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Pebble Morphometric Study of the Ogwashi-Asaba Formation at Ubakala and Environs in Southeastern Nigeria

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Abstract
Pebble morphometric study was carried out for the Ogwashi-Asaba Formation so as to understand its paleodepositional environment. The three axes; the long (l), the intermediate (i) and the short (s) were measured for the two sets of one hundred and forty (140) and one hundred and fifty (150) pebbles collected from two outcrops of the Ogwashi-Asaba Formation. Pebble form indices such as Maximum Projection Sphericity (MPSI), coefficient of flatness (FR %), elongation ratio (ER) and oblate-prolate (OP) index were computed from these measurements. Roundness was estimated using Sames image sets. The mean values of the pebble form indices ranges from 49.78 to 52.02 for coefficient of flatness (FR %). 0.71 to 0.73 for sphericity, 2.60 t0 3.53 for oblate-prolate index, and 0.66 to 0.69 for elongation ratio. The calculated indices are suggestive of fluvial sedimentation for the Ogwashi-Asaba Formation. Bivariate plots of coefficient of flatness (FR %) versus maximum projection sphericity index (MPSI) and plots of sphericity (MPSI) versus oblate-prolate index (OP) are also indicative of fluvial origin. Scatter plots of roundness versus elongation ratio shows that 100% of the pebbles are in a littoral field. Plots of bivariate parameters such as simple skewness versus simple standard deviation, and second moment skewness versus second moment standard deviation suggests the Ogwashi-Asaba Formation as a product of the fluvial depositional processes.
Keywords: Niger Delta Basin, Ogwashi-Asaba Formation, Pebble morphometry, Pebble Form indices.
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1. Introduction

Pebble morphometric and other granulometric analysis have been utilized in paleoenvironmental interpretation of several sedimentary basins in Nigeria and worldwide. Ephraim *et al* (2015) used pebble morphometric investigations to suggest that the Benin Formation as exposed at Nsie, in southeastern Nigeria were deposited by fluvial processes. Odumodu and Isreal (2014) combined pebble morphometric analysis, lithofacies interpretation and sand textural analysis to infer a fluvial depositional environment for the Ogwashi-Asaba Formation as exposed at Nnewi and environs. Odumodu (2014) also utilized pebble form indices as a paleoenvironmental reconstruction tool to provide evidence for the fluvial origin of the Benin Formation, outcropping along Atamiri River, in Uli, Anambra State. Other previous pebble based paleoenvironmental interpretations include the works of Odumodu (2013), Odumodu and Odumodu (2012), Odumodu and Ephraim (2007a, 2007b) and Nwajide and Hoque (1982).

Several outcrops of the Ogwashi-Asaba Formation occur at Ubakala, in the vicinity of Umuahia in Abia State of Nigeria. Jan Du Chene *et al* (1978) has previously on the basis of palynological study of lignite's; shales and clays samples, interpreted the Ogwashi-Asaba Formation as a swamp deposit. All previous paleoenvironmental studies utilizing pebbles and other granulometric materials did not consider the outcrops of Ogwashi-Asaba Formation outcropping at several localities around Umuahia. It is therefore necessary to evaluate these exposures so as to resolve its paleodepositional setting.

1.1 Geological Background

The study area lies within the Niger Delta Basin. The study area is located at Ubakala, near Umuahia as shown in Figure 1. The area is underlain by the Oligocene to Miocene Ogwashi-Asaba Formation, which was formerly known as the 'lignite series' (Parkinson, 1907; Simpson, 1954) or 'lignite group' (Wilson, 1925; Wilson and Bain, 1928; Du Preez, 1946; Okezie and Onuogu, 1985). Du Preez (1946) described the Ogwashi-Asaba Formation to consist of clays, sands, grits and seams of lignites alternating with grit clays. Umeji (2003) described the formation to be composed of sandstone, shales, carbonaceous shales and lignites.

Short and Stauble (1967) discussed the various diachronous units constituting the Niger Delta Basin to include the basal marine prodelta shales of the Akata Formation, which is overlain by the paralic sand-shale sequence of the Agbada Formation. The Agbada Formation is overlain by the continental sands and gravels of the Benin Formation. Short and Stauble (1967) considered the Imo Formation as the outcrop equivalent of the Akata

Formation in the subsurface of the Niger Delta, and also regarded the Ameki Group (Ameki Formation and Nanka Sands) and the Ogwashi-Asaba Formation as being correlative to the Agbada Formation (Table 1).

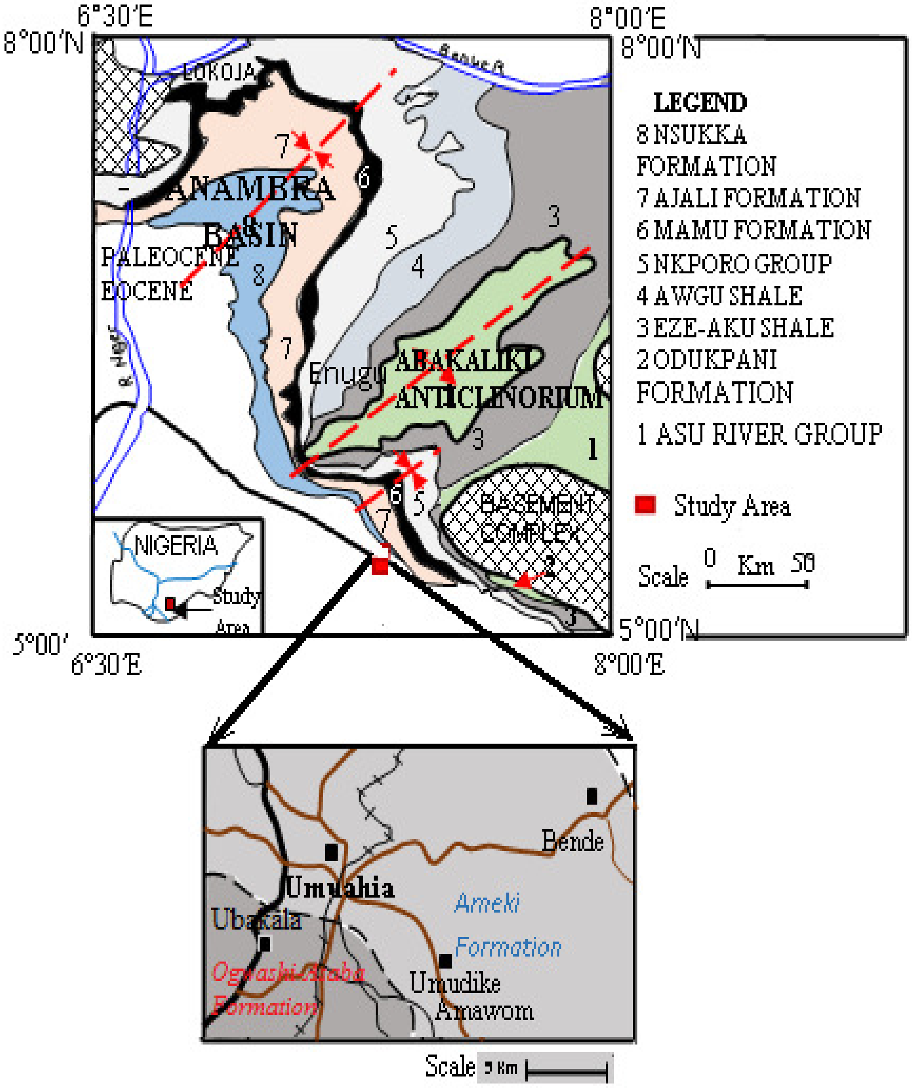

Fig. 1: Location map of the study area. Inset is the geologic map of southeastern Nigeria.

Table 1: Correlation of subsurface formations in the Niger Delta with outcrops (Short and Stauble, 1967; Avbovbo, 1978).

