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PALYNOFACIES ANALYSIS OF PSA-1 WELL SEDIMENTS, NIGER DELTA BASIN: IMPLICATIONS FOR PALEOENVIRONMENTAL RECONSTRUCTION

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ABSTRACT

The Niger Delta basin is an important geological region of economic significance, serving as a critical oil and gas exploration area. Hence, there is a need to comprehend the geological history and environmental changes within the basin. Detailed palynofacies analyses, which provide crucial insights into paleoenvironmental conditions and organic matter preservation, are limited in the onshore depobelt. This study addresses this gap by focusing on a detailed palynofacies analysis of the PSA-1 well. Palynofacies analysis was carried out on ninety ditch-cutting samples from the PSA-1 well, located in the onshore Niger Delta Basin, to delineate the paleoenvironment of deposition across depths from 3520–6160ft. Standard acid maceration and microscopic examination were utilized; 200 palynomaceral counts were made per slide to determine the abundance and size fractions of each group. Four lithofacies units were identified through physical examination and textural characteristics, namely: shaly sandstone, clayey sandstone, mudrock, and shale facies. The palynofacies assemblage is quantitatively dominated by medium and small-sized fractions of Palynomaceral-1 (PM1) and Palynomaceral-2 (PM2), moderate amount of Palynomaceral-4 (PM4) with lesser amounts of Palynomaceral-3 (PM3). Moderate records of Structureless Organic Matter (SOM) was also observed. The consistent high percentage of phytoclasts PM1, PM2 and low to moderate percentage of amorphous organic matter (AOM) established a predominantly proximal depositional setting, suggesting a Terrestrial-Brackish swamp environment characterized by fluctuating energy conditions, such as a shifting deltaic or estuarine system.This study contributes to the depositional framework and organic matter distribution within the onshore Niger Delta and beyond.

Keywords: Palynofacies, Palynomacerals, Paleoenvironment, Lithology, Structureless Organic Matter (SOM)

INTRODUCTION

Palynofacies are acid-resistant organic matter remaining after chemical digestion, serving as crucial tools in various geological applications. They are highly effective for stratigraphic analysis, including biostratigraphy, chronostratigraphy, and sequence stratigraphy, and are instrumental in age determination, paleoenvironmental reconstruction, paleogeography, paleoecology, paleoclimate studies, hydrocarbon generation potential, and sea-level change analysis (Batten, 1982; Fadiya et al., 2021; Abdelhalim et al., 2025; Aigbadon et al., 2022; Alege et al., 2020a; Alege et al., 2023a; 2023b; Alege et al.,2025). The term "palynofacies" also refers to the microscopic examination of specific organic components, such as kerogen and palynomacerals, within unconsolidated strata (Batten & Stead, 2005; Thomas et al., 2015; Chukwuma-Orji et al., 2019). While palynofacies assemblages effectively identify conditions of their local depositional environment, it is important to note that they can sometimes present a non-representative palynofloral assemblage for a specific locality (Mendonça Filho et al., 2012). The evolution of the Niger Delta basin spans from the early tertiary period, a time of regression and increased clastic sedimentation. It existed at the center of a triple junction and resulted in the formation of a trough as the failed arm of a rift system, linked to the separation of the South American and African plates (Alege et al., 2020b; Obaje, 2009; Mascle, 1976). The basin encompasses the coastal, ocean-facing region of the Benue Trough, which ties its geological development to this larger sedimentary complex (Ogbahon et al., 2019). Its formation is intricately linked to tectonic processes, sedimentation, and eustatic sea-level changes. Amogu (2011) emphasized the role of extensional tectonics and faulting in shaping the structural framework and the importance of faults in hydrocarbon accumulation and redistribution in the basin. The Niger Delta Basin consists of growth faults, antithetic faults, shale diapirs, collapsed crest structures, salt structures, and rollover anticlines, which can be delineated by 3D seismic data and well logs, among other tools, giving information about potential reservoirs and map structures that are useful for hydrocarbon accumulation (Obasuyi et al., 2019). This also indicates a history of crustal deformation and basin subsidence, which influenced sedimentation patterns and hydrocarbon entrapment. The basin is a significant oil-generating region in Nigeria, as the country's economy depends largely on hydrocarbons (Williams et al., 2024).The stratigraphic fill of the Niger Delta Basin, as stated by Short and Stauble (1967), gives the lithostratigraphic subdivision for the Niger Delta Basin consisting of the upper sandy Benin Formation, an alternating unit of sandstone and shale named the Agbada Formation, and the lower shaly Akata Formation, and their age ranges from Tertiary to recent(Nton & Ogungbemi, 2011). Hence, there is a need to comprehend the geological history and environmental changes within this basin. Despite the established usefulness of palynofacies in assessing paleoenvironments, there is a lack of research addressing the sediments of the onshore depobelt, Niger Delta Basin. Previous studies by Alege and Joseph (2024) investigated the paleoenvironment of Miocene sediments in the onshore Niger Delta Basin using palynology. Olatunji (2022) utilized palynofacies analysis to determine the paleoenvironment of the offshore depobelt, Niger Delta Basin, concentrating on the relative abundance and types of organic matter (palynomorphs, phytoclasts, amorphous organic matter). Onyeachonam et al. (2021) employed palynofacies and organic thermal maturation to determine the kerogen types in Upper Cretaceous-Paleocene rocks in the Benin Flank, Anambra Basin. This research aims to expand knowledge on the paleoenvironment of deposition and organic matter distribution in the onshore depobelt of the Niger Delta using the palynofacies present in the PSA-1 well. This study focuses on the palynofacies characterization of the PSA-1 well, employing palynological analyses to determine depositional environments. The analysis follows standard acid maceration techniques to isolate organic matter, which is then classified into different palynomacerals based on morphological characteristics. By examining the PSA-1 samples of the onshore depobelt, Niger Delta Basin, the study aims to delineate lithologic units and analyze the Palynomaceral assemblages to interpret the depositional environment.

