



Pollen Rain at Offshore Locations in the Eastern Niger Delta: Implications on Geologic Sedimentation, Vegetation Reconstruction and Allergy - A Preliminary Study

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Improvised pollen sampler made of a cylindrical tin of 5cm diameter was used with diluted formalin solution as the medium and sited on a stationary vessel. Collected samples were subjected to acetolysis and recovered palynomorphs studied microscopically.

Eight pollen genera were recovered from the proximal site while five genera were found in the distal site. Pollen population is higher in the proximal than distal sites. Large sized pollen of *Sida* sp. is seven times higher in number in the proximal than the distal sites. Fungal species - cf. *Alternaria* and cf. *Cladosporium* - spores and hyphae as well as mycelia of other fungi were recovered along with charred Gramineae cuticles.

This scenario of pollen settling from the air is similar to that from water currents. The proximal area has higher proportions and the larger ones settle first. The study confirms pollen rain as important contributor to marine sediments in the Niger Delta with implications for paleoclimatology, palynostratigraphy and allergy sensitivity.

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1. INTRODUCTION

Muller (1959) remarked that the transport of pollen and spores from one area to the other is climatically controlled by the wind strength and direction as well as rainfall. Pollen grains are thought not to be much in the air of offshore areas due to the absence of vegetation. Hence almost all the pollen and spores recovered from the Niger Delta are believed to be sourced through River currents (Sowunmi, 1981a&b; Adeonipekun and Ige, 2007). This is due to the domination of the south-westerly Monsoon winds over the Niger Delta area for most part of the year even during the dry season which prevented serious effect of

the northeast Trade winds as observed also at the Orinoco delta by Muller (1959). The high fluvial activities of rivers Niger and Benue and other neighbouring rivers such as the Volta in Ghana (Allen, 1965; Sowunmi, 1981a; Adeonipekun, 2006) therefore transport most of the pollen to the depositional sites. However, in the offshore locations of Senegal, Rosignol-Strick and Duzer (1979) reported the significant contribution of the wind system in transporting pollen into the deep marine sites. Jahns *et al.* (1998) also made a similar observation at a location offshore Liberia while Dupont *et al.* (1998) recorded abundant pollen during the cold oxygen stages at a location in the offshore Angolan deep waters. In these areas, there is no major river system that could compete with the wind transport hence its domination. In the offshore Senegal coast sediments, pollen population was observed to be greater during the arid period when the wind energy was at its peak coming from the northeast Trade winds and lower during the humid periods when the wind energy from the east had gone down. This is of course contrary to the Niger Delta situation where river action dominates.

Reconstructing past vegetation settings for paleoecology is a popular approach by Quaternary palynologists. Inferences from recovered palynomorphs have been used for deducing coastal proximity and paleoenvironment as well as past climatic changes (Muller, 1959; Cross *et al.*, 1966; Groot and Groot, 1966; Sowunmi, 1981a&b; Adeonipekun, 2006).

The domination by river action in the Niger Delta has also been reported by Weber (1972), Pastouret *et al.* (1978) and Zabel *et al.* (2001) from inferences made from sedimentological parameters. Despite the fact that these works on the Niger Delta were carried out mainly on onshore and shallow offshore locations, samples from the deep offshore Niger Delta may give wind-borne palynomorph trends similar to the ODP sites such as Jahns *et al.* (1998).

Nevertheless, the significance of pollen rain in the offshore area cannot be under estimated since there are local air currents which may carry these palynomorphs farther into the Atlantic Ocean and therefore alter the water transported pollen records. These will have great implications for paleoecological,

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paleovegetational and palynostratigraphic deductions.

Due to the absence of vegetation, hypersensitive people working on oil rigs may feel “safe” whenever on duty. However, the presence of wastes generated on offshore sites allowed the growth of fungi apart from the presence of some pollen in the air, which pollute the work site, and may therefore cause clinical problems to sensitive crew members.

