Textural Attributes and Mineralogy of River Forcados Floodplain Sediments along Patani and Environs

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ABSTRACT

River Forcados floodplain sediments were collected along Patani and environs from five locations at depths 0 m, 5 m, 10 m and 15 m in order to study their textures and mineralogy. Textural attributes were derived from grain size analysis using mechanical sieving and graphical determination of statistical parameters. Oxide analysis from the bulk chemistry using XRF was used to study the mineralogy of the sediments. The grain size range from very coarse sand to clay deposits with the modal class in the fine silt grade in all the locations. The sediment load represents traction, saltation and suspension modes of transportation deposited during several cycles of flooding by fluctuating high and low energy regimes. The average mean (M) is 4.89 (very coarse silt size grade), the average median is 5.27 (coarse silt grade), the average sorting (σ) is 1.86 (poorly sorted), they are negatively skewed on the average with a value of -0.29 and are very leptokurtic with an average value of 1.80. The sediment is enriched in SiO_2, Al_2O_3, Fe_2O_3, K_2O, TiO_2, CaO and Cl with values 75.39%, 9.98%, 5.09%, 4.20%, 1.44%, 1.26% and 1.02% respectively. The SiO_2/Al_2O_3 ratio has an average value of 8.281 which shows the sediment is rich in silica and has an acid igneous rock source. The enrichment in K_2O also corroborates an acid igneous source. The mineral suite indicates the soil in the studied floodplain is rich in nutrients and is fertile for use by both plants and animals

Keywords: Floodplain, Grain size, Mineralogy, Sediment, Fluvial system

INTRODUCTION

Geologically, the earth's surface is divided into several sub environments based on their distinctive physical, chemical and biological characteristics that are different from adjourning environments. The floodplain environment is part of the fluvial system. Rivers are a major means of transporting weathered materials from point of disintegration to where the sediments are deposited in a basin. The river system is divided into three stages: the young, the mature, and the old stage. Not all the weathered sediment transported by a river is carried to the seas, lakes or ocean bodies. Some are deposited as thick sequence of deposits on the alluvial plains and on flanks or banks of rivers (floodplain environment). This is especially common in lower reaches of the river, which is usually the mature stage of the river. The mature stage of a river is characterized by the formation of floodplains and bar deposits. The mature and old stages of a fluvial system are the major stages of fluvial deposition [1].

Floodplains are low lying elongated areas that are parallel to the river and are usually flooded during high waters. Sediments deposited during overbank flow on this area are referred to as floodplain deposits. The sediments are made up of mud, silt, organic matter and abundant amount of sand depending on the source rock, climate, vegetation and geology of the area. In sandy areas, intercalations of thin mud and fine sand layers occur, but generally, a fining upward sequence of fine sand, silt and clay layers is observed [1].

According to [2], floodplain sediments consist of varying minerals reflective of the provenance, geology of the area and climate of the region. Mineralogical and textural studies of the sediments give understanding of the transport and depositional processes as well. The geological processes that shape the floodplain and the dynamics of the river can also be deduced from such studies.

[3] describe floodplain as long narrow relatively smooth land bordering a stream or channel. It is termed living if it overflows during high water and consists of channel and overbank deposits. Floodplains show the most distinguishing features of soil and environment formed from the geochemical alterations of weathered materials. The deposits of floodplains range from fine sand to silt to clay sediments laid down during overbank flooding of rivers. The sediments can provide good source of soil fertility and are inferred to be very rich in nutrients like potash, phosphoric acid and lime for use by both plants and animals [4].

The Forcados River which is a tributary of River Niger leaves River Niger just after Aboh community travelling down south in the western direction through several communities amongst which you have Patani. Patani and environs is along the lower reaches of the river where you have lots of floodplains and sandbars to indicate the mature stage of the River. Patani and environs are within the Niger Delta basin. According to [5], the surface geology of the basin is made up of Quaternary deposits of gravel, sand, silt and clay formed in Alluvium, freshwater backswamps, meander belts, saltwater backswamps, active/abandoned beaches and deltaic sands. The sub-surface is made up of three lithostratigraphic units: The basal Akata Formation (Marine shale), Agbada Formation (Intercalation of sand and shale) and the topmost Benin Formation (Coastal Plain Sand) see Table 1.

The study area is within latitudes N05º2'10.2" and N05º14'02.2" and longitude N05º14'02.2" and E005º11'50.9" (Figure 1) within Patani and environs. The study is aimed at looking at the textural parameters and mineralogy of the deposits of the floodplain in Patani and environs for floodplain management, agriculture and industrial benefits.

Table 1: Stratigraphic Column of the Niger Delta (after [5])

Geologic Unit	Lithology	Age
Alluvium (General)	Gravel, sand, clay, silt	Quaternary
Freshwater Backswamp, Meander Belt	Sand, clay, some silt gravel	
Mangrove and Salt Water/Backswamps	Medium fine sands, Clay and some silt	
Active /Abandoned Beach Ridges	Sand, clay, and some silt	
Sombreiro – Warri Deltaic Plain Sands	Sand, clay, and some silt	
Benin Formation Coastal Plain Sand	Coarse to medium sand with subordinate silt and clay lenses	Miocene
Agbada Formation	Mixture of sand, clay and silt	Eocene
Akata Formation	Clay	Paleocene

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Figure 1: Map showing River Forcados along Patani and environs (Google map).

MATERIALS AND METHODS

The samples from the floodplain were collected from five locations that are about 100 m apart, at depths of 0 m (surface), 5 m, 10 m and 15 m with the aid of the hand augur and properly labelled in sample bags. They were then taken to the laboratories for the required analyses. The geo –references of the sampling points for the floodplains are indicated respectively in Table 2.