Age	Surface	Subsurface Niger Delta
Miocene - Recent	Benin Formation	Benin Formation
U. Eocene - Oligocene	Ogwashi-Asaba Formation	Upper Agbada Formation
Middle – Lower Eocene	Nanka Fm / Ameki Fm	Agbada Formation
Paleocene	Imo Formation	Akata Formation

1.2 Sedimentary Facies

Five outcrop sections of the Ogwashi-Asaba Formation were logged at some quarries and erosional cuts located at Ubakala near Umuahia, off Umuahia-Aba expressway at Location 1: Lat.: 5°30′53.87″N, Long.:7°27′01.99″E, Location 2: Lat.: 5°30′54.65″N, Long.: 7°27′08.65″E, Location 3: Lat. 5°20′54.25″N, Long.: 7°27′11.62″E, Location 4: Lat.: 5°32′ 50.58″N, Long.: 7°27′27.13″E, Location 5: Lat. 5°33′140.74″N, Long.: 7°26′56.67″E (Fig. 2a-e). The lithology consists of fine, medium and coarse grained sandstones, sandy clay and carbonaceous shales. Six sedimentary facies were observed in the studied area, which include (i) coarse to very coarse grained massive sandstones. In this facies, the sedimentary fabric consist of pebbly massive sandstone beds, in which many pebbles are embedded in a matrix of coarse grained to very coarse grained sandstones. This facies are very prominent at

Location 6. (ii) coarse grained bioturbated sandstones. In this facies, the sedimentary fabric consists of a matrix of coarse grained bioturbated sandstones embedded with very few pebbles. Sedimentary structures present are planar crossbeds and *Ophiomorpha* burrows (Fig. 3a). This facies were observed at location 1 and 6. (iii). medium to coarse grained bioturbated sandstone facies. The lithology in this facies consists of medium to coarse grained bioturbated sandstones. The trace fossil present is *Ophiomorpha* burrows. It is also planar crossbedded, with paleocurrents pointing southwards. This facies were observed at Location 6. (iv) Planar cross bedded sandstone facies. In this facies, lithology consists of planar crossbedded sandstones. The thickness of this facies thins down southwards. This facies were observed at Location 3. (vi) Lignitiferous clays. The lithology in this facies consists of massive clayey beds containing very thin lenses of sands and some thin bands of lignite. This facies occurs at Location 3. (vii) Fissile shales. This consists of beds of dark grey laminated and carbonaceous shales, often with some lenses of sand in places.

2.0 Materials and Methods

The methodology involved lithologic logging of quarries and erosional cuts where the pebbly units were encountered. The pebbles were carefully collected from the beds and latter selected so as to exclude cracked or broken ones. A total of 140 and 150 pebbles were selected from the several pebbles collected from two locations 1 and 2. Pebbles selected were considered to be of isotopic constitution and of high resistant to wear. The venier caliper were used to measure the three mutually perpendicular (Long, L; Intermediate, I; Short, S) axis of the pebbles based on Krumbein (1941), Sneed and Folk (1958) and Dobkins and Folk (1970) technique. Other morphometric parameters were computed in an excel spreadsheet, using the values obtained from the measurement of the three axis (Table 2). The pebbles were arranged into half-phi size group using the intermediate axes (Table 3), which is known as the 'sieve diameter' for pebbles (Tucker, 1981). Roundness of pebbles was evaluated using a visual comparison chart of images as compiled by Sames (1966) and used by Sneed and Folk (1958).

Table 2: Pebble Morphometric Indices used for the study

Morphometric Indices	Formula	Author
Flatness ratio Coefficient of flatness	S/L S/L * 100	Lutig, 1962
Elongation ratio	I/L	Lutig, 1962
Maximum projection sphericity	$\left(\frac{S^2}{LI}\right)^{1/3}$	Sneed and Folk, 1958
Oblate – prolate index	$10\left[\frac{L-I}{L-S} - 0.50\right] S/L$	Dobkins and Folk, 1970
Roundness (%)	Visual Estimation	Sames (1966)

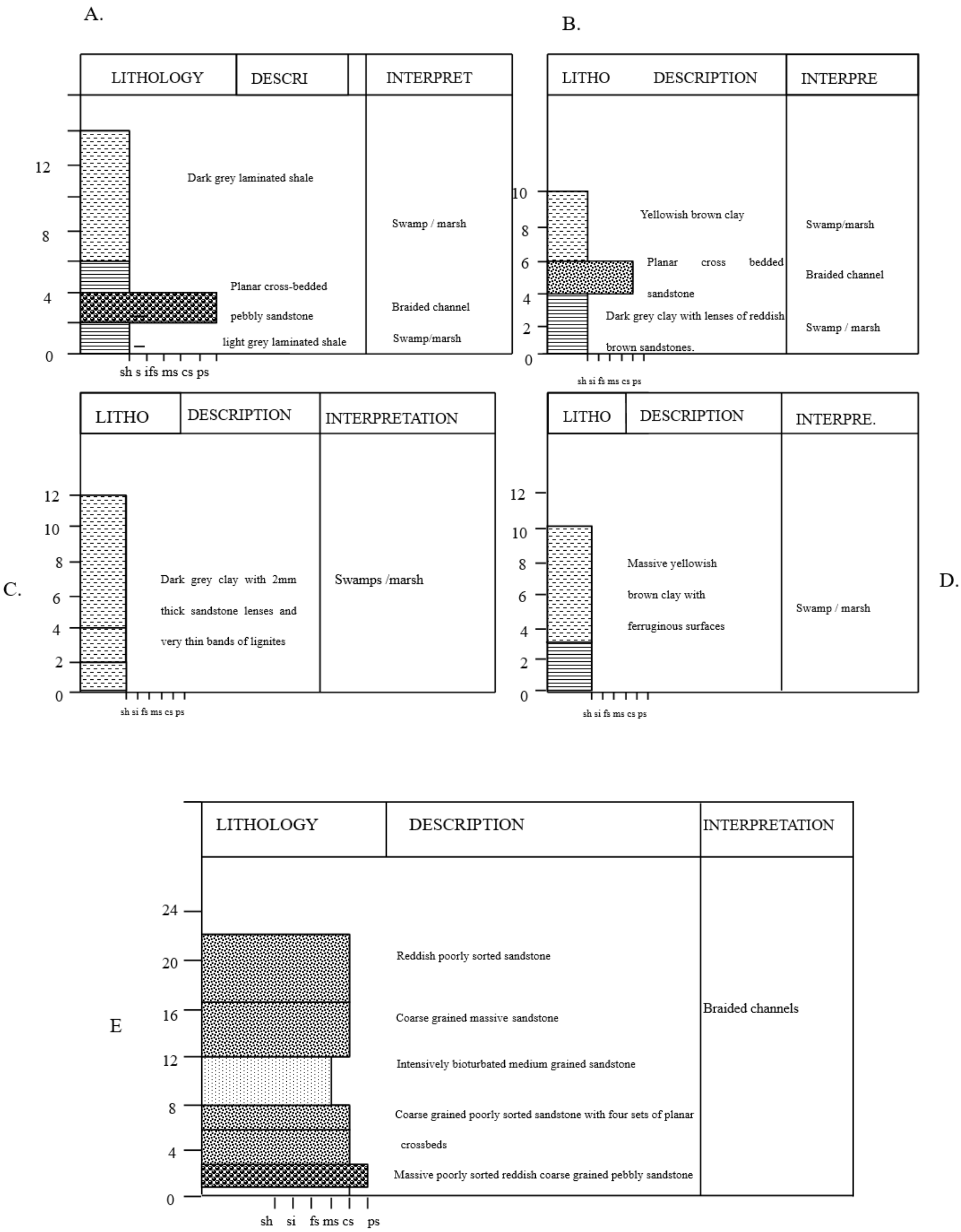

Fig. 2: Lithologs of outcrops of the Ogwashi-Asaba Formation studied


Fig. 3a: Planar cross beddings


Fig. 3b: *Ophiomorpha* burrows


Fig. 3c; Pebbly beds

Table 3: Grain size scales for pebbles (modified from Tucker (1981)

mm	*Phi*	*Class Term*
48 - 64	> - 5.5	*Pebble*
32 – 48	> - 5.0	
24 – 32	> - 4.5	
16 – 24	> - 4.0	
12 – 16	> - 3.5	
8 – 12	> - 3.0	*Granule*
6 – 8	> - 2.5	
4 - 6	> - 2.0	

Table 4. Statistical parameters of sandstones used in this study

Statistical parameters	Formula	Author
Mean (1st Moment)	$x = \sum fm\varphi / 100$	Friedman (1967, 1979)
Standard Deviation or sorting (2nd Moment	$\sigma = \sqrt{\sum f(m\varphi - x)^2} / 100$	"
Skewness (3rd Moment)	$\alpha_3 = \sum f(m\varphi - x)^3 / 100 \sigma^3$	"
Kurtosis (4th Moment)	$\sum f(m\varphi - x)^4 / 100 \sigma^4$	"
Graphic Mean	$1/3(\varphi 16 + \varphi 50 + \varphi 84)$	Folk, 1974
Inclusive (graphic) skewness	$\frac{1}{2} \frac{\phi16+\phi84-2\phi50}{\phi84-\phi16} + \frac{\phi5+\phi95-2\phi50}{\phi95-\phi5}$	"
Inclusive (graphic) standard deviation	$\sigma_1 = \varphi84 - \varphi16 / 4 + \varphi95 - \varphi5 / 6.6$	"

1.1.2 Textural Parameters

Textural parameters of sandstone samples of the Ogwashi-Asaba Formation were evaluated using conventional sieving procedures (Folk, 1974). First of all, the samples were carefully disaggregated. About 50 gram of each sample was sieved using one phi sieve interval. The sieving time used is about 15 minutes. The plotted cumulative probability curves were then used to determine the critical percentiles (5ϕ, 16ϕ, 25ϕ, 50ϕ, 84ϕ and 95ϕ. The calculated textural parameters include graphic mean, (Mz), inclusive graphic skewness ($S_{k)}$, inclusive graphic standard deviation (σ_o**)** and moment mean grain size (m_1), moment standard deviation (m_σ), moment skewness (m_3) and moment kurtosis (Table 4). These parameters were employed in bivariate plots for paleoenvironmental reconstructions (Figs. 4a-b, 5a-b, 6a-b).

