2225	4	7	11	0	11
29.	7440	2268	44	38	82	0	82
30.	7620	2323	32	19	51	0	51
31.	7800	2377	35	16	51	0	51
32.	7860	2396	28	18	46	0	46
33.	8060	2457	6	8	14	0	14
34.	8180	2493	7	13	20	0	20
35.	11040	3365	17	14	31	0	31
36.	11100	3383	20	14	34	0	34
37.	11160	3402	17	11	28	0	28
38.	11280	3438	21	14	35	1	36
39.	11400	3475	6	2	8	0	8
40.	11580	3530	15	9	24	0	24
41.	11640	3548	7	7	14	0	14
42.	11760	3584	6	10	16	0	16
	TOTAL				954	10	964

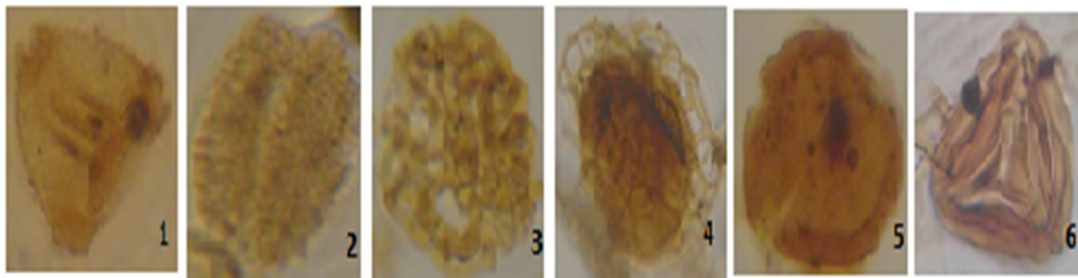**Plate 1:** 1. Retibrevitricolporites obodoensis (178), 2. Racemonocolpites hians (250), 3. Peregrinipollis nigericus (399, 4. Praedapollis africanus(443), 5. Pachydemites diederixi (317), 6. Magnastriatites hawardi (9)

Table 2: Range Chat of recovered diagnostic Palynomorphs

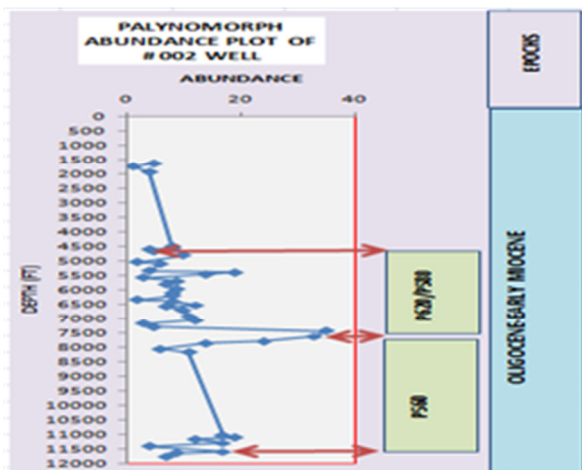| DEPTH (FEET)	Polypediaceisporites	Verrucatosporites usmensis	Dichtyphidiles harassi	Echiperiporites estelae	Pradapollis africanus	Retibrevitricolporites obodoensis	Retitricolporites irregularis	Praedapollis flexibilis	Psilatricolporites crassus	Pachydemites diederixi	Arecipites exilimuratus	Striatmonocolpites rectostriatus	Striatricolpites catatumbus	Monoporites annulatus	Spirosincoporites brunnii	Cincticeriporites mulleri	Racemonocolpites hians	. Peregrinipollis nigericus
1640	1	3	4															
1760				1														
1940			3	1														
4500	1		3		2	1	2											
4560						1	3	3	1									
4620			2				2											
4680			1				2			1								
4820		2	1			1	2				1	2	1	1				
5040		3	1										1					
5100	1										1				1	1		
5340		3					3						1					
5400		4	3				4	2	1		3					1	2	
5460	1	2	1		2		5	2				1			1			
5580	1					1				1								
5700	3	2	2						1		2							
5820	2										3							
5980	2									1	3							
6100	1	1					2				3		1					
6220		2	3		1		3	1			1			1				
6340		4									1			1				
6400	1	1			1		4				1							
6520	3	4	2				4		1		1							
6580	1	1					1		1		1							
6700	2	1									5						3	
6940	3	6	2				2	2					1				1	
7060	3	6					3	2			3						1	
7180	1		2															
7300		1						1						1			1	
7440	1	28	3				1				11	4					9	
7620	6		3		3	1	4			1	4			1	1		2	1
7800	1	7	3		2			2					2	1	2	2	6	
7860	2	8		1	2		2				3	1		2			1	
8060	2	3			1										2		1	
8180	2	1	2				6			1								
11040		5	2		1		3	2		2	2	1	1			1	2	
11100	1	3	2			2				3	3	1			1		2	
11160										4							3	
11280	2	4	2		2			1			5	2						
11400										2					1			
11580	2	6			2	2	1			2	4	1			2		1	
11640	1		4		2						1						1	
11760	1	2	1				2				2	1						

Fig. 3: Palynological abundance pattern of the well

Palynological Zones: P620 and P580 Zones: This zones were lumped together and was established based on the occurrence of Top *Pradapollis africanus* at 4500ft and quantitative base of *Peregrinipollis nigericus* at 7620ft. This zone was lumped together because the Top/FDO *Cicatricosisporites dorogenesis* (30)/*Gemmatriporites sp* (573) which represents the base of P620 zone and top of P580 zone were undefined.

P560 Zone: Top of this zone was defined by the appearance of quantitative base *Peregrinipollis nigericus* at 7620ft and and increase *Retibrevitricolporites obodoensis* at 11580ft.

Age Determination: The presence of diagnostic palynomorphs such as *Praedapollis africanus, Peregrinipollis nigericus, Retibrevitricolporites*

obodoensis aided in the establishment of *P620, P580 and P560* Zones which concurs with the Oligocene to Early Miocene Age of paralic sequence Doust and Omatsola, (1990).

Conclusion: The Palynological analysis of the studied samples was used to determine the Palynological zonation and age of the sediments penetrated by the drill.

The presence of diagnostic palynomorphs such as *Praedapollis africanus, Peregrinipollis nigericus, Retibrevitricolporites obodoensis* aided in the establishment of the age and P-zones in the well.

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