Grain size analysis by mechanical sieving and graphical determination of statistical parameters using [6] was carried out to determine the textural characteristics of the sediments from the floodplain. 100g of each of the sample was oven dried for 24 hour to remove the moisture content before pouring the loose samples through a stack of wide set of sieves with different aperture of known sizes and mechanically vibrated for a minimum of fifteen minutes. This is done to separate the grains into their various sizes. The weight retained in each sieve is measured This is used to calculate the percentage weigh retained, cumulative percentage, plotting of cumulative curve, frequency histogram and further statistical parameters derived according to [6] such as the mean, median, mode, sorting, skewness and kurtosis. The result is presented in Table 3. The mineralogical constituents were analyzed using XRF for the bulk chemistry; nine of the samples were presented for this analysis. The appropriate filters were selected for each element and probed accordingly. The concentration of the elements were initially presented in diffractions and later converted to concentration in weight percentage of oxides. The result is presented in Table 4.

RESULTS

Grain Size Analysis of the Floodplain Sediment

Table 2 shows the sample points with geo-references, grain size, colour and lithology. The samples range from medium size sand to clay deposits. They are mostly brown, dark brown to very dark sediments. Table 3 is a presentation of the graphically determined statistical parameters according to [6]. The parameters are the: mean (M), median, sorting (σ), skewness and kurtosis which describe the textures of the sediment.

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Table 2: Sampling Points for Floodplain Sediment

Location	Geo-Reference	Grain size	Color	Lithology
FP 1 (5m)	N05º2'10.2"	Medium	Brown	Medium Sand
FP1 (10m)		Clay	Very dark	Clay
FP1 (15m)	E006º14'03.1"	Clay	Very dark	Clay
FP 2 (5m)	N05º14'03.1"	Very fine	Brown	Very Fine Sand
FP 2 (10m)		Fine	Brown	Fine Sand
FP 2 (15m)	E006º11'51.4"	Clay	Dark brown	Clay
FP 3 (5m)	N05º11'28.2"	Very Fine	Brown	Very Fine Sand
FP 3 (10m)		Medium	Brown	Medium Sand
FP 3 (15m)	E005º11'02.2"	Clay	Dark brown	Clay
FP 4 (5m)	N05º14'02.5"	Clay	Dark brown	Clay
FP 4(10m)		Fine	Brown	Fine Sand
FP 4(15m)	E006º11'51.1"	Silt	Brown	Silty sand
FP 5(5m)	N05º14'02.2"	Fine	Brown	Fine Sand
FP 5(10m)		Silt	Brown	Silty Sand
FP 5(15m)	E005º11'50.9"	Silt	Brown	Silty sand

Table 3: Grain size statistical parameters for floodplain sediment

Sample No.	Mean (M)	Median	Sorting (σ)	Skewness	Kurtosis
1(5m)	2.56	3.20	3.44	-0.22	0.19
1(10m)	5.46	6.30	2.02	-0.13	4.25
1(15m)	3.20	3.40	2.87	-0.12	0.49
2(5m)	6.40	6.70	1.92	-0.52	2.12
2(10m)	6.30	6.40	0.66	-0.39	1.52
2(15m)	5.80	6.50	2.01	-0.79	3.32
3(5m)	6.10	6.10	0.57	-0.12	2.88
3(10m)	4.13	5.50	3.25	-0.62	0.88
3(15m)	2.26	2.80	3.06	-0.28	0.74
4(5m)	6.26	6.20	0.49	0.23	0.94
4(10m)	6.03	6.00	0.56	-0.19	2.68

4(15m)	6.06	6.00	0.68	0.16	3.62
5(5m)	4.10	4.50	2.26	-0.39	1.09
5(10m)	3.73	4.00	1.82	-0.40	1.38
5,(15)	4.96	5.50	2.33	-0.50	0.94
Average	4.89 (Very Coarse Silt)	5.27 (Coarse Silt)	1.86 (Poorly Sorted)	-0.29 (Negatively Skewed)	1.80 (Very Leptokurtic)

Mineralogy of the Floodplain Sediment

The mineralogy of sediment as derived from the bulk chemistry analysis using XRD is presented in Table 4. The mineralogy is expressed in percentages of oxides and elemental concentrations. The sediment is enriched in oxides and elements with concentrations >1 and depleted in those <1. The sediment is enriched in SiO_2, Al_2O_3, Fe_2O_3, K_2O, TiO_2, CaO and Cl and their associated elements with their average concentration >1 and depleted in the remaining oxides and their associated elements listed that have concentration <1. The depleted oxides are: V_2O_5, Cr_2O_3, MnO, Co_3O_4, NiO, CuO, Nb_2O_3, MoO_3, WO_3, P_2O_5, SO_3, MgO, BaO, Ta_2O_5, ZnO, Ag_2O, ZrO_2, SnO_2, SrO.

Table 4: Oxide and Elemental Analysis of Floodplain Sediment

	Oxide Analysis of Sediments (Concentration In Wt %)											Elemental Constituents of Sediments (Concentration In Wt %)										
		F1 0 m	F1 .5 m	F1. 10 m	F2 0 m	F2 .5 m	F2. 10 m	F2. 15 m	F4. 10 m	F4. 15 m	**AVER.**		F1 0 m	F1 .5 m	F1. 10 m	F2 0 m	F2 .5 m	F2. 10 m	F2. 15 m	F4. 10 m	F4. 15 m	**AVER.**
1	SiO_2	**79.827**	**84.263**	**65.605**	**86.808**	**81.153**	**61.242**	**80.528**	**57.823**	**81.203**	**75.39**	O	**49.624**	**50.227**	**46.522**	**51.064**	**49.935**	**45.851**	**49.491**	**45.038**	**49.508**	**48.58**
2	V_2O_5	0.053	0.074	0.111	0.000	0.029	0.111	0.069	0.086	0.051	**0.07**	Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0**
3	Cr_2O_3	0.077	0.092	0.044	0.056	0.095	0.072	0.082	0.068	0.082	**0.07**	Al	**5.219**	**4.113**	**6.260**	**3.812**	**4.802**	**7.516**	**4.345**	**7.518**	**3.962**	**5.28**
4	MnO	0.041	0.030	0.199	0.033	0.052	0.309	0.065	0.372	0.054	**0.13**	Si	**37.315**	**39.388**	**30.667**	**40.578**	**37.935**	**28.627**	**37.643**	**27.029**	**37.958**	**35.24**
5	Fe_2O_3	**2.219**	**1.374**	**8.526**	0.166	**2.015**	**11.844**	**1.971**	**15.140**	**2.587**	**5.09**	P	0.000	0.000	0.226	0.000	0.000	0.000	0.101	0.000	0.000	**0.04**
6	Co_3O_4	0.006	0.004	0.038	0.013	0.019	0.044	0.005	0.067	0.000	**0.02**	S	0.237	0.054	0.255	0.251	0.118	0.111	0.139	0.064	0.148	**0.15**
7	NiO	0.000	0.018	0.011	0.007	0.004	0.011	0.004	0.004	0.011	**0.01**	Cl	0.946	0.884	**1.658**	0.841	0.762	0.964	**1.332**	0.892	0.865	**1.02**
8	CuO	0.035	0.057	0.082	0.045	0.064	0.075	0.053	0.083	0.041	**0.06**	K	**3.126**	**2.966**	**4.776**	**1.700**	**2.630**	**4.594**	**3.217**	**4.759**	**3.599**	**3.49**
9	Nb_2O_3	0.009	0.007	0.014	0.007	0.011	0.019	0.010	0.017	0.009	**0.01**	Ca	0.825	0..68	**1.550**	0.459	**1.001**	**1.581**	0.940	**1.467**	**1.017**	**1.11**