2.0 Results

The computed form data and roundness data are presented in Tables 5 and 8a-b whereas a summary of the morphometric indices, characteristics and environmental implications are given in Table 6. The results of pebble morphometric analysis (Table 5) suggest that the mean values for maximum projection sphericity range from 0.71 to 0.73. The mean values of the oblate-prolate index range from 2.60 to 3.53. The mean values of the coefficient flatness range from 49.78 to 52.02. The form indices are also displayed using the graphic method by plots of coefficient of flatness versus sphericity (Fig. 4a-b) (Stratten, 1974), and plots of sphericity versus oblate-prolate index (Fig.5a-b) (Stratten, 1974), and plots of roundness versus elongation ratio (Fig. 6 a-b) (Dobkins and Folk, 1970).

Table 5 : Pebble Form Indices for the Ogwashi - Asaba Formation pebbles

	n	Coefficient of flatness ×	s	Sphericity ×	s	Oblate -Prolate Index ×	s
(A) Combined form Data for pebbles larger than – 2.0 phi							
Locality							
Location 1	140	52.02	33.50	0.73	0.22	3.53	4.47
Location 2	150	49.78	12.14	0.71	0.10	2.60	4.40
(B) Form Data for Location 1							
Size (Phi Units)							
> - 3.5	23	64.748	78.986	0.843	0.520	6.943	4.472
> - 4.0	85	50.414	11.647	0.719	0.080	3.196	4.049
> - 4.5	25	48.948	8.775	0.709	0.077	3.194	3.243
> - 5.0	6	42.235	8.217	0.615	0.073	-2.221	4.909
> - 5.5	1	31.461	-	0.512	-	-3.778	-
(C) Form Data for Location 2							
> - 3.5	23	44.964	12.125	0.703	0.093	6.664	3.588
> - 4.0	100	50.856	11.764	0.714	0.096	2.147	3.911
> - 4.5	24	50.710	12.174	0.703	0.115	0.619	4.887
> - 5.0	3	42.690	20.050	0.636	0.156	2.634	1.872

Table 6: Roundness indices for the pebbles from the Ogwashi – Asaba Formation

(A) Combined roundness indices for pebbles of different sizes for the five locations studied

Roundness Location	n	×	s
1	140	0.798	0.083
2	150	0.805	0.098

(B) Roundness indices for different fractions at the five locations studied

Phi Class	n	x	s	n	s	x
> - 3.5	23	0.80	0.10	23	0.83	0.07
> - 4.0	85	0.81	0.06	100	0.80	0.09
> - 4.5	25	0.77	0.10	24	0.82	0.11
> - 5.0	6	0.80	0.11	3	0.71	0.07
> - 5.5	1	0.93	-	-	-	-

(C) Combined roundness indices of all pebbles for the different size fractions

Roundness Phi Class	n	×	s
> - 3.5	1	0.960	-
> -4.0	8	0.911	0.013
> - 4.5	65	0.775	0.140
> - 5.0	44	0.796	0.153
> - 5.5	2	0.850	-

× is ths mean roundness; s is the standard deviation of the observations, n = number of samples;

Table 7: Summary of environmental diagnosis for pebble morphometric analysis for Ogwashi-Asaba pebbles

Morphometric Indices	**Characteristics**	**Environmental indications**
Coefficient of Flatness	Average values 52.02 ±33.5, 49.78 ± 12.14	Fluviatile
Elongation Ratio	Average values 0.661 ± 0.127, 0.682 ± 0.118	Fluviatile
Maximum Projection Sphericity	Average value 0.73 ± 0.22, 0.71 ± 0.10	Fluviatile
Oblate-prolate index	Average values 3.53 ± 4.47, 2.60±4.40	Fluviatile
Roundness %	Average values 0.798 ± 0.083, 0.805 ± 0.098	Fluviatile
Dominant pebble forms	Elongate (E)(29%), Compact Elongate(CE = 22%) Bladed (B = 21%), Compact Bladed (CB = 14%)	Fluviatile
Plot of coefficient of flatness versus Maximum projection sphericity	70% fluvial and 30 % Beach	Fluviatile
Plot of Roundness versus elongation ratio	100% littoral	Littoral
Plot of OP index versus Sphericity	Cluster in fluviatile field	Fluviatile

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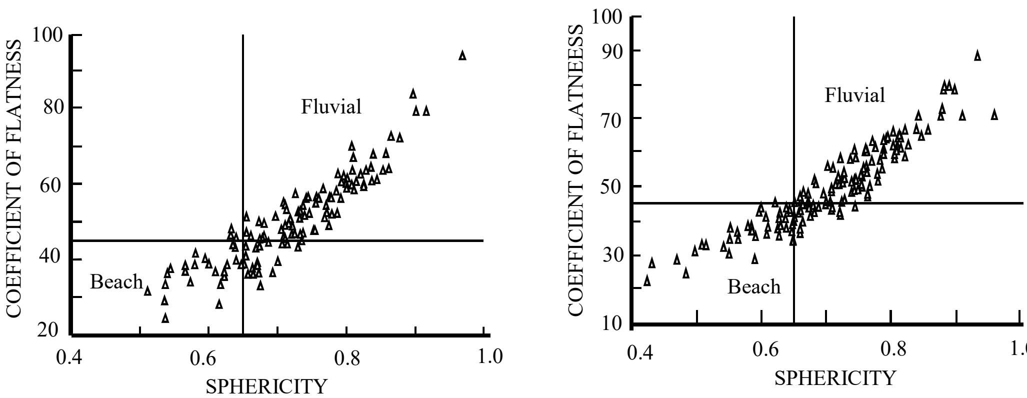

Fig. 4: Plot of coefficient of flatness against sphericity for pebbles of the Ogwashi-Asaba Formation at Location 1 and Location 2.

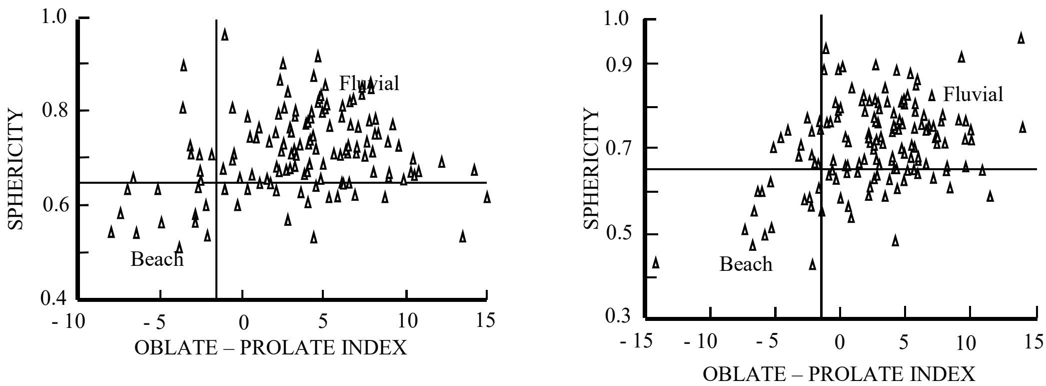

Fig. 5: Plot of Sphericity against oblate-prolate index for pebbles of the Ogwashi-Asaba Formation at Location 1 and Location 2

