A STUDY ON SEDIMENTS DEPOSITIONAL MECHANISM AT NAYAKANKUPPAM COAST, TAMILNADU, INDIA

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Abstract— Textural analysis carried out for the sediments of the Nayakkankuppam coast revealed that inlet part is dominated by fine sand, central part is dominated by medium sand and outlet part is dominated by coarse sand. The grain size parameters namely Mean size (MZ), standard deviation (σ1), skewness(Ski), and kurtosis (KG) of percentile values derived from the cumulative curves following Folk and Ward and the moment technique based upon grouped data are most widely used. It is observed that in Nayakkankuppam, most of the samples were fallen in the moderately well sorted to well sorted nature. Skewness measures asymmetry of frequency distribution and marks the position of mean with respect to median. The fine skewed nature of the sediments clearly exhibits sediment input from various sources of tributaries. The finely skewed nature is also implies a low velocity than normal, this skewness data indicated that the sediments are nearly symmetrical to fine skewed, the median class of the sediments dominate almost throughout their distribution. The kurtosis data indicated Mesokurtic to platykurtic. The CM pattern divulged that the sediments were transported bottom suspension and rolling as well as graded suspension. The comparison with the tractive current diagram, the berm samples fall in beach environment, the remaining samples fall in beach and tractive current environment.

Keywords— Sediments, depositional mechanism, sand**,** coastal environment**.**

1. INTRODUCTION

At present, few research works are available to understand processes involving in a wide variety of environmental formation and long-term interaction among environmental components. A beach which is the zone of unconsolidated materials is a dynamic environment constantly acted upon by waves; currents and tide. Depending upon the intensity, nature and duration of the coastal processes, the beaches constantly undergo physical changes that in turn result in different types of sediments. These often reflect the dynamic conditions that were prevalent at the time of deposition with the study of seasonal fluctuations of the beach profiles where beach changes were mentioned [1].

Heavy minerals studies were used mainly to understand the provenance history, diagenetic changes, sediment source and sediment transport [2]. Since few decades, important contributions were made by sedimentologists on the study of the nature of sediments in modern environments. Present day littoral sediments were studied not only to understand their mode of deposition, but also to recognize ancient beach sediments in the geologic history. Specific studies on statistical properties of the grain size distribution, grain size variation across the beach, degree of roundness, shape of the sediment grains and sedimentary structure etc., were also attempted [3].

For an effective conservation of the coastal zone, knowledge of the basic processes in modern as well as palaeo-environments is imperative. With this broader perspective in mind, a detailed programme has been worked out to decipher the interrelationship of the strand plain, beach and inner shelf sediments based on the granulometry, surface textures and mineralogy. Thus, the main objectives of the investigation were (i) to study the textural characteristics of the sediments in the foreshore and breaker zone of Nayakkankuppam coast, (ii) to determine the grain size distribution of the sediments in the light of wave energy and morphological changes of the beach during different seasons, (iii) to derive a depositional mechanism–controlling the variability in the sand mineralogy.

2. STUDY AREA

The study area forms (fig-1) part of Nayakankuppam, Nagapattinam District, Tamil Nadu, India. It falls between the latitude 11°11' 46.49"N and 79° 50' 28.85"E in survey of India toposheet 58 M/15. Major rivers flowing in the study area includes Cauvery, Arasalar, Tirumalairajanar, Vellar, Adappar, Vettar and Vedaranyam canal. The study area is surrounded by Tanjore District in the west, Cuddalore District in the North, Palk Strait in the south and Bay of Bengal in the East.

It is a part of Cauvery delta where the distributaries of Cauvery bring in considerable amount of sediment load to the Bay of Bengal. The area is composed of soft unconsolidated sediments of Pleistocene, Holocene and Quaternary age. The deltaic plain/coastal sediment is mainly constituted by unconsolidated sand with or without clay silt with considerable permeability. The area is gently dipping towards Bay of Bengal. The area is packed with various land forms of Aeolian and marine origin. The presence of geomorphic land forms like beach, beach ridges, sand dunes, mud flats, alluvial plain, flood plain and palaeochannels indicate that the area underwent rhythmic processes dominated by Aeolian over beach process and vice versa.