Though on a vessel originally commissioned for an Environmental Impact Assessment (EIA) project for Mobil Producing Nigeria Unlimited, of which one of the authors participated, he thought it wise to investigate airborne flora of the offshore locations during the short period of the project. The inspiration came from the *HMS Beagle* exercise of Charles Darwin in 1831, who was on board the vessel as a naturalist. Though the *HMS Beagle* vessel was originally commissioned to map coastlines; Darwin however used the opportunity to study several natural phenomena that have made up our present knowledge in biology according to Castro and Huber (2005). It is hoped that this work will stir up more research in this exclusive areas (offshore locations) in Nigeria and a more extensive work can be carried out. The objectives of this investigation are to ascertain: the

aeropalynological components of these offshore locations; which pollen and spores get that far; what is the source of the sporomorphs recovered and the significance of distance from shore on their fall? These will give information on the source area vegetation and dominant wind system. Inferences from these information can be useful in paleoecology, climate and palynostratigraphical studies. The health/allergy implications of these aeroflora for offshore site workers can also be evaluated.

II. MATERIALS AND METHODS

An improvised pollen sampler - 5 cm diameter tin cylinder - was used while diluted formalin solution served as the medium of preservation and suspension. Two sites A (15km from coast) and B (43km from coast) at 20m and 61m water depths respectively were sampled on a stationary Survey Vessel -- *RV Brone Explorer* -- contracted by Mobil Producing Nigeria Unlimited/Mak Mera Nigeria Limited, Lagos for the Environmental Assessment Studies (Table-1). Sampler was sited for two days at each of the locations on the topmost part of the Survey Vessel. Collected samples were stored in well-sealed sample bottles (Figure -1).

TABLE-1: SAMPLING POINTS DETAILS

SAMPLING SITE	GEOGRAPHICAL COORDINATES		WATER DEPTH (M)	DISTANCE FROM COAST (KM)
	Longitude	Latitude		
A	7 ⁰ 38 ¹ 39.815” E	4 ⁰ 14 ¹ 11.591” N	20	15
B	7 ⁰ 29 ¹ 35.467” E	4 ⁰ 0 ¹ 50.973” N	61	43



Fig. 1: Map of Nigeria showing the Location of studied sites offshore Eastern Niger Delta

III. LABORATORY TREATMENT

Collected samples were subjected to acetolysis according to Erdtman (1969) where a mixture of acetic anhydride and concentrated H_2SO_4 in the 9:1 ratio was used in treatment process. The recovered residue (0.05ml) was stored in a known volume of glycerine (0.05ml) and microscopically analyzed. One gram of sediment in proximal location **A** produced 0.1 ml (100 μ l) of residue and glycerine. Twenty microlitres (20 μ l) of residue and glycerine was pipetted on microslide and studied. It generated 21 sporomorphs. From this, 100 μ l residue and glycerine will generate 105 sporomorphs. One gram of sediment in distal location **B** generated 60 sporomorphs since 20 μ l residue and glycerine produced 12 sporomorphs.

IV. PHOTOMICROGRAPHY

Photomicrographs of some recovered pollen, fungal elements and charred Gramineae cuticles were taken Plate -1. Identification of recovered palynomorphs was done by making use of the reference collections at the Palaeobotany/Palynological Laboratory of the Department of Botany, University of Lagos, Nigeria and other published works on the palynology of the Niger Delta and Nigeria.



a. b.
Figures 2 a. and b.: Photographs of improvised artificial pollen sampler

V. RESULTS

From the proximal shallow location (**A**), 21 sporomorphs, 10 fungal elements and 6 charred Gramineae cuticles were recovered while twelve sporomorphs, 31 fungal elements and seven charred Gramineae cuticles were recovered from the distal location (**B**). Out of the 21 sporomorphs in the proximal location, only one pteridophyte spore was recovered while none was recovered from the distal location (Table -2).

No savanna pollen was recovered from the two locations despite the collection period being dry season. In the distal location, one grain of large-sized pollen of *Sida* sp. occurred while in the proximal, seven grains were recovered.

Cf. *Cladosporium* and cf. *Alternaria* genera dominate the fungal flora with some other hyphae and mycelia.

VI. DISCUSSION

The higher proportions of sporomorphs recovered from the air particles of the proximal site compared to that of distal agrees with reported trend of sporomorph recovery from offshore sediments. In offshore sediments, palynomorphs "behave" like sedimentary particles (Muller 1959; Groot and Groot 1966). More pollen get to this proximal site while lesser number is carried to the distal location due to weight difference. This scenario is corroborated by the sporomorphs recovered in this work. The lighter/small sized ones are carried further into the distal locations while the heavier/large sized forms are deposited at the proximal end. This is further supported by the recovery of only one grain of pollen of *Sida* sp. in the distal site while the proximal site recorded seven. The pollen size of the family Malvaceae can be as large as 158 μ m (Dongock *et al.*, 2008). The heavier ones therefore get settled first like sedimentary particles. Recovered charred Gramineae cuticles and Poaceae (grass) however did not show this trend probably because of the light nature of their particles. Charred Gramineae cuticles and the grass pollen are very light, though large in size, and therefore buoyant thus the air current carries them farther offshore.