MATERIALS AND METHODS

Physical examination based on texture, colour, and size was used to identify the lithologies, giving a detailed description of the sample lithology (Oretade & Ali, 2021; Alege & Joseph, 2024). A careful palynofacies analysis was carried out on 90 ditch cuttings composited at an interval of 150ft, spanning depths from 3520-6160ft, to ensure representative coverage of the studied section and provide good resolution for identifying paleoenvironmental shifts. They were processed using the standard acid analysis method, followed by routine microscopic identification of plant materials. A 25g sample of the ditch cuttings was processed to yield the maximum quantity of organic matter. This was followed by the digestion of the samples using concentrated inorganic hydrochloric (HCI) and hydrofluoric (HF) acid. These acids were added to dispel carbonates and silicate content, respectively (Odoma & Aigbadon, 2024). Zinc bromide (ZnBr2) was then added, leading to heavy liquid separation of the organic content (Faegri & Iversen, 1989; Batten & Stead, 2005; Fadiya et al., 2021). Schulze's solution (HNO + KCIO) was used to gently oxidize excess amorphous organic matter. After acid maceration, the remnant palynomorphs were filtered using a 5-micron meter sieve to remove fine mineral particles and amorphous debris, preventing them from clogging slides and interfering with transmitted light during microscopic examination. The recovered organic matter was then arranged on the slide and viewed under a binocular transmitted light microscope for examination and identification conducted at x40 magnification. 200 palynomaceral of each type were counted and their size fraction percentages calculated to identify the dominant palynomaceral, classifying major classes based on Oyede's (1991) work.

The paleoenvironment of deposition was interpreted based on the abundance of PM 1, and PM 2 types with common records of PM4 type and SOM present.

RESULTS AND DISCUSSION

Lithology

Four lithologies were identified based on the physical characteristics of the ditch cuttings, such as size, colour, and texture (Alege & Joseph, 2024, 2025; Alege et al., 2024b; Aigbadon et al., 2024). The depth of the well ranges from 3520 ft to 6160 ft, with a thickness of 2640 ft.