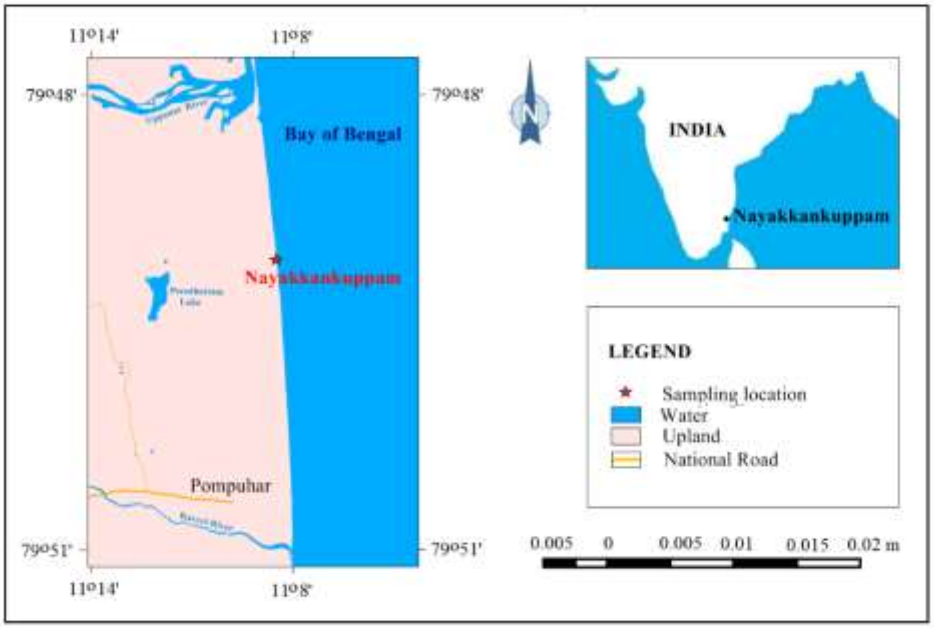


Fig-1: Study area map and sampling location

3. MATERIALS AND METHODS

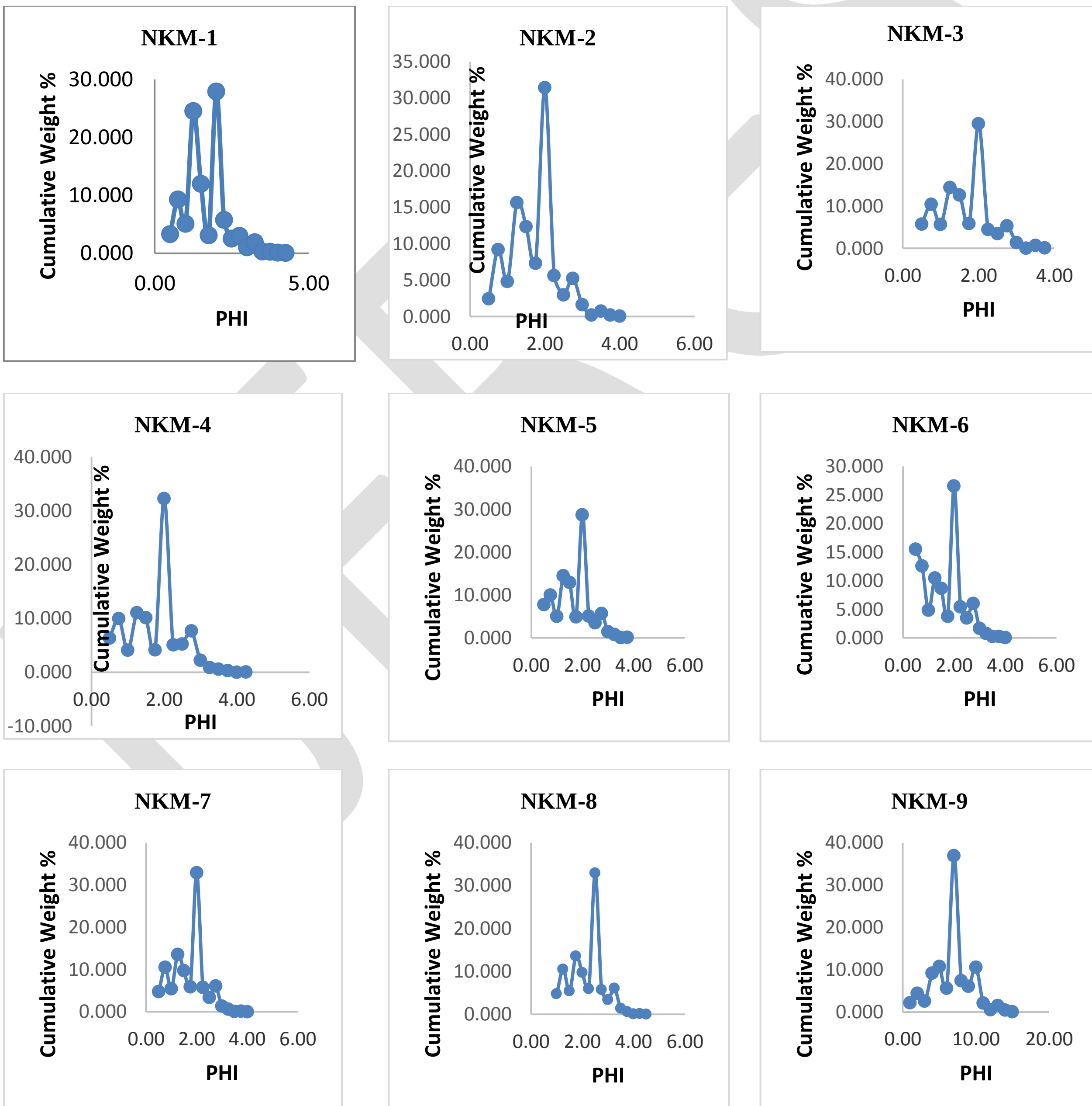
Sampling of sediments was carried out by pit sampling method. The pit of 1m deep had been dug out from sampling site and one sample was collected to a depth of 100cm from each surface at 2 cm interval from the surface downward the bottom using appropriate spoon. In other words, in situ, 50 samples in total were directly packed in different polythene bags and carried to the laboratory. In lab, each sample was dried and mixed by following coning and quartering method and 100gm of the sample was taken for sieving. Sieving of dried sediments sample was carried out by using a series of standard ASTM test sieves of ¼ Φ interval to get known size fractions in Ro tap sieve shaker for 15 minutes.