The only pteridophyte spore recovered came from the proximal location due also to the weight of this sporomorph group. None pteridophyte spore was recovered from the distal site. This may mean that the occurrence of spores in distal locations like the deep offshore is mainly river-bound with lesser wind impact. Spores have been reported to be abundant during regressive marine phases when the river activity is strong to carry them (Poumot, 1989). This is due to the fact that they are usually heavier than pollen. This weight factor may be the reason for their non-recovery from the distal location. Although the period of this experiment was short (two days) to conclude on this and it was during the dry season. Nevertheless, this deduction that

TABLE -2: RECOVERED PALYNOMORPHS AND THEIR PROPORTIONS

S/N	PALYNOMORPHS	SCIENTIFIC NAMES/FAMILY	ABUNDANCE (PROXIMAL)	ABUNDANCE (DISTAL)
1.	Uapaca sp.	<i>Uapaca</i> sp.	3	-
2.	Trilete spore	Pteridophyte	1	-

3.	<i>Sida</i> sp.	Malvaceae	7	1
4.	cf. <i>Pelliceira</i>	cf. <i>Pelliceira</i>	1 (Broken)	-
5.	Grass pollen	Poaceae	4	3
6.	Mangrove pollen	<i>Rhizophora</i> sp.	1	2
7.	Moraceae	<i>Morus</i> sp.	1	-
8.	<i>Berlinia grandifolia</i>	<i>Berlinia grandifolia</i>	1	-
9.	<i>Uapaca staudtii</i>	<i>Uapaca staudtii</i>	2	-
10.	<i>Crudia</i> sp.	<i>Crudia</i> sp.	-	3
11.	<i>Syzygium</i> sp.	Myrtaceae	-	2
12.	Charred Gramineae cuticles	Charred Gramineae cuticles	6	7
13.	Fungal spores		3	1
14.	Fungal hyphae		-	2
15.	Fungus	cf. <i>Cladosporium</i> spp.	9	26
16.	Fungal Mycelium		-	1
17.	Fungus	cf. <i>Alternaria</i> spp.	1	3

weight limits their recovery in the distal location may prove to be right. This is because the wet season would not even allow much of aero-floral components to get to the offshore site due to the domination of the Southwest Monsoon winds with associated heavy precipitation.

The lack of trend in the occurrence of fungal elements in this work is most probably due to the closeness of waste bins to the sampler location on the topmost part of the vessel. This phenomenon has far reaching implications for the health of the vessel crew. Fungal species of *Alternaria* and *Cladosporium* spores are among notorious mycoallergens that cause discomfort to sensitive individuals Gomez de Ana *et al.* (2006). The recovery of fungal spores comparable to these allergenic species shows the risk workers in offshore locations are exposed to just like those working onshore. Hygiene onboard vessels and rigs should be given proper attention.

Though savanna ecological zone pollen have been reported from sediments offshore Niger Delta (Sowunmi, 1986, Adeonipekun, 2006), their presence is however minimal compared to other proximal ecological zones like the Freshwater, Lowland rainforest and the Mangrove. This is because the long distance they traverse has subjected them to destruction along the river course. This result indicates that the Northeast Trade winds have little effect in the offshore even during the dry season. Sowunmi (1981a) reported that the Niger Delta coast experiences the harmattan occasionally in January and February.

Despite the closeness of the Lowland rainforest to the Niger Delta coast, all the pollen grains recovered

belong to the mangrove and freshwater ecological zones. This shows that it was only local currents that took the recovered sporomorphs to the collection sites during sampling.

It is important to state here that the findings reported here are tentative due to the short period involved in the investigation. With aeropalynological investigation across the delta over a longer period of time, at least one year, better picture and findings will be produced which will be useful for modern climate, paleoclimate and palynostratigraphic studies since vegetation and climate are closely related. Nevertheless, these findings are pointers to the fact that wind also contributes significantly to the pollen recovered from rock sediments in the offshore Niger Delta.