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													8								
10	MoO_3	0.007	0.006	0.005	0.007	0.002	0.000	0.001	0.001	0.003	**0.003**	Ti	0.457	0.285	**1.440**	0.165	0.840	**1.401**	0.948	**1.539**	0.696	**0.86**
11	WO_3	0.023	0.010	0.000	0.022	0.019	0.000	0.005	0.003	0.002	**0.01**	V	0.030	0.041	0.062	0.000	0.016	0.062	0.039	0.048	0.029	**0.04**
12	P_2O_5	0.000	0.000	0.518	0.000	0.000	0.000	0.231	0.000	0.000	**0.08**	Cr	0.053	0.063	0.030	0.038	0.065	0.049	0.056	0.046	0.056	**0.05**
13	SO_3	0.592	0.134	0.636	0.626	0.293	0.277	0.346	0.159	0.369	**0.38**	Mn	0.032	0.023	0.154	0.026	0.040	0.239	0.050	0.288	0.041	**0.10**
14	CaO	**1.154**	0.962	**2.168**	0.642	**1.400**	0.212	**1.316**	**2.053**	**1.423**	**1.26**	Fe	**1.552**	0.961	**5.963**	0.815	**1.410**	**8.284**	**1.379**	**10.589**	**1.809**	**3.64**
15	MgO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0**	Co	0.004	0.003	0.028	0.009	0.014	0.032	0.003	0.050	0.000	**0.02**
16	K_2O	**3.765**	**3.573**	**5.753**	**2.047**	**3.168**	**5.533**	**3.875**	**5.733**	**4.336**	**4.20**	Ni	0.000	0.014	0.008	0.006	0.003	0.009	0.003	0.003	0.008	**0.01**
17	BaO	0.285	0.135	0.038	0.097	0.100	0.190	0.110	0.194	0.110	**0.14**	Cu	0.028	0.045	0.065	0.036	0.051	0.060	0.042	0.066	0.032	**0.05**
18	Al_2O_3	**9.861**	**7.770**	**11.827**	**7.202**	**9.073**	**14.201**	**8.210**	**14.205**	**7.485**	**9.98**	Zn	0.003	0.000	0.006	0.000	0.000	0.010	0.000	0.018	0.0003	**0.004**
19	Ta_2O_5	0.046	0.042	0.048	0.053	0.080	0.039	0.033	0.031	0.040	**0.05**	Sr	0.032	0.025	0.057	0.013	0.025	0.080	0.021	0.082	-	**0.04**
20	TiO_2	0.763	0.475	**2.401**	0.275	**1.401**	**2.337**	**1.582**	**2.567**	**1.161**	**1.44**	Zr	0.087	0.037	0.160	0.019	0.158	0.276	0.098	0.272	0.110	**0.14**
21	ZnO	0.003	0.000	0.007	0.000	0.000	0.013	0.000	0.022	0.004	**0.01**	Nb	0.007	0.005	0.011	0.006	0.009	0.015	0.008	0.013	0.007	**0.01**
22	Ag_2O	0.024	0.011	0.026	0.010	0.017	0.032	0.017	0.017	0.018	**0.02**	Mo	0.005	0.004	0.003	0.005	0.001	0.000	0.000	0.001	0.002	**0.002**
23	Cl	0.946	0.884	**1.658**	0.841	0.762	0.964	**1.332**	0.892	0.865	**1.02**	Ag	0.022	0.010	0.024	0.009	0.015	0.030	0.016	0.016	0.017	**0.02**
24	ZrO_2	0.118	0.050	0.216	0.026	0.213	0.373	0.132	0.367	0,148	**0.19**	Sn	0.087	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.01**
25	SnO_2	0.110	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.01**	Ba	0.255	0.121	0.034	0.087	0.090	0.176	0.098	0.173	0.099	**0.13**
26	SrO	0.038	0.029	0.067	0.016	0.029	0.095	0.025	0.097	-	**0.05**	Ta	0.038	0.034	0.039	0.044	0.066	0.032	0.027	0.026	0.032	**0.04**
												W	0.018	0.008	0.000	0.17	0.015	0.000	0.004	0.002	0.002	**0.02**
	SiO_2/Al_2O_3	8.095	10.845	5.547	12,053	8.944	4.313	9.808	4.071	10.849	**8.281**											

DISCUSSION

Grain Size Analysis of the Floodplain Sediment

The grain size of the sediment range from very coarse sand to clay deposits with the modal class (which is the most common grain size) in the fine silt grade in all the locations as shown by the frequency histograms in Figures 2a – 2e. Floodplain sediments are deposited during overbank flow of the river and usually composed of size ranging from sand, silt to clay and organic matter depending on the source rock, climate, vegetation and geology of the area [1]. Plots of cumulative weight versus grain size at depths 5m, 10m and 15m show that the sediment load represented three modes of transportation. The coarse fraction transported by traction and saltation and the fine sediments transported by suspension mode (Figures 3a – 3c).