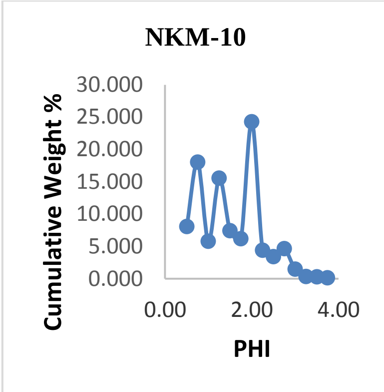
The weight percentage and cumulative weight percentage were manually recorded. The log-probability graph was used to draw segments from the calculated values. From the graphs, statistical parameters like mean (M_z), standard deviation (σ_I), skewness (SK_I) and kurtosis (K_G) were calculated and processed in the spreadsheet for statistical analysis. [4]

4. RESULTS AND DISCUSION

4.1 Vertical size distribution of sediments

Grain size distribution has been used for the determination of sedimentary environment with the help of log-probability studies. The entire grain size distribution is believed to be considered of several normal subpopulations representing the sediments transported by the process of rolling, suspension and siltation [5]. The combination of two or more of these processes produces characteristics log probability curve shapes. Thus, the mentioned characteristics of the sediments and the mechanisms were utilized to study the size analysis. Textural attributes of sediments and sedimentary rocks viz. mean (Mz), Standard deviation (σ_1), Skewness (Sk_I) and Kurtosis (K_G) are widely used to reconstruct the depositional environments of sediments and sedimentary rocks. Correlation between size parameters and transport processes/depositional mechanisms of sediments has been established by exhaustive studies from many modern and ancient sedimentary environments [6]. The size analyses of the sediments from various locations show one surface creep, either one or two siltation and one suspension. About 95% of the samples exhibit the fine truncation at less than 95% and coarse truncation at about 5% and others exhibit the fine truncation more than 90% and coarse truncation below 10%. The steepness and truncation points of the sediments exhibit that they were deposited mostly by the back and forth motion of water. On the basis of probability curves the samples indicate that the coarser grains are lacking and indicate a moderately high energy condition. The steepness of the curves of samples indicates that they were well sorted to very well sorted. The bottom sets of sediments clearly gives two well-defined saltated populations and having sharp contacts of curves in the fine and coarse truncation. This indicates that the sediments were deposited by the seasonal cyclic tidal waves by back and forth action. The histogram of size frequency distribution shows a bimodal or polymodal distribution (Fig-2) which in turn indicates a wide range of size distribution and asymmetrical nature of sediments. Some of the samples exhibit unimodal distribution also indicating good sorting i.e. dominant of one fraction over the others. This also infers that the samples have received the sediments from different sources during seasonal and tidal variations.