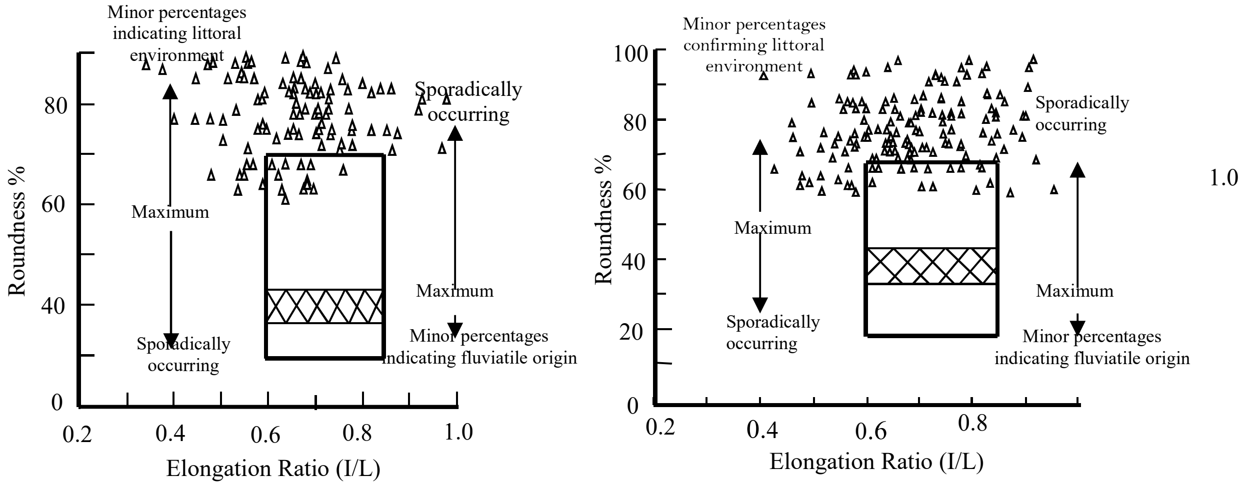

Fig. 6: Plot of Roundness against elongation Ratio using environmental determination chart of Sames (1966) for location 1 and 2

Table 8a: Seive Analysis Result (Graphic method) for the Ogwashi-Asaba Formation

Sample no	Median	Mean (M_Z)	Standard deviation σ_2	Kurtosis (KG)	Skewness (Ski)	Interpretation / Remarks
A1	1.5	1.4	0.67	0.93	-0.18	m,ps, ns,M
A2	1.6	1.08	1.17	1.05	-0.18	m,ps,ns,M.
A3	1.5	1.5	1.48	0.81	0.67	m, ps,vps, M
A4	0.8	-0.8	0.89	1.29	-0.26	c, mws, ns, L
A5	-1.7	-0.3	2.29	0.82	0.75	c, vps, vps, P
A6	1.2	3	1.2	1	-0.28	f, ps, ns, M
A7	1.6	1.6	0.95	1.14	-0.48	m, mws, vps, L
Average		1.10	1.2	1.0	0.04	m, ps, vps, M

Table 8b: Sieve analysis Result (Moment measures) for the Ogwashi-Asaba Formation

Sample no	Mean Grain size, Ist moment	Standard Deviation of sorting, 2nd moment	Skewness 3rd moment	Mean cubed Deviation	Interpretation /Remarks
A1	0.56	0.55	0.65	0.39	c,mws,vfs
A2	0.52	0.39	0.34	0.10	c, ws,vfs
A3	0.72	0.95	0.96	1.71	c,ms,vfs
A4	1.99	1.64	0.04	0.22	vc,ps,ns
A5	0.83	0.89	0.61	0.99	c,ms,vfs
A6	1.16	1.05	0.40	0.88	vc,ps,vfs
A7	0.29	0.44	0.54	0.21	c,ws,vfs
A8	0.65	0.72	0.56	0.58	c,mws,vfs
Average	0.84	0.83	0.51	0.64	

3.0 Discussion of Results

3.1 Pebble Form Indices

The mean elongation ratio for pebbles of Ogwashi-Asaba Formation (0.661 ± 0.21 – 0.686 ± 0.118) from Ubakala lies within the 0.65 – 0.75 range of Lutig's torrent type flowing waters or brooks and rivulets. The mean flatness ratio computed for the pebbles (0.52 ± 0.34 – 0.50 ± 0.12) falls beyond the fluviatile range of 0.25 – 0.35 and slightly above the marine range of 0.40 – 0.50 (Lutig.1962). Certain shape classes of pebbles are diagnostic of depositional environments (Dobkins and Folk, 1970). The dominant pebble forms common in beaches include bladed, very bladed, platy, and very platy whereas elongate, compact elongate, compact, and compact bladed are indicative of fluviatile pebbles. The pebble form common in the studied area include elongate (29%), compact elongate (22%), bladed (21%) and compact bladed (14%), (Table 6) which are indicative of the dominance of fluvial processes over beach action in the area.

The maximum projection sphericity index (M.P.S.I) calculated for the Ogwashi-Asaba Formation pebbles at Ubakala (0.71 ± 0.10 – 0.73 ± 0.22) lies above 0.65 / 0.66 lower index limits that separates beach and fluvial pebbles. It has been established that pebbles with lower sphericity values are characterized by beach pebbles while those with higher sphericity values are suggestive of a fluvial environment (Dobkins and Folk, 1970). The sphericity values of the Ubakala pebbles are thus indicative of a fluvial setting.

The oblate-prolate index for pebbles of Ogwashi-Asaba Formation from Ubakala (2.60 ± 4.40 – 3.53 ± 4.47) lies above the – 1.5 lower index limit established by Dobkins and Folk (1970) that separates beach and fluvial pebbles. The oblate-prolate index values are suggestive of a fluvial depositional environment.

The mean values of the various form indices (Tables 5 and 8) for the two sets of pebble samples lie within the limits suggested for pebbles formed in a fluvial setting. The bivariate plots coefficient of flatness versus sphericity (Figs. 4 a-b), and sphericity versus oblate-prolate index (Figs. 4a-b) indicate that majority of the pebbles lie within the fluvial field. The plot of roundness versus elongation ratio suggests that 100% of the pebbles are in the littoral field (Fig. 5a-b). Plots made on the sphericity form diagram of Sneed and Folk (1958) (Fig.7) for the -3.0, -3.5, - 4.0, - 4.5, - 5.0, -5.5 phi size classes for the two locations studied confirm the finding that larger pebbles are generally more bladed than smaller ones. In a nutshell, the study of form indices of pebbles from Ogwashi-Asaba Formation has indicated the fluvial origin of these pebbles. The sphericity form plots also suggest a decrease in sphericity as size increases.

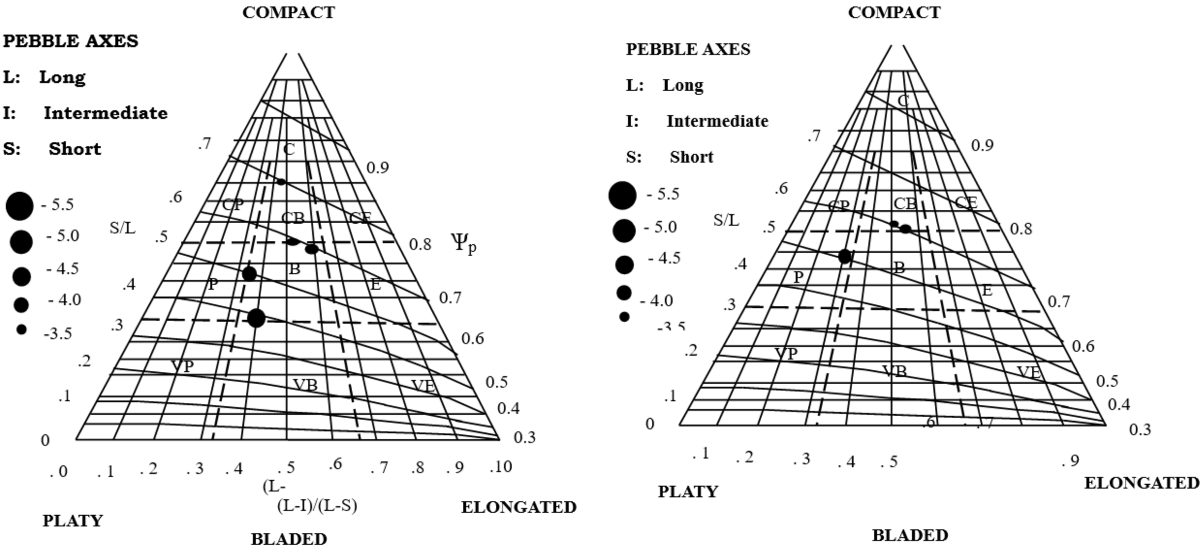

Fig 7: Sphericity-form diagram of Sneed and Folk (1958), Sphericity-form plots of mean indices of the -3.5, -4.0, -4.5, -5.0, - 5.5 phi size classes for Location 1 and Locaton 2.