Table 1: Lithological Description of the Samples Based on Depth

Depth (ft)	Lithology	Colour	Grain Size
3520-3910	Shaly-sandstone	Grey-brown	Fine-Coarse
3910-4000	Mudrock	Grey -brown	Fine-medium
4000-4150	Clayey-sandstone	Grey-brown	Fine-medium
4150-4750	Mudrock	Grey, yellow-brown	Fine-medium
4750-4780	Shale	Grey	Fissile
4780-5140	Mudrock	Grey-brown	Fine-Medium
5140-6160	Shaly-sandstone	Grey-brown	Fine-medium

The shaly-sandstone facies constitute approximately 62% of the total samples, comprising ~10% shale and ~90% sandstone. The Murdock facies account for about 30%, with a composition of 30% shale, 40% clay, and 30% fine- to medium-grained sandstone. The clayey sandstone facies represent roughly 7% of the PSA well, consisting of ~10% clay and ~90% sandstone. The shale facies, characterized by their grey color and fissility, comprise the lowest proportion among the identified facies.

Palynofacies Analysis and Paleoenvironmental Reconstruction

The palynofacies analysis of the PSA well resulted in a wide range of palynomacerals contained in (Fig 1), which shows the various palynomaceral types, and taxa within the study interval. It revealed an abundant occurrence of palynomaceral types I and II, with fewer occurrences of palynomaceral types III and IV, as well as a record of structureless organic matter (SOM). The interpretation of the palynofacies is based on the model proposed by Oyede (1991) and Chukwuma-Orji et al. (2019). The size distribution of each palynomaceral (PM) group was determined by counting 200 specimens of each PM type per slide. The medium- and small-sized structured fractions of PM1 and PM2 quantitatively dominate the palynofacies assemblage of the samples. Moderate records of PM4, smaller amounts of PM3, and structureless organic matter (SOM) were also recorded. The colour of the palynofacies types is predominantly dark brown to black(Table 3). The record of palynomacerals identified in the study include;

Palynomaceral 1 (PM1)

The PM(1) identified are irregularly shaped plant materials with colour ranging from orange-brown, dark brown to black. The PM(1) accounts for about 44% of the total plant materials found in the PSA well. They originate from plant debris such as resinous cortex material and gel-like substances. Their size ranges from Large to Medium to Small sizes. They are easily degraded by physical abrasion or in high-energy, oxidizing environments and generally indicate a continental environment.

Palynomaceral 2 (PM2)

They are brown to orange, structured plant materials such as leaves, algal detritus, stems, or small rootlet debris. This plant matter represents about 32% of the PM of the entire PSA-1 well. PM2 is less dense than PM1 and is associated with continental environments, particularly rainforests and freshwater swamps.

Palynomaceral 3 (PM3)

This is a pale-colored, structured material that occasionally bears stomata. They constitute a percentage of 8%. It is cuticular in origin and consists of degraded plant matter. PM3 may indicate vegetation from savannah to rainforest environments.

Palynomaceral 4 (PM4)

This is black, almost equidimensional, and typically blade- or needle-shaped. It is uniformly opaque, black, and structureless. PM4 may include coal, charcoal, or geothermally fusinized material. It is highly buoyant, resistant to degradation, and can be transported over long distances. They consist of about 16%. Unlike other palynomacerals, PM4 generally indicates brackish water swamp or fluvio-marine environments.