These processes of transportation to an extent, determine the distribution of the grain size of a deposit [7]. Table 3 shows the average mean value is 4.89 (very coarse silt) with the average median value as 5.27 (coarse silt). The sediments are poorly sorted on the average with a value of 1.86.

Sedimentologists have come to know that the plotting of two variants can help in the understanding and the characterization of depositional environment and processes. According to [8], the mean size and sorting can be plotted because they are hydraulically controlled, and the best sorted sediments have their mean size in the fine size grade in all depositional environments. Bivariate plot of mean (M) and sorting (**σ**) in the studied sediments, show the grain size range from fine sand to medium silt. The plot shows that some of the samples are well sorted but majority is poorly sorted to very poorly sorted (Figure 4), which does not agree with [8]. Sediments consist of grain sizes from medium grain sand to clay particles that may have been deposited during several cycles of flooding (Figures 4 and 5). Skewness indicates sorting in the tail of the population [9]. The sediment is negatively skewed with an average value of -0.29 showing there is an abundance of fine sediments that are very leptokurtic with an average value of 1.80.

Kurtosis is a measure of the peakedness of a sample population. According to [10], extreme high or low values of kurtosis are a reflection of the energy of the environment. [11] opined that platykurtic to very platykurtic and leptokurtic to very leptokurtic sediments are due to extremely low and high energy environments respectively. The bivariate scattergram plot of skewness and kurtosis indicates that the sediment range from very platykurtic to extremely leptokurtic, though, they are very leptokurtic on the average (Figure 6). The energy regime of the depositional environment is inferred to be fluctuating from high to low as depicted by the peaks and lows of the line plot of skewness and kurtosis in Figure 7.

Mineralogy of the Floodplain Sediment

The mineralogy of sediment is dependent on the composition of the source rock, climate and relief within the source area [12]. The mineralogical composition of sediments is also affected by activities and the terrain along which sediment are transported, because some sediments are incorporated along, while some are deposited. Some minerals get depleted along while others are enriched during transit. Table 4 is the result of the bulk chemistry of the studied sediments expressed in oxide and elemental weight concentrations. The sediment is enriched in SiO_2, Al_2O_3, Fe_2O_3, K_2O, TiO_2, CaO and Cl with their average concentration >1 and depleted in the remaining oxides listed that have concentration <1. Silica (SiO_2) is an original component of acid igneous rocks, metamorphic rocks and sandstones which result from their weathering. It has the highest concentration with an average of 76.39% in the studied samples and ranges from 57.823% to 86.808%. Alumina (Al_2O_3) with a range of 7.485% to 14.205% in the sediment is an oxide of aluminum. Aluminum is the most abundant metal in the earth crust and does not occur in the free-state. It is a major component of clay minerals, and silicates such as feldspars, micas, muscovite etc. It is the second common oxide in the sediment with an average of 9.98%. Hematite (Fe_2O_3) is third, it is an oxide of iron, and mostly occurs in pockets and hollows replacing limestone. They may also result from ferruginous sandstone and residual deposits [13]. The concentration ranges from 0.166% to 15.140% with an average of 5.09%. Potassa (K_2O) results from the weathering of igneous rocks containing orthoclase feldspars, muscovite etc. It increases the fertility of soils and an indication of an acid igneous source rock. The sediment is also enriched in this mineral; it has an average concentration of 4.20% with a range from 2.047% to 5.753%. Titanium dioxide (TiO_2) is a trimoph of three distinct minerals: rutile, anatase and brookite. It occurs as accessory minerals of igneous rocks and the

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metamorphic rocks derived from them. The range is from 0.275% to 2.567%, while the average concentration is