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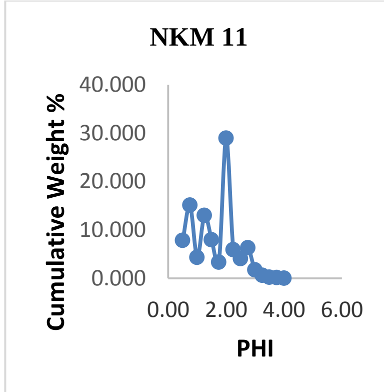
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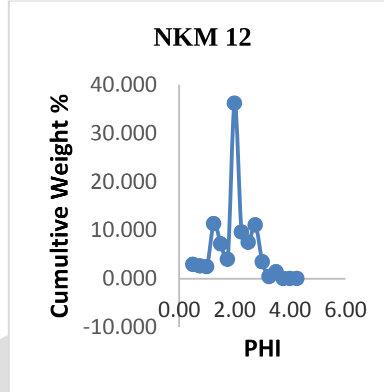
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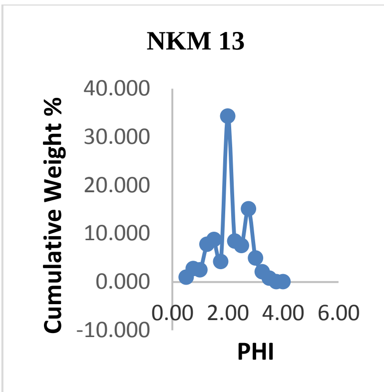
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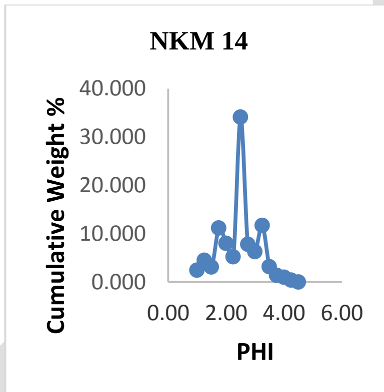
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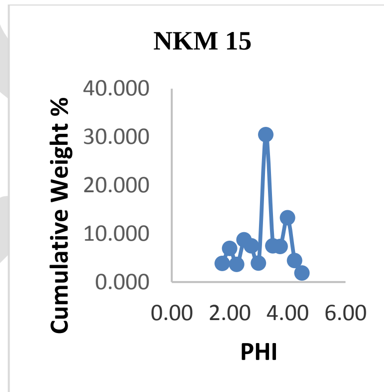
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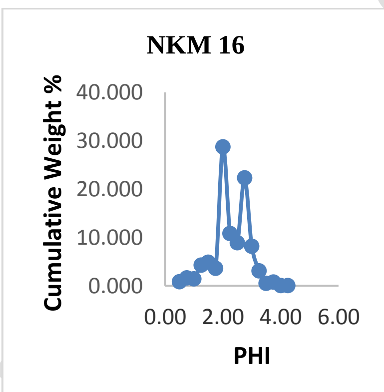
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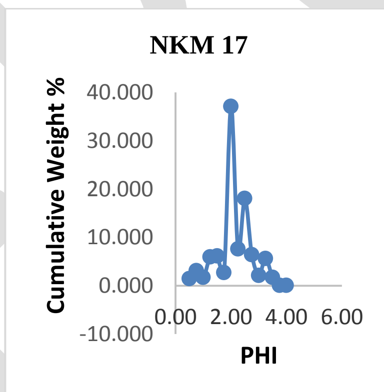
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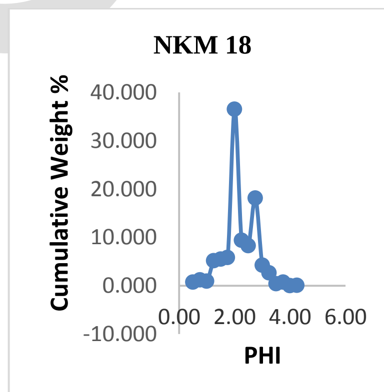
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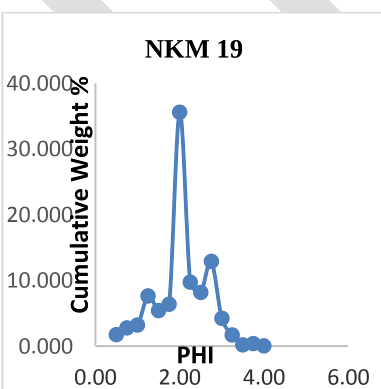