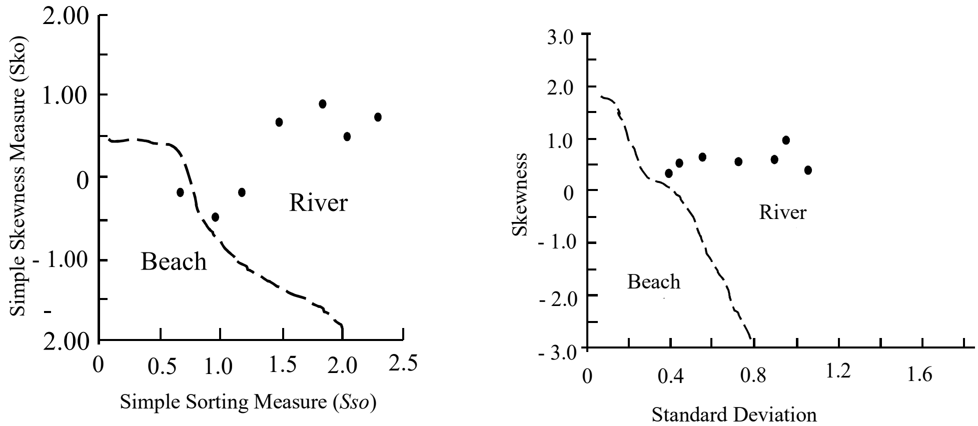

FIG: 8a Bivariate plot of Simple Skewness Measure (Sko) against Simple sorting measure (Sso) for Ogwashi- Asaba Formation and (b) Bivariate Plot of 3rd moment (Skewness) against 2nd moment standard deviation

3.2 Textural Parameters

Graphical plots of simple skewness measures versus simple standard deviation (Fig. 8a) and 3rd moment skewness versus 2nd moment standard deviation (Fig. 8b) for sandstones of the Ogwashi-Asaba Formation suggest a fluvial paleodepositional environment for the sandstones. The sieve analysis results in Table 7a suggests that the sandstones from the Ogwashi-Asaba Formation have grain sizes ranging from- 0.8 to1.6 with an average of 1.10 (medium sand). The result of standard deviation ranges from 0.67 to 2.29 and suggests that the sands are well to poorly sorted

4.0 Conclusison

Odumodu and Isreal (2014) using pebble form indices inferred a fluvial depositional environment for the Ogwashi-Asaba Formation in Nnewi area in Anambra State. Results of their study gave the mean sphericity values to range from 0.605 to 0.834, coefficient of flatness as 65.60 to 71.75 and oblate-prolate index as ranging from – 1.869 to – 0.877. Results from the present study have yielded sphericity values that vary from 0.71 to 0.73, coefficient of flatness values from 49.78 to 52.02 and oblate-prolate index values from 2.60 to 3.53. All these values also fall within the range required for fluvial pebbles. The entire cross plots of the bivariate parameters are also indicative of a fluvial environment of deposition. A long distance of transport is inferred from the roundness index. The lithofacies also supports a braided fluvial channel, swamps and marshland as the depositional environments.

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Table 9a: Results of pebble morphometric study of Ogwashi-Asaba Formation at Location 1

	L	I	S	S/L	S/L*100	I/L	L-I/L-S	SPHERICITY	OP INDEX	ROUN DNESS	
1	52.7	25.2	20	0.38	37.951	0.478	0.841	0.67	8.985	0.66	E
2	41.8	25.3	14.1	0.337	33.732	0.605	0.596	0.573	2.836	0.68	B
3	48.4	26.1	22.3	0.461	46.074	0.539	0.854	0.733	7.692	0.66	E
4	48.3	30.8	26.1	0.54	54.037	0.638	0.788	0.771	5.335	0.68	CE
5	46.4	23.4	18.1	0.39	39.009	0.504	0.813	0.671	8.017	0.73	E
6	71.2	52.6	22.4	0.315	31.461	0.739	0.381	0.512	-3.78	0.93	B
7	59.2	46	31.4	0.53	53.041	0.777	0.475	0.713	-0.47	0.72	CB
8	43.2	19.3	16.9	0.391	39.12	0.447	0.909	0.7	10.45	0.85	E
9	39.4	21	17.1	0.434	43.401	0.533	0.825	0.707	7.491	0.79	E
10	43.2	20.6	16.1	0.373	37.269	0.477	0.834	0.663	8.961	0.77	E
11	33.4	23.8	11.1	0.332	33.234	0.713	0.43	0.537	-2.09	0.76	B
12	43.5	24.7	19.7	0.453	45.287	0.568	0.79	0.712	6.402	0.68	E
13	29.3	19.5	14.2	0.485	48.464	0.666	0.649	0.707	3.075	0.78	B
14	49.3	43.1	18.5	0.375	37.525	0.874	0.201	0.544	-7.96	0.74	E
15	65.3	42.2	29.6	0.453	45.329	0.646	0.647	0.683	3.244	0.82	B
16	25.3	18.5	14.3	0.565	56.522	0.731	0.618	0.759	2.091	0.83	CE
17	34.9	26.8	20.5	0.587	58.739	0.768	0.563	0.766	1.064	0.98	CB
18	37.7	29	19.2	0.509	50.928	0.769	0.47	0.696	-0.58	0.79	CB
19	31	16.6	14.8	0.477	47.742	0.535	0.889	0.752	8.146	0.85	E
20	40.9	26.8	19.6	0.479	47.922	0.655	0.662	0.705	3.38	0.75	E
21	32.5	18.5	15.1	0.465	46.462	0.569	0.805	0.724	6.556	0.85	E
22	32.6	18.1	16.9	0.518	51.84	0.555	0.924	0.785	8.171	0.88	CE
23	32.3	21.1	14.6	0.452	45.201	0.653	0.633	0.679	2.937	0.83	B
24	47.5	42.2	19.8	0.417	41.684	0.888	0.191	0.58	-7.4	0.99	E
25	46.6	26.9	21.1	0.453	45.279	0.577	0.773	0.708	6.019	0.81	E
25	42.9	36.9	20	0.466	46.62	0.86	0.262	0.632	-5.1	0.83	P
27	30	23.3	20.3	0.677	67.667	0.777	0.691	0.839	2.819	0.76	CE
28	32.4	19.1	14.9	0.46	45.988	0.59	0.76	0.711	5.654	0.76	E
29	27.8	18.9	12.1	0.435	43.525	0.68	0.567	0.653	1.537	0.88	B
30	32.1	24.3	17.9	0.558	55.763	0.757	0.549	0.743	0.884	0.67	CB
31	37.7	24.5	19.3	0.512	51.194	0.65	0.717	0.739	4.246	0.74	CE
32	47.2	30.7	24.4	0.517	51.695	0.65	0.724	0.743	4.327	0.85	CE
33	48.4	25.1	17.1	0.353	35.331	0.519	0.744	0.622	6.918	0.94	E
34	37.5	26.5	23.8	0.635	63.467	0.707	0.803	0.829	4.773	0.75	CE
35	33	22.4	15.3	0.464	46.364	0.679	0.599	0.682	2.132	0.83	B
36	80.1	44.5	23.4	0.292	29.213	0.556	0.628	0.536	4.377	0.71	VB
37	25.5	14.4	13.2	0.518	51.765	0.565	0.902	0.78	7.774	0.85	CE
38	23.4	19.6	12.8	0.547	54.701	0.838	0.358	0.71	-2.59	0.83	CB
39	18.1	17.5	15.1	0.834	83.425	0.967	0.2	0.896	-3.6	0.71	C
40	24.9	16.2	12.6	0.506	50.602	0.651	0.707	0.733	4.097	0.82	CE
41	39.4	21.5	14.3	0.363	36.294	0.546	0.713	0.623	5.873	0.86	E
42	36.3	24.3	16.4	0.452	45.179	0.669	0.603	0.673	2.28	0.85	B
43	31.2	20	18.7	0.599	59.936	0.641	0.896	0.824	6.607	0.82	CE
44	26.4	14.7	12.2	0.462	46.212	0.557	0.824	0.727	7.01	0.68	E
45	16.7	16.3	15.7	0.94	94.012	0.976	0.4	0.967	-1.06	0.81	C
46	31.5	20.7	14.2	0.451	45.079	0.657	0.624	0.676	2.757	0.75	B
47	26.8	18.9	14.9	0.556	55.597	0.705	0.664	0.76	2.947	0.92	CE
48	21.9	15.9	14.8	0.676	67.58	0.726	0.845	0.857	5.106	0.87	CE
49	57.9	31.8	22.4	0.387	38.687	0.549	0.735	0.648	6.08	0.85	B
50	33.1	19.7	17.3	0.523	52.266	0.595	0.848	0.771	6.66	0.75	CE
51	34.2	29.1	18.8	0.55	54.971	0.851	0.331	0.708	-3.07	0.75	CP
52	43.2	18.9	15.5	0.359	35.88	0.438	0.877	0.665	10.51	0.94	E
53	30.8	18.1	12.5	0.406	40.584	0.588	0.694	0.654	4.78	0.81	E
54	28.7	15.2	13.6	0.474	47.387	0.53	0.894	0.751	8.315	0.88	E
55	30.9	18.2	11.3	0.366	36.57	0.589	0.648	0.61	4.046	0.82	B
56	31.3	22	19.5	0.623	62.3	0.703	0.788	0.82	4.625	0.82	CE
57	26.1	16.1	15.9	0.609	60.92	0.617	0.98	0.844	7.886	0.73	CE
58	18.6	15.2	13.5	0.726	72.581	0.817	0.667	0.864	2.296	0.82	C
59	30.8	18.7	11.9	0.386	38.636	0.607	0.64	0.626	3.629	0.68	B
60	32.8	24.9	12.6	0.384	38.415	0.759	0.391	0.579	-2.84	0.67	B
61	23.9	20.4	18.9	0.791	79.079	0.854	0.7	0.901	2.529	0.93	C
62	29.7	20	17.7	0.596	59.596	0.673	0.808	0.808	5.174	0.95	CE
63	35.6	24.1	21.5	0.604	60.393	0.677	0.816	0.814	5.226	0.79	CE
64	32.7	20.6	15.9	0.486	48.624	0.63	0.72	0.721	4.529	0.84	E
65	28.5	16.5	14.6	0.512	51.228	0.579	0.863	0.768	7.092	0.75	CE
66	21.9	17.9	17.3	0.79	78.995	0.817	0.87	0.914	4.678	0.75	C
67	26.3	16.9	15.4	0.586	58.555	0.643	0.862	0.811	6.189	0.74	CE