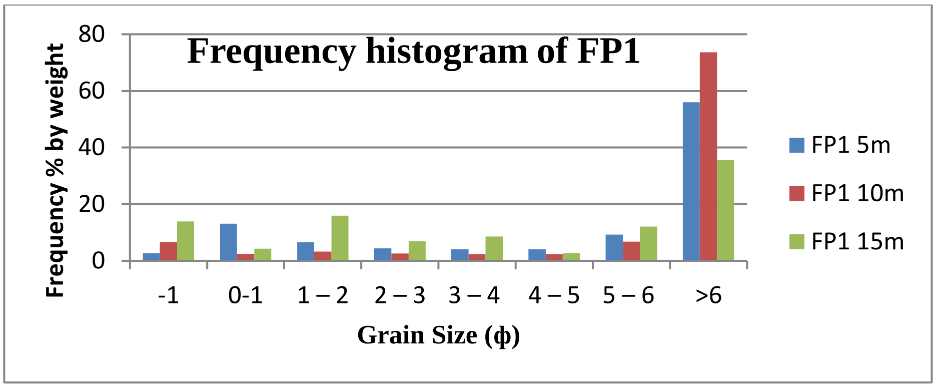

Figure 2a: Frequency histogram of FP1

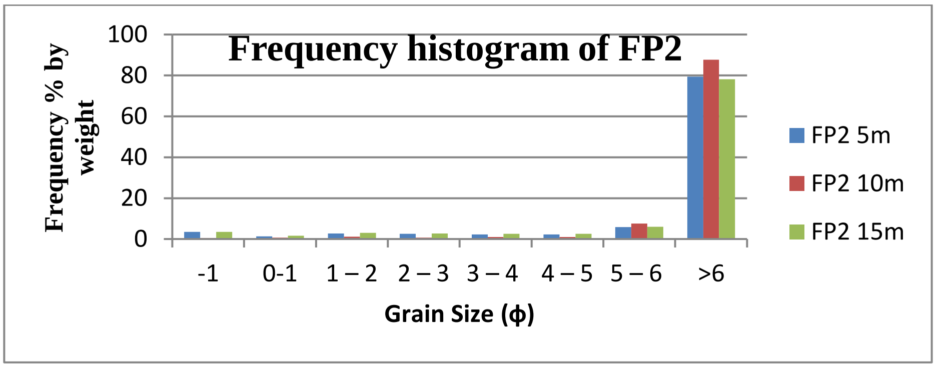

Figure 2b: Frequency histogram of FP2

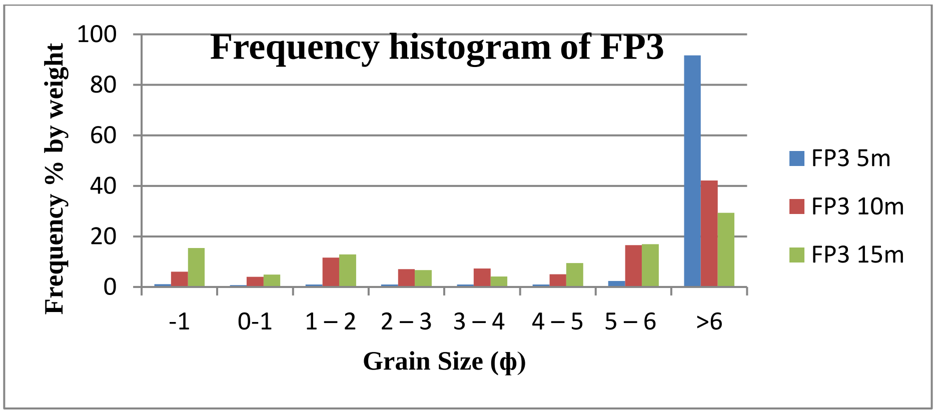

Figure 2c: Frequency histogram of FP3

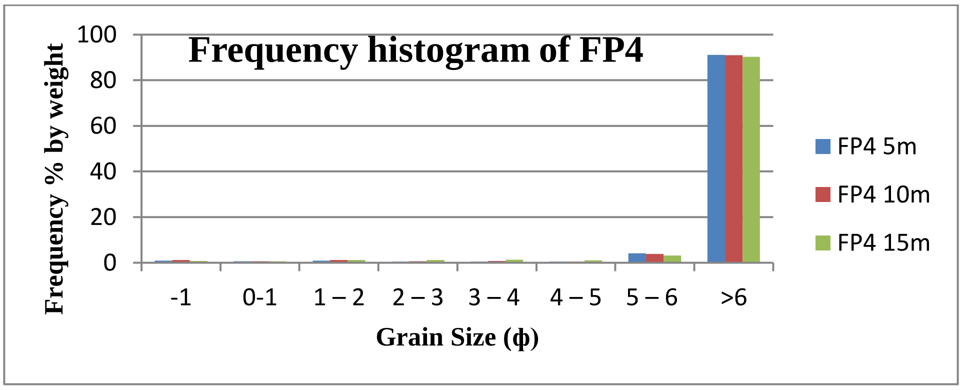

Figure 2d: Frequency histogram of FP4

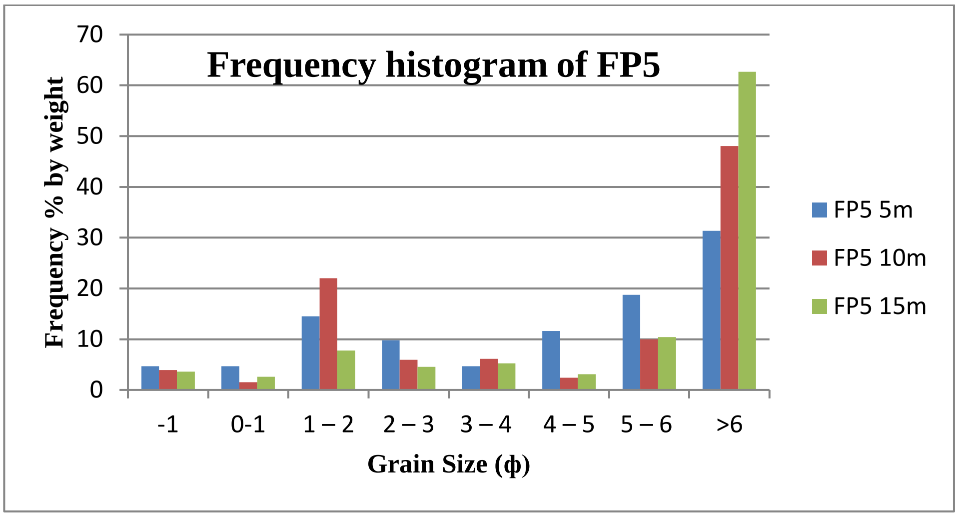