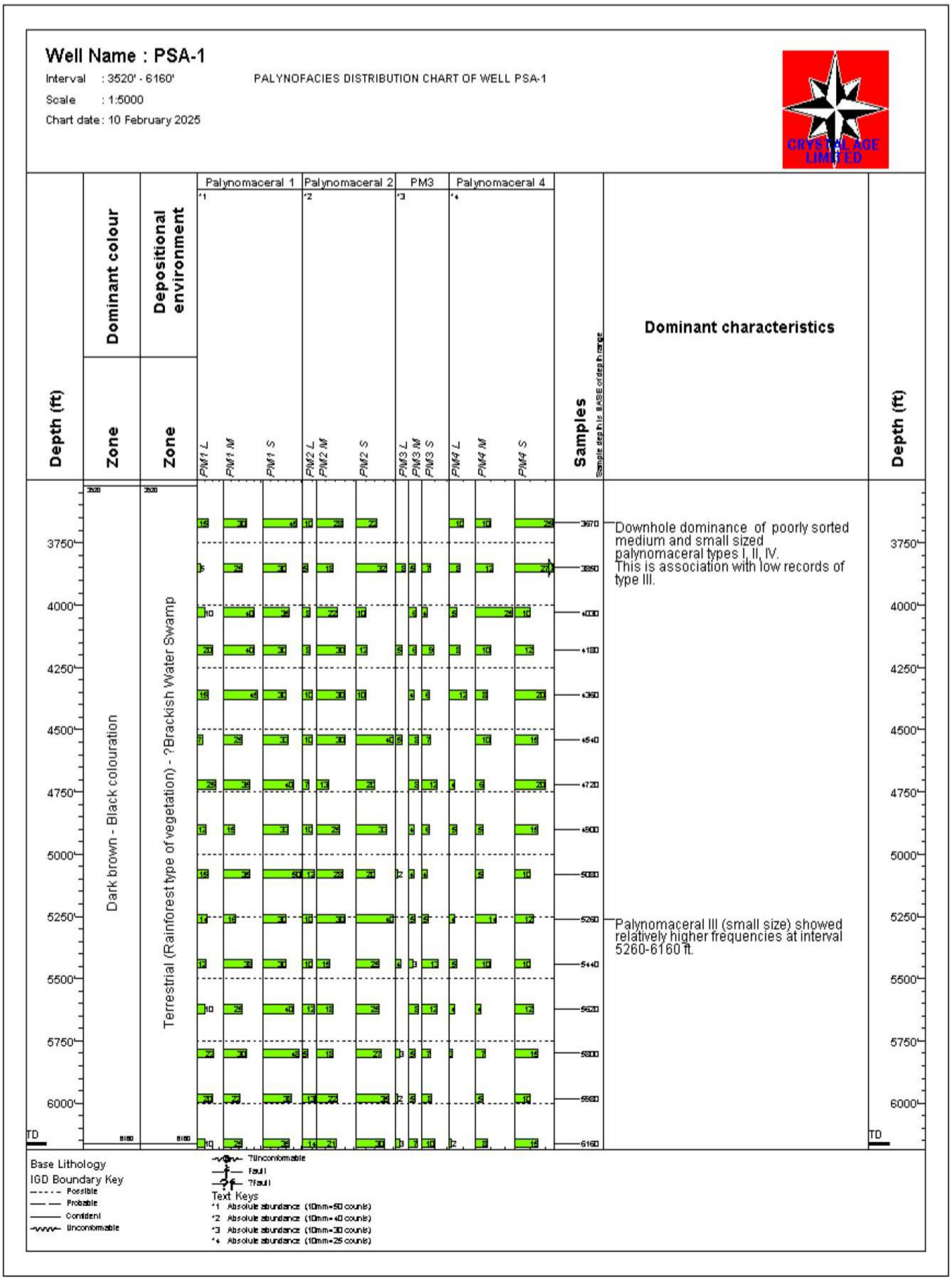

Figure 1: Palynofacies Distribution of the PSA-1 Well

Table 2: Statistical Result of the Palynofacies Analysis of PSA-1 Samples

Depth (feet)	Palynofacies / Counts of size fraction.			Counts of each PM	% Cts.
3520-3670	PMI	L	15	70	35
		M	30		
		S	45		
	PM2	L	10	60	30
		M	28		
		S	22		
	PM3	L	-		
		M	-	5	2.5
		S	-		
	PM4	L	10	45	22.5
		M	10		
		S	25		
	SOM			20	10
3700-3850	PM1	L	5	60	30
		M	25		
		S	30		
	PM2	L	5	55	27.5
		M	18		
		S	32		
	PM3	L	8	20	10
		M	5		
		S	7		
	PM4	L	8	42	21
		M	12		
		S	27		
	SOM:			23	11.5
3980-4030	PM1	L	10	85	42.5
		M	40		
		S	35		
	PM2	L	8	40	20
		M	22		
		S	10		
	PM3	L	-	10	5
		M	6		
		S	4		
	PM4	L	5	40	20
		M	25		
		S	10		
	SOM			25	12.5
4050-4180	PM1	L	20	90	45
		M	40		
		S	30		
		L	8	50	25
	PM2	M	30		
		S	12		
	PM3	L	5	20	10
		M	6		
		S	9		
	PM4	L	8	30	15
		M	10		
		S	12		
	SOM			10	5
4210-4360	PM1	L	15	90	45
		M	45		
		S	30		
	PM2	L	10	50	25
		M	30		
		S	10		