VII. CONCLUSION

Sporomorphs and fungal spores are present in appreciable quantity in the air of shallow offshore locations in the Niger Delta at least in the dry season and therefore contribute significantly to the sedimentary deposit by river action. Their presence in the air offshore may alter the sedimentary profiles with great implication for palynostratigraphy in the delta. Heavy/large-sized pollen settles first into the proximal location while lighter/small-sized ones are taken further into distal locations. This follows clastic sedimentation patterns in the Niger Delta. There was no record of distant vegetation ecosystem like the Savanna hence the palynospectrum was dominated by Freshwater and Mangrove ecosystems species.

Recovery of pollen at studied locations shows that hypersensitive individuals working at offshore sites are also prone to pollen attack despite the zero vegetation condition of these settings. Moreover, proper hygiene needs to be emphasized onboard vessels and oil rigs to prevent the growth of allergenic fungi at refuse dump sites.

ACKNOWLEDGEMENTS

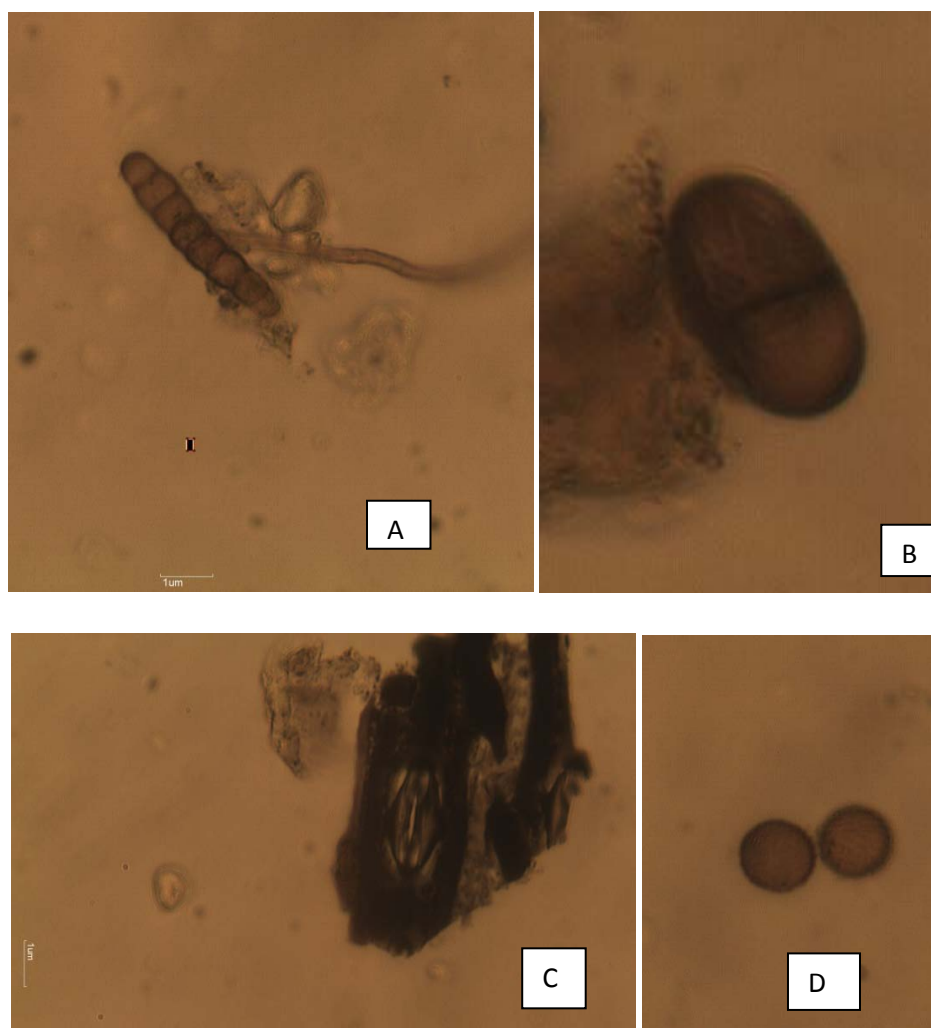
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Plate-1 : Photomicrographic plate of some recovered palynomorphs