Figure 2e: Frequency histogram of FP5

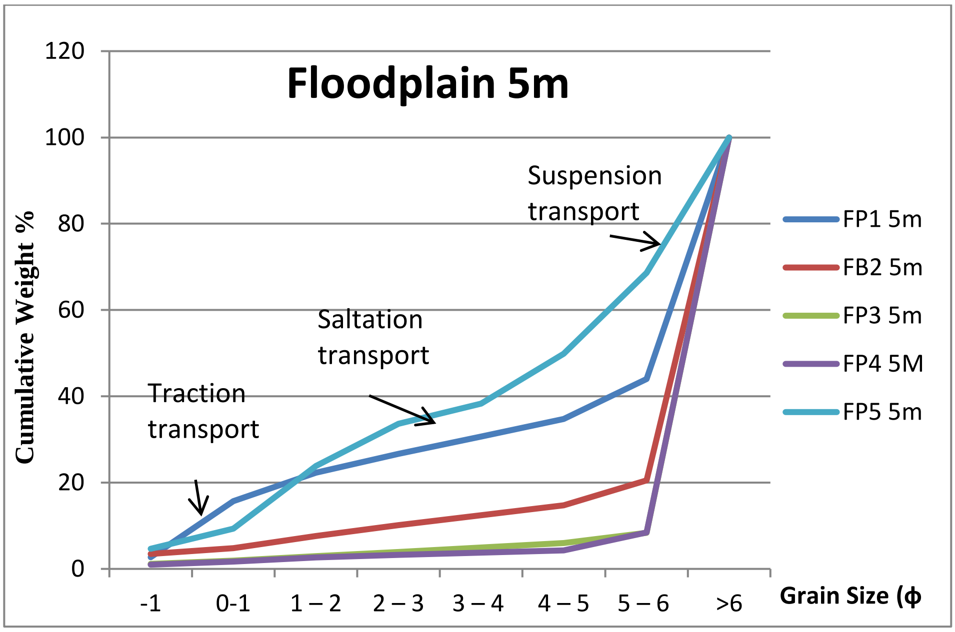

Figure 3a: Cumulative weight % vs grain size of floodplain sediments at 5m

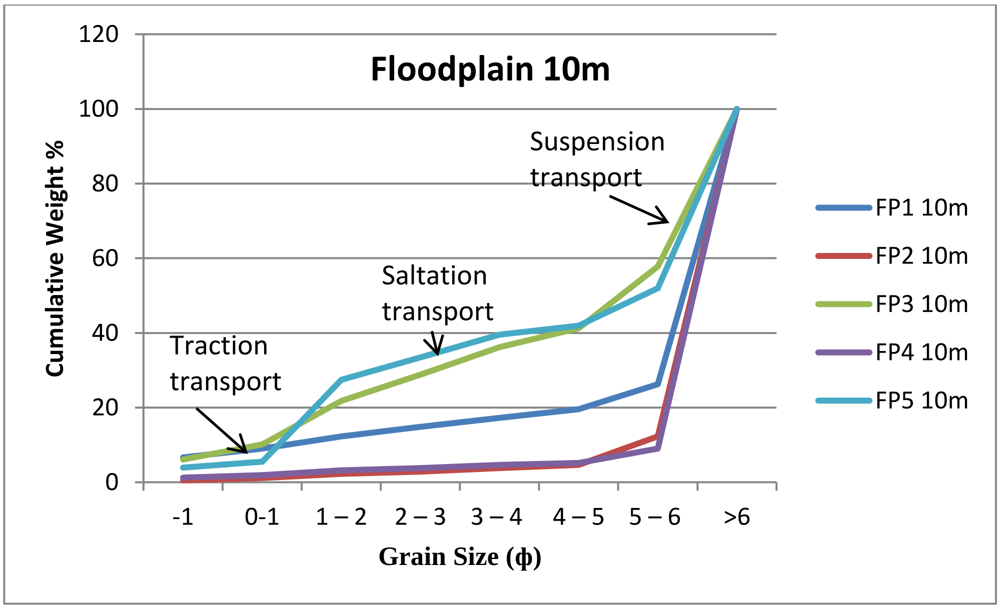

Figure 3b: Cumulative weight % vs grain size of floodplain sediments at 10m

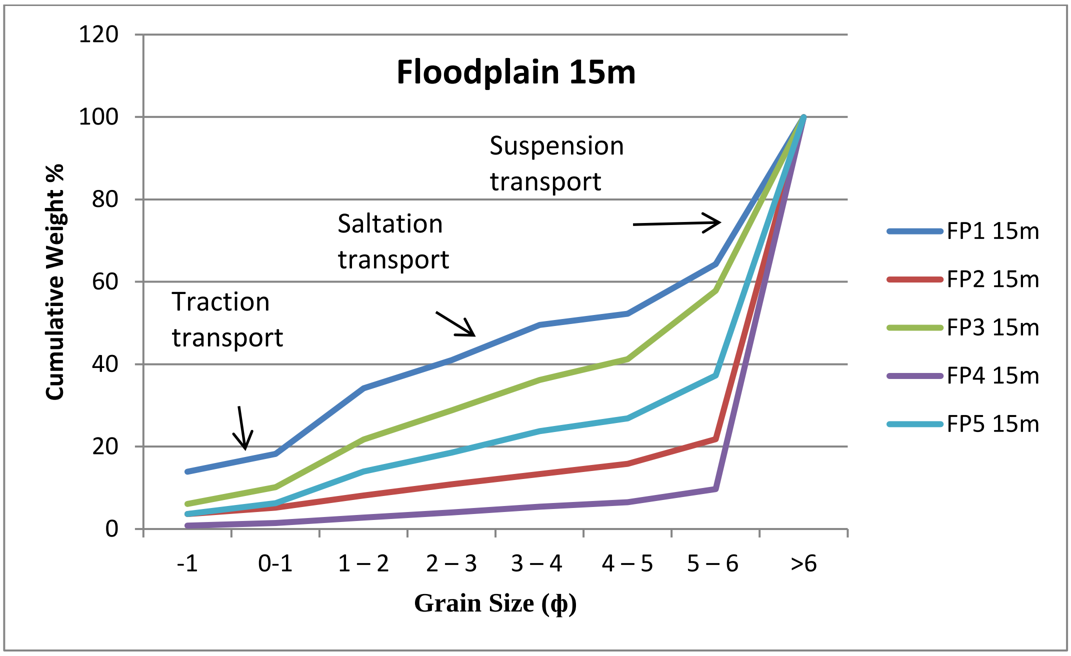