Depth (feet)	Palynofacies / Counts of size fraction.			Counts of each PM	% Cts.
	PM3	L	-	10	5
		M	4		
		S	6		
	PM4	L	12	40	20
		M	8		
		S	20		
	SOM			10	5
4390-4540	PM1	L	7	65	32.5
		M	25		
		S	33		
	PM2	L	10	70	35
		M	30		
		S	40		
	PM3	L	5	20	10
		M	8		
		S	7		
	PM4	L	-	25	12.5
		M	10		
		S	15		
	SOM			20	10
4570-4720	PM1	L	25	100	50
		M	35		
		S	40		
	PM2	L	7	40	20
		M	13		
		S	20		
	PM3	L	-	20	10
		M	8		
		S	12		
	PM4	L	4	30	15
		M	6		
		S	20		
	SOM			10	5
4720-4900	PM1	L	12	70	35
		M	15		
		S	33		
	PM2	L	10	80	40
		M	25		
		S	45		
	PM3	L	-	10	5
		M	4		
		S	6		
	PM4	L	5	25	12.5
		M	5		
		S	15		
	SOM			15	7.5
4930-5080	PM1	L	15	90	45
		M	35		
		S	50		
	PM2	L	12	60	30
		M	28		
		S	20		
	PM3	L	2	10	-5
		M	4		
		S	4		
	PM4	L	-	15	7.5
		M	5		
		S	10		
	SOM			25	12.5

Depth (feet)	Palynofacies / Counts of size fraction.			Counts of each PM	% Cts.
5110-5260	PM1	L	14	60	30
		M	16		
		S	30		
	PM2	L	10	80	40
		M	30		
		S	40		
	PM3	L	-	10	-5
		M	5		
		S	5		
	PM4	L	4	30	15
		M	14		
		S	12		
	SOM			20	10
5290-5440	PM1	L	12	80	40
		M	38		
		S	30		
	PM2	L	10	50	25
		M	15		
		S	25		
	PM3	L	4	20	10
		M	3		
		S	13		
	PM4	L	5	25	12.5
		M	10		
		S	10		
	SOM			25	12.5
5470-5620	PM1	L	10	75	37.5
		M	25		
		S	40		
	PM2	L	12	55	27.5
		M	18		
		S	25		
	PM3	L	-	20	10
		M	8		
		S	12		
	PM4	L	4	20	10
		M	4		
		S	12		
	SOM			30	15
5650-5800	PM1	L	22	100	50
		M	30		
		S	48		
	PM2	L	5	40	20
		M	18		
		S	27		
	PM3	L	3	15	7.5
		M	5		
		S	7		
	PM4	L	3	25	12.5
		M	7		
		S	15		
	SOM			20	10
5830-5980	PM1	L	20	80	40
		M	22		
		S	38		
	PM2	L	13	70	35
		M	22		
		S	35		

Depth (feet)	Palynofacies / Counts of size fraction.			Counts of each PM	% Cts.
	PM3	L	2	15	7.5
		M	5		
		S	8		
	PM4	L	-	15	7.5
		M	5		
		S	10		
	SOM			20	10
6010-6160	PM1	L	10	70	35
		M	25		
		S	35		
	PM2	L	14	65	32.5
		M	21		
		S	30		
	PM3	L	3	20	10
		M	7		
		S	10		
	PM4	L	2	25	12.5
		M	8		
		S	15		
	SOM			20	10

Table 3: Summary of the Palynofacies Interpretation of PSA-1 Samples

Depth (Feet)	Dominant Colour	Depositional Environment	Dominant Characteristics
3520 – 5260	Dark Brown – Black colouration	Terrestrial (Rainforest type of vegetation) – (?) Brackish Water Swamp	Downhole dominance of poorly sorted medium and small sized palynomaceral types I, II, IV. This is association with low records of type III
5260 – 6160TD			Palynomaceral III (small size) showed relatively higher frequencies at interval 5260-6160 ft.