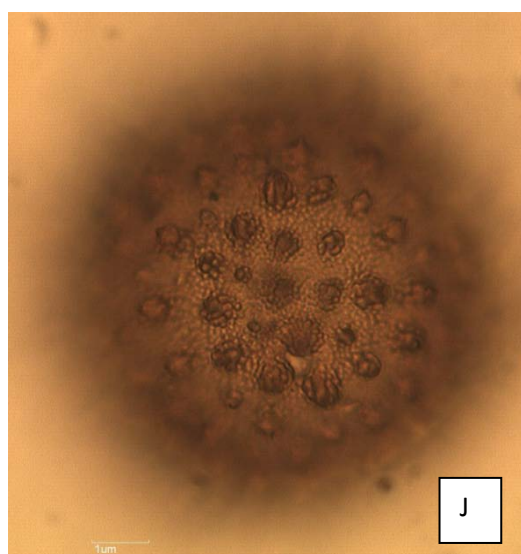
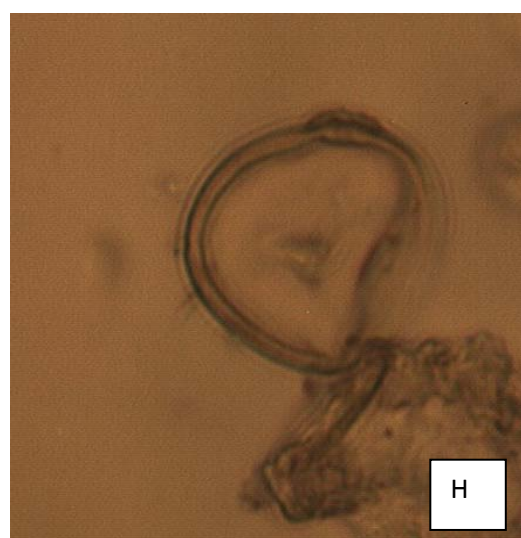
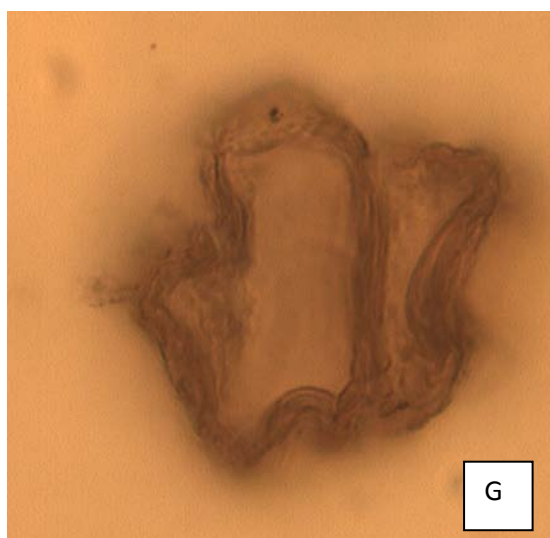
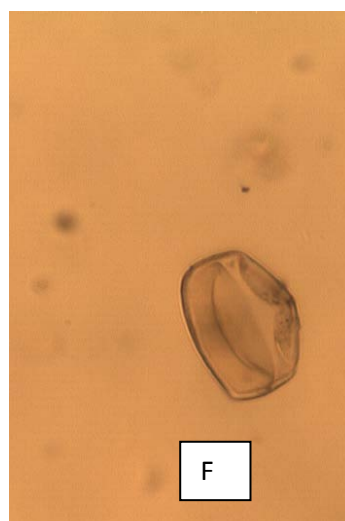
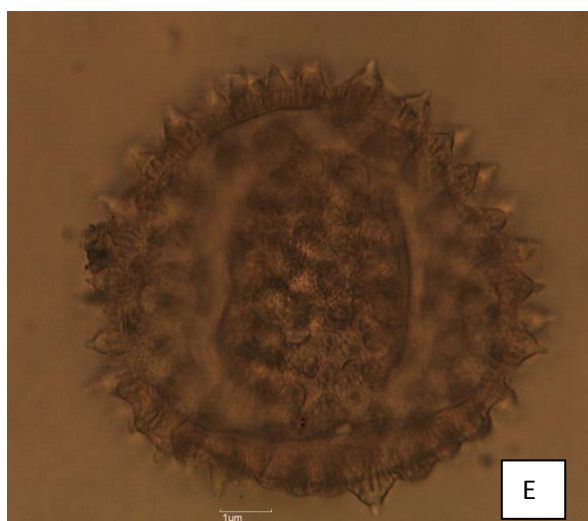


Plate : A -- B. Cf. *Alternaria* sp., C. Charred Gramineae cuticle, D. cf. *Cladosporium* sp., E. *Sida* sp., F. Poaceae, G. Indeterminate pollen, H. Poaceae, I -- J. *Sida*