Figure 3c: Cumulative weight vs grain size of floodplain sediments at 10m

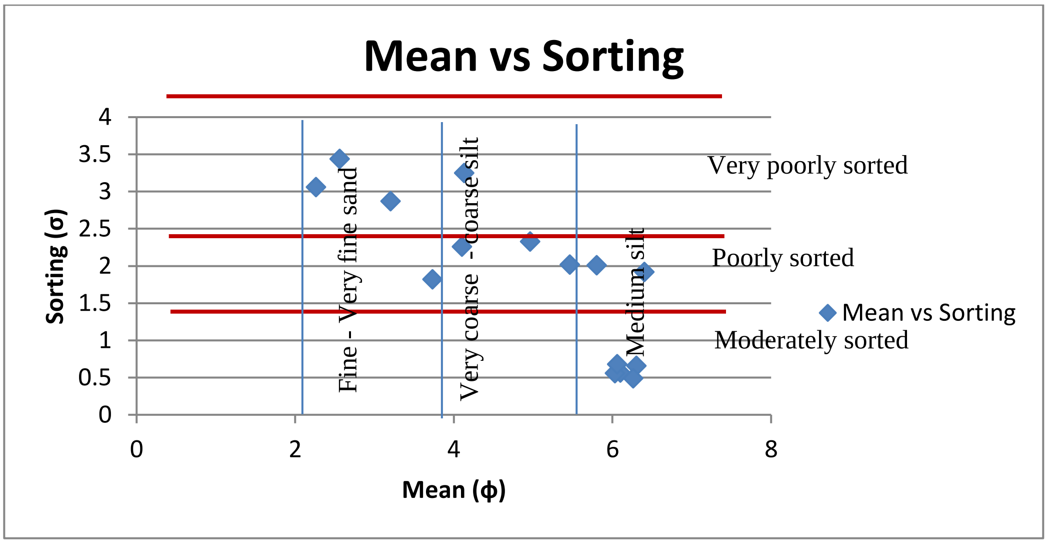

Figure 4: Bivariate plot of mean versus sorting

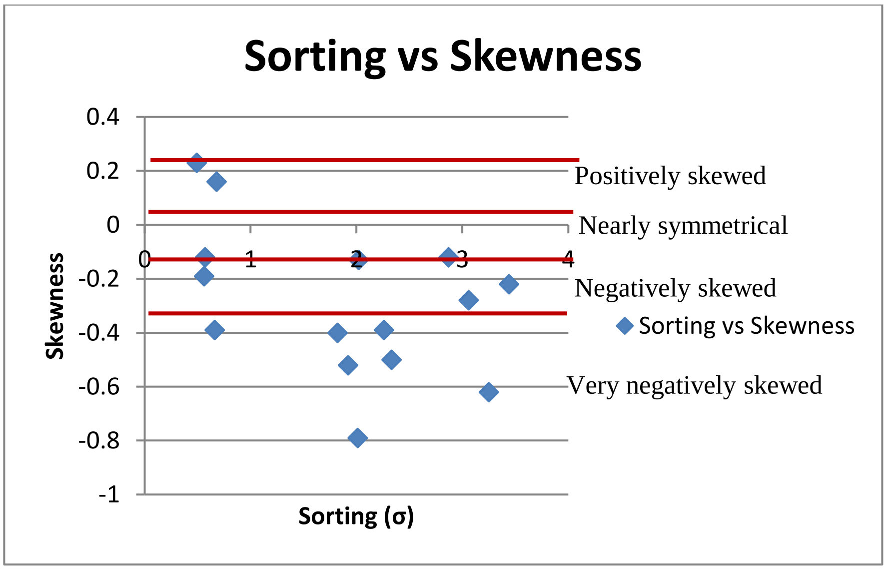

Figure 5: Bivariate plot of sorting versus skewness

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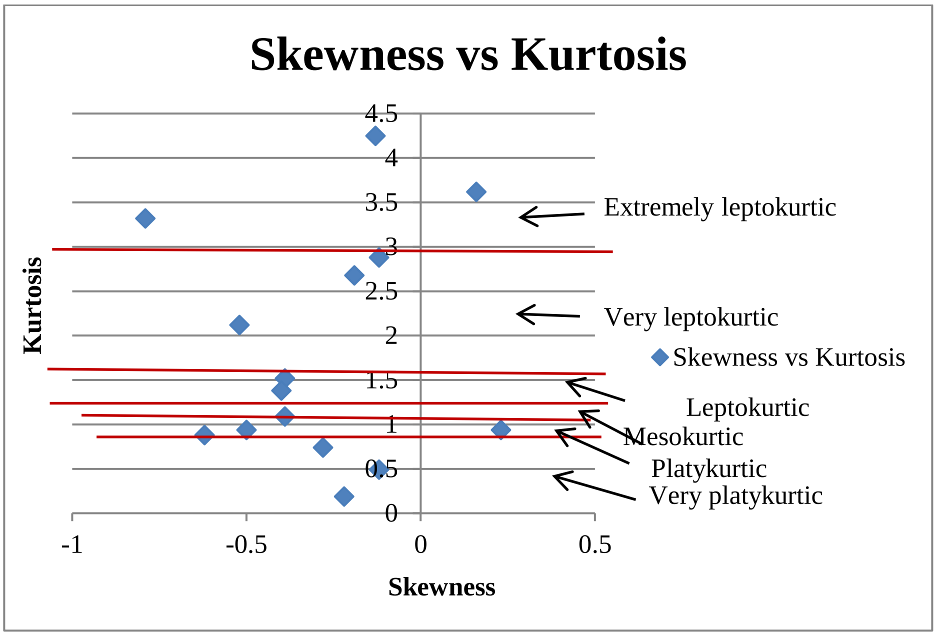