Table 4: Distribution of the various Palynomacerals in the PSA-1 well

Depth (ft)	PM1	PM2	PM3	PM4	Phytoclast (PM1+PM2+PM3)
3520-3670	80	50	5	45	135
3700-3850	70	60	10	37	140
3980-4030	85	40	10	40	135
4050-4180	90	50	20	30	160
4210-4360	90	50	10	40	150
4390-4540	65	70	20	25	155
4570-4720	100	40	20	30	160
4720-4900	70	80	10	25	160
4930-5080	90	60	10	15	160
5110-5260	60	80	10	30	150
5290-5440	80	50	20	25	150
5470-5620	75	55	20	20	150
5650-5800	100	40	15	25	155
5830-5980	80	70	15	15	165
6010-6160	70	65	20	25	155
PM1=1205					
PM2=860					
PM3=215					
PM4=427					
Total Palynomacerals=2707					

Table 5: Distribution of the Various Palynofacies Components in the PSA- Well Based on Percentage

Depth (ft)	PM1	PM2	PM3	PM4	Phytoclast (PM1+PM2+PM3)	AOM (% count of PM4 + % count SOM)	% count of Phytoclast
3520-3670	80	50	5	45	135	32.5	67.5
3700-3850	70	60	10	37	140	30.0	70.0
3980-4030	85	40	10	40	135	32.5	67.5
4050-4180	90	50	20	30	160	20.0	80.0
4210-4360	90	50	10	40	150	25.0	75.0
4390-4540	65	70	20	25	155	22.5	77.5
4570-4720	100	40	20	30	160	20.0	80.0
4720-4900	70	80	10	25	160	20.0	80.0
4930-5080	90	60	10	15	160	20.0	80.0
5110-5260	60	80	10	30	150	25.0	75.0
5290-5440	80	50	20	25	150	25.0	75.0
5470-5620	75	55	20	20	150	25.0	75.0
5650-5800	100	40	15	25	155	22.5	77.5
5830-5980	80	70	15	15	165	17.5	82.5
6010-6160	70	65	20	25	155	22.5	77.5

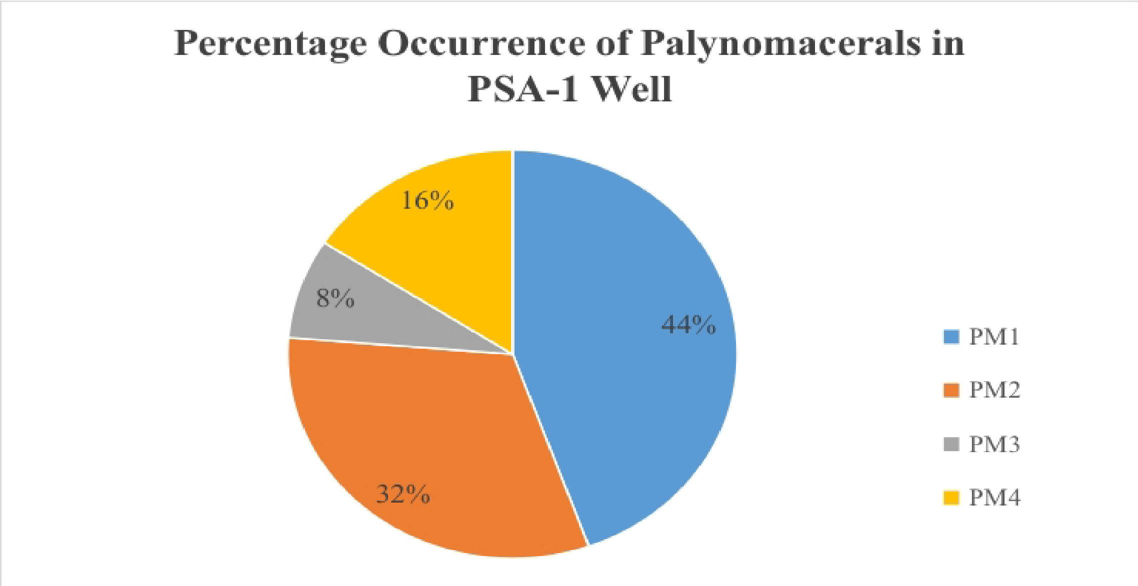

Figure 2: Percentage Occurence of Palynomacerals in PSA Well

The distribution and abundance of palynomacerals in the PSA-1 well, as illustrated in Figure 2, indicate that Palynomaceral 1 (PM1) is the most dominant type, with Palynomaceral 2 (PM2) also occurring in significant quantities. Moderate amounts of Palynomaceral 4 (PM4) are present, while Palynomaceral 3 (PM3) is the least abundant.