	L	I	S	S/L	S/L*100	I/L	L-I/L-S	SPHERICITY	OP INDEX	ROUN DNESS	
68	27.4	18.4	11.7	0.427	42.701	0.672	0.573	0.648	1.715	0.88	B
69	21.4	16.5	15.4	0.72	71.963	0.771	0.817	0.876	4.4	0.93	C
70	27.2	16.8	11.8	0.434	43.382	0.618	0.675	0.673	4.041	0.95	E
71	20.1	13.8	11.4	0.567	56.716	0.687	0.724	0.777	3.952	0.82	CE
72	15.9	14.7	11.1	0.698	69.811	0.925	0.25	0.808	-3.58	0.81	C
73	26.4	17.5	12.9	0.489	48.864	0.663	0.659	0.712	3.259	0.74	B
74	30.5	21.1	15.4	0.505	50.492	0.692	0.623	0.717	2.426	0.93	CB
75	24.2	16.9	12.7	0.525	52.479	0.698	0.635	0.733	2.568	0.84	CB
76	22.9	17.6	12.9	0.563	56.332	0.769	0.53	0.745	0.533	0.83	CB
77	24.1	15.3	14.4	0.598	59.751	0.635	0.907	0.825	6.815	0.61	CE
78	24.3	13.3	9.3	0.383	38.272	0.547	0.733	0.644	6.097	0.66	E
79	22.9	15.3	11.3	0.493	49.345	0.668	0.655	0.714	3.145	0.68	B
80	27.6	20.5	12	0.435	43.478	0.743	0.455	0.634	-1.03	0.89	B
81	27.4	22.7	9.9	0.361	36.131	0.828	0.269	0.54	-6.41	0.93	P
82	25.9	20.9	9.9	0.382	38.224	0.807	0.313	0.566	-4.91	0.99	P
83	31.2	23.4	11.5	0.369	36.859	0.75	0.396	0.566	-2.82	0.71	B
84	23.1	18.3	10.5	0.455	45.455	0.792	0.381	0.639	-2.62	0.98	B
85	20.5	14.9	12.5	0.61	60.976	0.727	0.7	0.8	3.28	0.81	CE
86	23.1	17.9	11.4	0.494	49.351	0.775	0.444	0.68	-1.13	0.75	B
87	21.1	17.2	11.4	0.54	54.028	0.815	0.402	0.71	-1.81	0.97	CB
88	44.1	15.5	14.5	0.329	32.88	0.351	0.966	0.675	14.18	0.93	E
89	24.1	19.4	15.1	0.627	62.656	0.805	0.522	0.787	0.355	0.93	CB
90	28.1	21.1	11.2	0.399	39.858	0.751	0.414	0.596	-2.15	0.98	B
91	26	22.4	14.9	0.573	57.308	0.862	0.324	0.725	-3.07	0.71	CB
92	18.5	16.9	8.9	0.481	48.108	0.914	0.167	0.633	-6.93	0.97	CP
93	24.2	18.3	15.3	0.632	63.223	0.756	0.663	0.809	2.577	0.85	CE
94	19.5	17.9	9.9	0.508	50.769	0.918	0.167	0.655	-6.57	0.79	CP
95	25.4	19.2	15.7	0.618	61.811	0.756	0.639	0.797	2.252	0.72	CB
96	39.6	31.6	18.7	0.472	47.222	0.798	0.383	0.654	-2.48	0.84	B
97	20.9	13.3	13.3	0.636	63.636	0.636	1	0.86	7.857	0.89	CE
98	44.3	19.1	16	0.361	36.117	0.431	0.89	0.671	10.81	0.94	E
99	34.1	24.1	21.8	0.639	63.93	0.707	0.813	0.833	4.896	0.79	CE
100	48.4	23.3	20.9	0.432	43.182	0.481	0.913	0.729	9.558	0.88	E
101	39.5	25.5	25	0.633	63.291	0.646	0.966	0.853	7.355	0.96	CB
102	46.8	25.7	20.8	0.444	44.444	0.549	0.812	0.711	7.01	0.89	E
103	37.5	22.4	16.5	0.44	44	0.597	0.719	0.687	4.978	0.96	E
104	30.7	15.8	15	0.489	48.86	0.515	0.949	0.774	9.19	0.85	E
105	31.5	23.1	14.5	0.46	46.032	0.733	0.494	0.661	-0.13	0.75	B
106	38.7	21	18	0.465	46.512	0.543	0.855	0.736	7.634	0.94	E
107	38.4	25.8	16.5	0.43	42.969	0.672	0.575	0.65	1.753	0.89	B
108	37.4	14	9	0.241	24.064	0.374	0.824	0.537	13.46	0.87	VE
109	31.6	22.3	17.6	0.557	55.696	0.706	0.664	0.76	2.95	0.82	CE
110	31.7	19.9	19.2	0.606	60.568	0.628	0.944	0.836	7.331	0.96	CE
111	37.7	12.8	10.6	0.281	28.117	0.34	0.919	0.615	14.9	0.88	VE
112	27.4	20	15.4	0.562	56.204	0.73	0.617	0.756	2.076	0.74	CB
113	37.5	26.7	17.1	0.456	45.6	0.712	0.529	0.663	0.645	0.72	B
114	29	18	13	0.448	44.828	0.621	0.688	0.687	4.183	0.66	E
115	26.4	18	14.9	0.564	56.439	0.682	0.73	0.776	4.083	0.65	CE
116	34.2	24	13.3	0.389	38.889	0.702	0.488	0.6	-0.31	0.74	B
117	31.3	22.8	16.9	0.54	53.994	0.728	0.59	0.737	1.672	0.79	CB
118	32.2	22.2	14	0.435	43.478	0.689	0.549	0.65	1.137	0.68	B
119	38.7	19.5	17.3	0.447	44.703	0.504	0.897	0.735	8.885	0.77	E
120	24.6	17.2	13.5	0.549	54.878	0.699	0.667	0.755	3.037	0.78	CP
121	26.3	19	15.8	0.601	60.076	0.722	0.695	0.793	3.25	0.78	CE
122	27.8	19	16	0.576	57.554	0.683	0.746	0.786	4.27	0.64	CE
123	33.9	16	11.3	0.333	33.333	0.472	0.792	0.617	8.761	0.88	E
124	36	18.8	15.7	0.436	43.611	0.522	0.847	0.714	7.963	0.94	E
125	38.2	21.4	14	0.366	36.649	0.56	0.694	0.621	5.299	0.88	E
126	26.9	18.7	16	0.595	59.48	0.695	0.752	0.798	4.242	0.63	CE
127	24.5	16	10	0.408	40.816	0.653	0.586	0.634	2.112	0.78	B
128	31.5	12.6	11.5	0.365	36.508	0.4	0.945	0.693	12.19	0.77	E
129	24.9	20.2	12.4	0.498	49.799	0.811	0.376	0.674	-2.49	0.99	E
130	26.1	22.1	17.5	0.67	67.05	0.847	0.465	0.81	-0.52	0.91	C
131	25.3	15.9	14.1	0.557	55.731	0.628	0.839	0.791	6.088	0.63	E
132	25.5	14.6	11.8	0.463	46.275	0.573	0.796	0.72	6.388	0.92	E
133	27.5	15	116	4.218	421.82	0.545	-0.14	3.195	-1.52	0.95	
134	28.6	19.3	16.8	0.587	58.741	0.675	0.788	0.8	4.905	0.63	CE
135	27.4	14.7	10.5	0.383	38.321	0.536	0.751	0.649	6.562	0.63	E