Figure 6: Bivariate plot of Skewness versus kurtosis

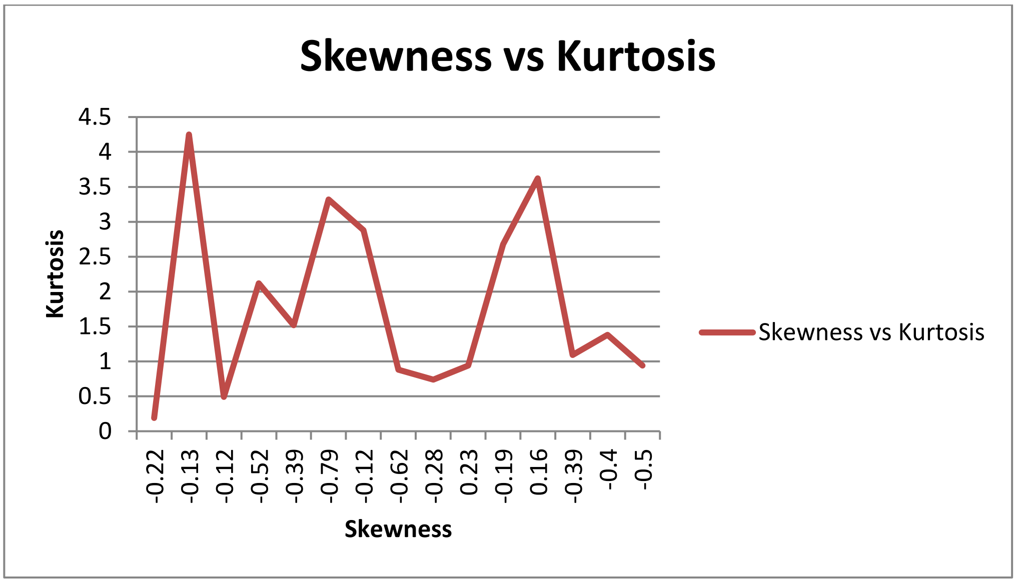

Figure 7: Bivariate line plot of Skewness versus kurtosis

1.44%. CaO – Calcium does not occur in free-state in nature but in combination with other elements. It has enormous number of compounds amongst which are calcite ($CaCO_3$) and dolomite ($CaMg(CO_3)_2$). In the study are MgO or Mg as an element is not evident which leaves us with the inference of calcite. Calcite may be organic or inorganic in origin. The average concentration of CaO is 1.26% with a range from 0.212% to 2.168%. Chlorine (Cl) forms different kinds of rock salts which are part of several silicate minerals. Its average concentration is 1.02%, while it ranges from 0.762% to 1.658%.

The floodplain is enriched in minerals such as K_2O, CaO and others as seen in Table 4. This mineral suite indicates the soil in the studied floodplain is rich in nutrients and is fertile for use by both plants and animals according to [4].

The mineral suite of sediment reflects that of the source rock. One measure of comparing the mineralogy of sediment with that of the source rock is by looking at its maturity by using the SiO_2/Al_2O_3 ratio. According to [14], the ratio range is from ~ 3.0, for basic rocks to ~ 5.0 in an unaltered igneous rock. The sediment is said to be mature if the ratio gives a value that is >5, it means progressive maturity, because there is higher degree of quartz. Quartz is very stable and therefore, very resistant to weathering. The range of the ratio in the studied sediment is from 4.071 -12,053. The average value is 8.281, with only about 22% of the samples below 5. Therefore, the sediment is mature and rich in silica; this infers an acid igneous source. This is also supported by K_2O enrichment.

CONCLUSION

The floodplain deposits of River Forcados along Patani and environs vary in size from very coarse sand to clay deposits that may have been deposited during different cycles of flooding. The modal class is in the fine silt grade, the mean (M) of the population is in the very coarse silt grade (4.89), and median is coarse silt with a value of 5.27. Traction, saltation and suspension modes of transport are represented by these sediments. The sorting (σ) varies from very poorly sorted to well sorted, but on the average, they are poorly sorted with a value of 1.86. They are negatively skewed (-0.29) and very leptokurtic (1.80) on the average. The energy regime of the depositional environment is inferred to be fluctuating from high to low as depicted by the peaks and lows of the line plot of skewness and kurtosis

The sediment is enriched in SiO_2, Al_2O_3, Fe_2O_3, K_2O, TiO_2, CaO and Cl with average values as 75.39%, 9.98%, 5.09%, 4.20%, 1.44%, 1.26% and 1.02% respectively. The mineral suite indicates the soil in the studied floodplain is rich in nutrients and is fertile for use by both plants and animals. The SiO_2/Al_2O_3 ratio has an average value of 8.281 which shows the sediment is rich in silica and from an acid igneous rock source. The enrichment in K_2O also corroborates an acid igneous source.

REFERENCES

1. Reineck, H.E. and Singh, I.B. (1980). Depositional Sedimentary Environments, With Reference To Terrigeneous Clastics. Springer – Verlag, Berlin Heidelberg, New York
2. Datta, D.K., and Subramanian, V. (1997). Texture and mineralogy of sediments from the River Ganges – Brahmaputra – Meghna river system in the Bengal basin, Bangladesh and their environmental implication. Environmental Geology, Vol 30, pages 181 – 188.
3. Wolman, M.G. and Leopold, L.B. (1957). River flood plains: Some observations on their formation. USGS Numbered Series, Professional Paper 282-C, https://doi.org/10.3133/pp282C
4. Joseph, O.M. and Mohammed, B.Y. (2021). The Agricultural Potentials Of Flood Plain Soils Along The Bank Of Warri River For Dry Season Cropping, International Journal of Agriculture, Environment and Bioresearch Vol. 06, No. 04; 2021 ISSN: 2456-8643
5. Allen, J.R.L. (1965). Late Quarternary Niger Delta and Adjacent Areas: Sedimentary Environment and Lithofacies. American Association Petroleum Geologist Bulletin, 49 (5): 549-600.
6. Folk, R.L. and Ward, W.C. (1957). Brazos River bar: A study in the significance of grain size parameters. Journal of Sedimentary Petrology, 27(1), 3-26.
7. Nichols, G. (2009). Sedimentology and Stratigraphy 2nd ed., John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK
8. Griffith, J.C. (1967). Scientific methods in analysis of sedimentary. McGraw–Hill, New York.
9. Boggs, S. Jr. (2006). Principles of Sedimentology and Stratigraphy (4th Edition) Pearson Education Inc.
10. Friedman, G.M. (1962). On sorting, sorting co-efficient and log normality of the grain size distribution of sandstones. Journal of Geology, 70: 737–753.
11. Dora, G.U., Kumar, V.S., Philip, C.S., Johnson, G., Vinayaraj, P. and Gowthaman, R. (2011). Textural characteristics of foreshore sediments along Karnataka shoreline, west coast of India. International Journal of Sediment Research, 26 (3), 364-377.
12. Pettijohn, F.J. (2004). Sedimentary Rocks (3rd Edition) CBS Publishers and Distributors, India.
13. Read, H.H. (1984). Rutleys's Element of Mineralogy (26th Edition) Billing and Sons Ltd, London and Worcester.
14. Roser, B.P., Cooper, R.A., Nathan, S. and Tulloch, A.J. (1996). Reconnaissance Sandstone Geochemistry, Provenance, and Tectonic Setting of the Lower Paleozoic Terrains of the West Coast and Nelson, New Zealand. New Zealand. J. Geol. Geophys., 39: 1-16