Discussion

Paleoenvironment

Different depositional environments can be identified based on the distinctive characteristics of palynomacerals. The abundance, sizes distribution, characteristics of palynomacerals, as well as structureless organic matter (SOM), have been used to decipher possible paleoenvironments of deposition. The depositional environment of the PSA-1 well exhibits coastal swamp to fluvial-deltaic conditions, transitioning between terrestrial freshwater swamp settings and brackish water estuarine conditions with seasonal energy fluctuations. The paleodepositional environments for these wells were determined using these criteria:

i. A high percentage of phytoclast indicates proximity to terrestrial sources, nearby or actively re-depositing river-delta systems that supply abundant terrestrial organic matter. They are environments where other organic components were selectively destroyed by oxidation, leaving behind predominantly phytoclasts, and are associated with sandy or silty sediments, as phytoclasts tend to settle hydrodynamically with these grain sizes. Large or coarse particle size indicates proximity to fluvio-deltaic sources of terrestrial organic matter (Tyson, 1995; Mendonça Filho, 2011, 2012; Atta-Petters et al., 2013).

ii. High Amorphous Organic Matter (AOM) content points to specific depositional conditions. It suggests reducing environments ranging from low oxygen (dysoxic) to no oxygen (anoxic), promoting significant preservation of organic matter originating from local plankton or benthic microbial material. Elevated AOM often characterizes distal environments that are geographically isolated from significant diluting sources of land-derived organic matter, particularly during periods of high sea level(Tyson, 1995; Mendonça Filho, 2011)

iii. The presence of poorly sorted Palynomacerals (PM) 1 and 2, along with dinocysts and abundant fungal spores, points to a terrestrial/coastal depositional environment. In contrast, a marine environment is characterized by well-sorted, small to medium-sized organic matter, predominantly Palynomacerals 1 and 2, along with some needle- or lath-shaped Palynomaceral 4, and the presence of dinocysts and/or foraminifera linings (Oyede 1992; Chukwuma-Orji et al., 2019).

iv. Proximal environment is associated with abundant terrestrial plant debris (phytoclasts) and less amorphous organic matter, while a Distal environment is characterized by fewer terrestrial fragments and more amorphous organic matter (Tyson, 1993, 1995; Mendonça Filho, 2011).

Terrestrial-Brackish swamp water environment

The PSA well is generally characterized by a consistent abundance of poorly to moderately sorted Palynomacerals I and II, and a high percentage of shaly sandstones and clayey sandstone, with a moderate amount of IV and lesser amounts of III in the Murdock and shale facies, indicating an environment of continental origin with influences of brackish swamp water. The ditch cutting samples used, which may lead to minor mixing of intervals, were composited at 150 ft intervals to ensure representative coverage of the studied section and provide good resolution for identifying paleoenvironmental shifts. The colour of the palynofacies types is predominantly dark brown to black. The Phytoclast percentages are consistently high, ranging from approximately 67.5% to 82.5% across the entire interval of 3520-6160ft, indicating high proximity to terrestrial sources. Meanwhile, low to moderate Amorphous Organic Matter (AOM), ranging from approximately 17.5% to 32.5% across the intervals, suggests the presence of localized or intermittent dysoxic to anoxic conditions in the bottom waters, which facilitated some organic matter preservation. The organic matter assemblage strongly suggests a proximal depositional setting with significant terrestrial influence. The well is generally poorly to moderately sorted, especially where palynomaceral type I and II dominate across all size fractions with smaller amounts of type IV and III. This suggests a Terrestrial-Brackish swamp environment with fluctuating energy conditions, such as a shifting deltaic or estuarine setting. The intervals of 4050-4180 ft for example consist of poorly sorted palynomacerals, types I and II, with a mix of large (L), medium (M), and small (S) sizes across most depth intervals, along with low values of AOM. This interval is dominated by sandstones, with minor occurrences of mudstones, suggesting a terrestrial/coastal environment. The findings of this study align with the terrestrial influence stated by Alege and Joseph (2024) in the Miocene sediments of the same region, unlike Olatunji's (2022) observation in the offshore depobelt, where marine organic matter is higher. The PSA-1 well consistently shows the prevalence of terrestrial phytoclasts, supporting the proximal nature of the PSA-1 well's depositional setting within the onshore Niger Delta.