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	L	I	S	S/L	S/L*100	I/L	L-I/L-S	SPHERICITY	OP INDEX	ROUN DNESS	
136	24.1	17	10.3	0.427	42.739	0.705	0.514	0.637	0.339	0.78	B
137	32	14.5	11.5	0.359	35.938	0.453	0.854	0.658	9.841	0.95	E
138	34	20	13.4	0.394	39.412	0.588	0.68	0.642	4.557	0.64	B
139	31.5	19.6	13.6	0.432	43.175	0.622	0.665	0.669	3.817	0.98	E
140	30	13.3	11	0.367	36.667	0.443	0.879	0.672	10.33	0.77	E
Mean	32.809	21.2	16.33	0.52	52.019	0.661	0.661	0.732	3.529	0.79792	CE
Standard Deviation	10.357	6.73	9.404	0.335	33.502	0.127	0.21	0.227	4.466	0.08298	

Table 9b: Results of pebble morphometric study of Ogwashi-Asaba Formation at Location 2

	L	I	S	S/L	S/L*100	I/L	L-I/L-S	SPHERICITY	OP INDEX	ROUN DNESS	
1	42.7	29.1	18.3	0.429	42.857	0.681	0.557	0.646	1.339	0.75	B
2	25.1	23.1	20	0.797	79.681	0.92	0.392	0.884	-1.353	0.71	CB
3	30.5	24.2	20.3	0.666	66.557	0.793	0.618	0.823	1.768	0.99	CB
4	33.3	26	9.5	0.285	28.529	0.781	0.307	0.471	-6.775	0.97	VP
5	33.7	26.3	11	0.326	32.641	0.78	0.326	0.515	-5.331	0.75	P
6	26.9	20.5	14.6	0.543	54.275	0.762	0.52	0.728	0.374	0.83	CB
7	29.5	22.4	18	0.61	61.017	0.759	0.617	0.789	1.924	0.84	CB
8	32.9	26.8	20.3	0.617	61.702	0.815	0.484	0.776	-0.257	0.69	CB
9	25	22.6	14.6	0.584	58.4	0.904	0.231	0.723	-4.61	0.91	CP
10	30.2	20.4	14.4	0.477	47.682	0.675	0.62	0.696	2.522	0.75	CB
11	28.9	20.4	15	0.519	51.903	0.706	0.612	0.725	2.148	0.74	CB
12	30	20.5	13.7	0.457	45.667	0.683	0.583	0.673	1.814	0.81	B
13	23.6	19.4	15.1	0.64	63.983	0.822	0.494	0.793	-0.092	0.95	CB
14	25.5	19.4	16.4	0.643	64.314	0.761	0.67	0.816	2.648	0.79	CE
15	27.7	18.1	16.2	0.585	58.484	0.653	0.835	0.806	5.724	0.74	CE
16	29.3	25.7	18.6	0.635	63.481	0.877	0.336	0.772	-2.576	0.79	CP
17	26.1	23.5	15.9	0.609	60.92	0.9	0.255	0.744	-4.023	0.83	CP
18	30.2	21	15.2	0.503	50.331	0.695	0.613	0.714	2.252	0.79	CB
19	28.9	21.9	11.1	0.384	38.408	0.758	0.393	0.58	-2.779	0.75	B
20	30.1	15.7	13	0.432	43.189	0.522	0.842	0.71	7.921	0.78	E
21	24.8	20.8	12.8	0.516	51.613	0.839	0.333	0.682	-3.229	0.76	CB
22	29.3	18.7	11.7	0.399	39.932	0.638	0.602	0.63	2.561	0.79	B
23	29.3	19.2	15.3	0.522	52.218	0.655	0.721	0.747	4.24	0.73	CE
24	26	17.2	18.4	0.708	70.769	0.662	1.158	0.911	9.296	0.71	
25	27.4	19.9	15.8	0.577	57.664	0.726	0.647	0.771	2.541	0.84	CB
25	25.6	16.5	13.5	0.527	52.734	0.645	0.752	0.756	4.78	0.73	CE
27	21	17.9	11.6	0.552	55.238	0.852	0.33	0.71	-3.081	0.89	CP
28	27.8	17	14.1	0.507	50.719	0.612	0.788	0.749	5.685	0.71	CE
29	50.1	31.3	29.5	0.589	58.882	0.625	0.913	0.822	7.008	0.68	CE
30	36.8	27.4	22.9	0.622	62.228	0.745	0.676	0.804	2.832	0.78	CE
31	37.6	26.8	17	0.452	45.213	0.713	0.524	0.659	0.537	0.74	B
32	31.3	23.3	22.2	0.709	70.927	0.744	0.879	0.878	5.345	0.83	CE
33	32.1	18.4	12	0.374	37.383	0.573	0.682	0.625	4.858	0.76	E
34	30	20.4	15.3	0.51	51	0.68	0.653	0.726	3.001	0.76	CE
35	25.9	21.9	15.1	0.583	58.301	0.846	0.37	0.738	-2.223	0.78	CB
36	26.5	24.3	7.2	0.272	27.17	0.917	0.114	0.432	-14.21	0.99	VP
37	30.2	19.9	15.6	0.517	51.656	0.659	0.705	0.74	3.978	0.99	CE
38	31.6	27.2	13.5	0.427	42.722	0.861	0.243	0.596	-6.014	0.87	P
39	23.9	17.2	10.1	0.423	42.259	0.72	0.486	0.628	-0.343	0.93	B
40	23.9	20.9	10.4	0.435	43.515	0.874	0.222	0.6	-6.384	0.61	P
41	30.5	20.9	11.3	0.37	37.049	0.685	0.5	0.585	3E-15	0.71	B
42	29.6	18.4	12.9	0.436	43.581	0.622	0.671	0.674	3.916	0.71	E
43	35.5	20.6	17.2	0.485	48.451	0.58	0.814	0.74	6.485	0.85	E
44	30.8	25.6	18.1	0.588	58.766	0.831	0.409	0.746	-1.541	0.89	CB
45	21.1	20.1	18.6	0.882	88.152	0.953	0.4	0.934	-1.134	0.62	C
46	31.9	20.5	10.2	0.32	31.975	0.643	0.525	0.542	0.793	0.97	B
47	27.4	15.1	10.4	0.38	37.956	0.551	0.724	0.639	5.889	0.88	E
48	23.7	17.4	8.6	0.363	36.287	0.734	0.417	0.564	-2.281	0.95	B
49	27.7	21.6	8.6	0.31	31.047	0.78	0.319	0.498	-5.818	0.84	P
50	24.1	19.9	14.5	0.602	60.166	0.826	0.438	0.76	-1.039	0.82	CB
51	21.4	18.1	8.1	0.379	37.85	0.846	0.248	0.553	-6.655	0.83	P
52	31.5	24.5	12.8	0.406	40.635	0.778	0.374	0.597	-3.093	0.74	B
53	35	22.7	7.8	0.223	22.286	0.649	0.452	0.425	-2.145	0.81	VB
54	26.5	16.9	10.1	0.381	38.113	0.638	0.585	0.611	2.24	0.75	B
55	31.6	18.9	11.1	0.351	35.127	0.598	0.62	0.591	3.402	0.82	B
56	26.3	19.5	11.9	0.452	45.247	0.741	0.472	0.651	-0.614	0.88	B

	L	I	S	S/L	S/L*100	I/L	L-I/L-S	SPHERICITY	OP INDEX	ROUN DNESS	
57	27.6	20.7	10.7	0.388	38.768	0.75	0.408	0.585	-2.366	0.93	B
58	23.3	19.3	7.7	0.33	33.047	0.828	0.256	0.509	-7.371	0.97	P
59	25.1	13.6	10	0.398	39.841	0.542	0.762	0.664	6.566	0.75	E
60	24.1	15.8	10.8	0.448	44.813	0.656	0.624	0.674	2.768	0.85	B
61	25.2	15.9	9.1	0.361	36.111	0.631	0.578	0.591	2.15	0.85	B
62	25.6	18.6	15.9	0.621	62.109	0.727	0.722	0.81	3.569	0.63	CE
63	26.4	17.4	9.1	0.345	34.47	0.659	0.52	0.565	0.587	0.71	B
64	28.1	13.9	10.3	0.367	36.655	0.495	0.798	0.648	8.123	0.64	E
65	26.6	14.9	10.4	0.391	39.098	0.56	0.722	0.649	5.684	0.73	E
66	31.1	14.3	11.3	0.363	36.334	0.46	0.848	0.66	9.591	0.81	E
67	26.5	17.6	12.9	0.487	48.679	0.664	0.654	0.709	3.172	0.83	E
68	21.4	17.3	10.9	0.509	50.935	0.808	0.39	0.685	-2.15	0.62	CB
69	24.2	21.7	19	0.785	78.512	0.897	0.481	0.883	-0.245	0.83	C
70	22.2	19.1	10.1	0.455	45.495	0.86	0.256	0.622	-5.359	0.74	P
71	26.2	19.5	10.7	0.408	40.84	0.744	0.432	0.607	-1.659	0.81	B
72	14.4	12.2	11.3	0.785	78.472	0.847	0.71	0.899	2.672	0.71	C
73	21.1	15.3	12.6	0.597	59.716	0.725	0.682	0.789	3.054	0.73	CE
74	21.1	15.9	10.1	0.479	47.867	0.754	0.473	0.672	-0.57	0.75	B
75	20.9	16.1	13.4	0.641	64.115	0.77	0.64	0.811	2.184	0.93	CB
76	19.6	17.8	11	0.561	56.122	0.908	0.209	0.703	-5.18	0.97	CP
77	27.1	17.2	11	0.406	40.59	0.635	0.615	0.638	2.831	0.73	B
78	26.4	19.6	11.6	0.439	43.939	0.742	0.459	0.638	-0.923	0.94	B
79	34.5	14.1	10	0.29	28.986	0.409	0.833	0.59	11.48	0.95	VE
80	28.6	16.5	11.4	0.399	39.86	0.577	0.703	0.651	5.105	0.87	E
81	20.3	14.3	8.8	0.433	43.35	0.704	0.522	0.644	0.501	0.84	P
82	25.5	18.3	11.6	0.455	45.49	0.718	0.518	0.661	0.395	0.93	B
83	28.8	20.4	15.1	0.524	52.431	0.708	0.613	0.729	2.158	0.89	CB
84	47.7	29.7	21.1	0.442	44.235	0.623	0.677	0.68	3.994	0.79	B
85	28.5	19.6	16.4	0.575	57.544	0.688	0.736	0.784	4.093	0.74	CE
86	37.9	28.4	20	0.528	52.77	0.749	0.531	0.719	0.582	0.75	CB
87	48.8	29.9	22.4	0.459	45.902	0.613	0.716	0.701	4.704	0.68	E
88	40.3	26.8	21.5	0.533	53.35	0.665	0.718	0.754	4.088	0.68	CE
89	38.6	25.4	20.9	0.541	54.145	0.658	0.746	0.764	4.539	0.78	CE
90	32	25.2	20.8	0.65	65	0.788	0.607	0.813	1.648	0.72	CB
91	41.6	25	17	0.409	40.865	0.601	0.675	0.653	4.277	0.85	E
92	44.4	27.1	23.9	0.538	53.829	0.61	0.844	0.78	6.389	0.64	CE
93	20.9	17.5	13.8	0.66	66.029	0.837	0.479	0.804	-0.32	0.85	CB
94	37.7	26.1	23.6	0.626	62.599	0.692	0.823	0.827	5.155	0.68	CE
95	28	22.1	13.5	0.482	48.214	0.789	0.407	0.665	-1.931	0.95	B
96	36.3	21.9	14.8	0.408	40.771	0.603	0.67	0.651	4.164	0.77	E
97	23.1	19.5	14.1	0.61	61.039	0.844	0.4	0.761	-1.638	0.84	CB
98	38.4	17.8	16	0.417	41.667	0.464	0.92	0.721	10.07	0.77	E
99	53.2	32.2	20.6	0.387	38.722	0.605	0.644	0.628	3.723	0.79	B
100	41.6	34.2	26.8	0.644	64.423	0.822	0.5	0.796	-2E-15	0.68	CB
101	29.9	19.5	15.5	0.518	51.839	0.652	0.722	0.744	4.287	0.75	CE
102	26.1	21.5	16.6	0.636	63.602	0.824	0.484	0.789	-0.248	0.78	CB
103	30.9	17.8	15	0.485	48.544	0.576	0.824	0.742	6.672	0.96	E
104	25.6	17.7	15.7	0.613	61.328	0.691	0.798	0.816	4.859	0.72	CE
105	31.6	15	14	0.443	44.304	0.475	0.943	0.745	10	0.73	E
106	36.9	20.9	18.1	0.491	49.051	0.566	0.851	0.752	7.157	0.68	E
107	30.2	21.3	16.7	0.553	55.298	0.705	0.659	0.757	2.88	0.63	E
108	31.3	21.6	14.1	0.45	45.048	0.69	0.564	0.665	1.42	0.73	B
109	42.5	25.5	18.8	0.442	44.235	0.6	0.717	0.688	4.912	0.96	E
110	30.6	23.9	14.5	0.474	47.386	0.781	0.416	0.66	-1.77	0.68	B
111	35.3	20.5	17.7	0.501	50.142	0.581	0.841	0.756	6.799	0.74	CE
112	64.6	35.3	16.1	0.249	24.923	0.546	0.604	0.484	4.178	0.65	VB
113	32.7	27.3	23.1	0.706	70.642	0.835	0.563	0.842	0.885	0.64	C
114	25.4	18.2	14.3	0.563	56.299	0.717	0.649	0.762	2.64	0.68	CE
115	32.4	16.7	11.6	0.358	35.802	0.515	0.755	0.629	7.117	0.74	E
116	21	14.5	12.7	0.605	60.476	0.69	0.783	0.809	4.682	0.88	CE
117	25.7	17.6	13	0.506	50.584	0.685	0.638	0.72	2.724	0.73	CB
118	34.2	19.1	17.2	0.503	50.292	0.558	0.888	0.768	7.72	0.85	CE
119	34.2	19.8	14.5	0.424	42.398	0.579	0.731	0.677	5.448	0.78	E
120	36.5	20.7	15.5	0.425	42.466	0.567	0.752	0.683	5.943	0.63	E
121	32.7	18	15.1	0.462	46.177	0.55	0.835	0.729	7.26	0.88	E
122	33.8	18.5	15.4	0.456	45.562	0.547	0.832	0.724	7.276	0.77	E
123	36.1	17.9	17	0.471	47.091	0.496	0.953	0.765	9.617	0.95	E
124	29.3	12.5	10	0.341	34.13	0.427	0.87	0.649	10.85	0.68	E

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	L	I	S	S/L	S/L*100	I/L	L-I/L-S	SPHERICITY	OP INDEX	ROUNDNESS	
125	30.6	21.5	20.4	0.667	66.667	0.703	0.892	0.858	5.882	0.78	CE
126	24	18.7	17.5	0.729	72.917	0.779	0.815	0.88	4.325	0.87	C
127	29.1	17	13	0.447	44.674	0.584	0.752	0.699	5.631	0.95	E
128	34.5	18.5	15.1	0.438	43.768	0.536	0.825	0.71	7.42	0.71	E
129	29.5	14.1	12.5	0.424	42.373	0.478	0.906	0.722	9.579	0.63	E
130	29.1	22.1	19.5	0.67	67.01	0.759	0.729	0.839	3.42	0.68	E
131	29.3	19	15.2	0.519	51.877	0.648	0.73	0.746	4.443	0.77	CB
132	25.8	23.1	20.5	0.795	79.457	0.895	0.509	0.89	0.119	0.77	C
133	30.7	17.3	15.9	0.518	51.792	0.564	0.905	0.781	7.828	0.87	CE
134	31	18	11.2	0.361	36.129	0.581	0.657	0.608	4.334	0.61	E
135	30.6	17.8	15	0.49	49.02	0.582	0.821	0.745	6.538	0.75	E
136	25.7	14.7	18.3	0.712	71.206	0.572	1.486	0.961	13.85	0.95	
137	27.5	17.5	15.3	0.556	55.636	0.636	0.82	0.786	5.746	0.87	CE
138	23.5	19.3	14.2	0.604	60.426	0.821	0.452	0.763	-0.801	0.78	CB
139	24.7	17.4	8.5	0.344	34.413	0.704	0.451	0.552	-1.435	0.85	B
140	27.6	16.5	14	0.507	50.725	0.598	0.816	0.755	6.233	0.77	CE
141	27.3	16.2	12.5	0.458	45.788	0.593	0.75	0.707	5.46	0.87	E
142	28	18	12.1	0.432	43.214	0.643	0.629	0.662	2.984	0.75	B
143	26	17	13.4	0.515	51.538	0.654	0.714	0.741	4.158	0.88	CE
144	29.2	15	14	0.479	47.945	0.514	0.934	0.765	9.056	0.66	E
145	25.7	17.8	16.7	0.65	64.981	0.693	0.878	0.848	5.814	0.83	CE
146	24.4	14	12	0.492	49.18	0.574	0.839	0.75	6.887	0.63	E
147	27.8	13.8	10.5	0.378	37.77	0.496	0.809	0.66	8.188	0.87	E
148	27.5	13.2	9	0.327	32.727	0.48	0.773	0.607	8.341	0.66	E
149	24	13.5	10	0.417	41.667	0.563	0.75	0.676	6	0.87	E
150	28.3	19.3	16.9	0.597	59.717	0.682	0.789	0.806	4.847	0.71	CE
Mean	29.72	20.1	14.58	0.498	49.779	0.686	0.631	0.709	2.605	0.8046	B
Standard Deviation	6.776	4.41	4.079	0.121	12.144	0.118	0.206	0.1	4.4	0.0976	