Table 6: The Proximal-Distal Concept and the parameters calculated for the groups and subgroups of the organic matter components and general trends proximal-distal, based on Tyson (1993, 1995) and Mendonça Filho (2011). ***Example Threshold***

Parameter	Trend	
	Proximal	**Distal**
% of phytoclasts of the total organic matter	High	Low
% of amorphous organic matter of the total organic matter	Low	High

Table 7: Paleoenvironmental Significance of the PSA-1 Well Based on the Proximal–Distal Concept Using Observed Organic Matter Component

Depth(ft)	AOM%	Phytoclasts %	Organic Matter Type	Paleoenvironmental Significance (Based on Observed Percentage)
3520-3670	32.5	67.5	Phytoclast	Proximal
			AOM	Proximal
3700-3850	30.0	70.0	Phytoclast	Proximal
			AOM	Proximal
3980-4030	32.5	67.5	Phytoclast	Proximal
			AOM	Proximal
4050-4180	20.0	80.0	Phytoclast	Proximal
			AOM	Proximal
4210-4360	25.0	75.0	Phytoclast	Proximal
			AOM	Proximal
4390-4540	22.5	77.5	Phytoclast	Proximal
			AOM	Proximal
4570-4720	20.0	80.0	Phytoclast	Proximal
			AOM	Proximal
4720-4900	20.0	80.0	Phytoclast	Proximal
			AOM	Proximal
4930-5080	20.0	80.0	Phytoclast	Proximal
			AOM	Proximal
5110-5260	25.0	75.0	Phytoclast	Proximal
			AOM	Proximal
5290-5440	25.0	75.0	Phytoclast	Proximal
			AOM	Proximal

5470-5620	25.0	75.0	Phytoclast	Proximal
			AOM	Proximal
5650-5800	22.5	77.5	Phytoclast	Proximal
			AOM	Proximal
5830-5980	17.5	82.5	Phytoclast	Proximal
			AOM	Proximal
6010-6160	22.5	77.5	Phytoclast	Proximal
			AOM	Proximal

CONCLUSION

The analysis of palynomaceral types, size, abundance, and Structureless Organic Matter (SOM) recovered from ninety (90) ditch cuttings obtained from the PSA well was used to interpret the paleoenvironment in the onshore Niger Delta Basin. Four lithofacies units were identified in the study: shaly sandstone, clayey sandstone, mudstone, and shale. These facies suggested a fluvial-deltaic to marginal marine depositional environment. Palynofacies analysis revealed abundant occurrences of palynomaceral types I and II, with moderate amount of IV and lesser quantities of types III, as well as Structureless Organic Matter (SOM). These components are indicative of a dominantly terrestrial (rainforest to freshwater swamp) environment, with occasional marine influence.The generally poor to moderate sorting of the palynomacerals suggests fluctuating energy conditions, characteristic of a dynamic, shifting deltaic or estuarine system. The percentage of phytoclast was consistently high throughout the PSA-1 well, ranging from approximately 67.5% to 82.5% across the intervals, indicating high proximity to terrestrial sources. Concurrently, low to moderate AOM, ranging from approximately 17.5% to 32.5% across the intervals, suggests the presence of localized or intermittent dysoxic to anoxic conditions in the bottom waters, which facilitated some organic matter preservation.The organic matter assemblage suggests a proximal depositional setting with significant terrestrial influence. These occurrences within the well indicate a Terrestrial-Brackish swamp environment. This study offers unique and detailed palynofacies based paleoenvironmental insights for the onshore depobelt of the Niger Delta Basin, advancing our understanding of the depositional history and organic matter distribution within this economically vital region. Future research could build upon these findings by integrating geochemical data (e.g., total organic carbon, Rock-Eval pyrolysis) to delineate the hydrocarbon potential of the identified organic matter assemblages and further constrain the anoxic/dysoxic conditions inferred in this region.

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