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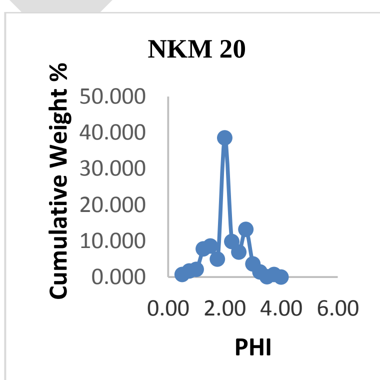
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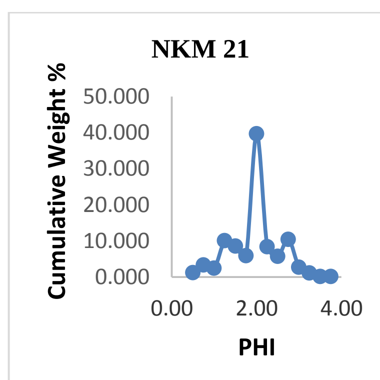
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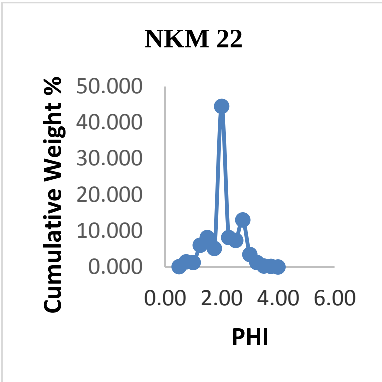
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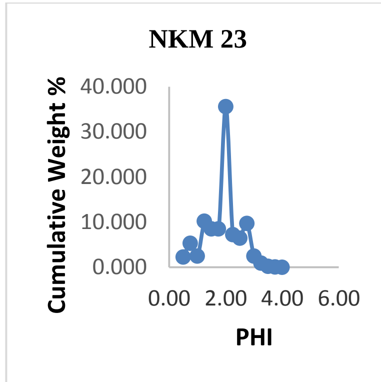
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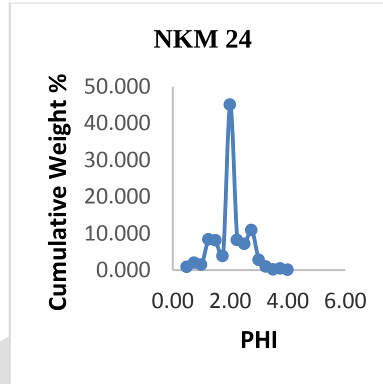
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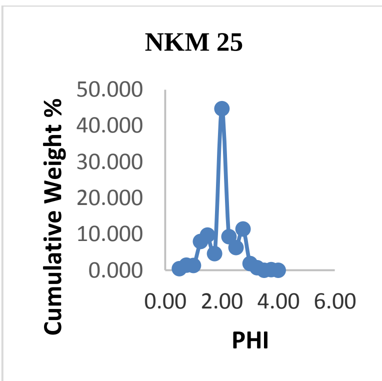
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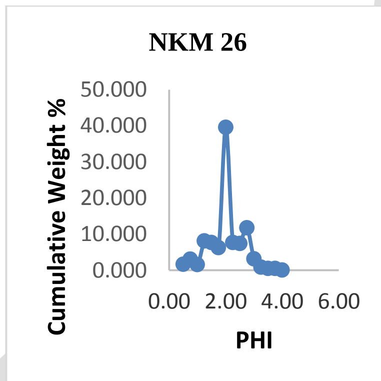
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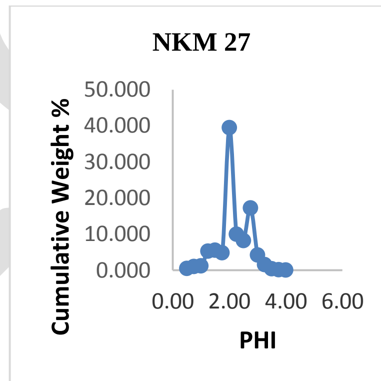
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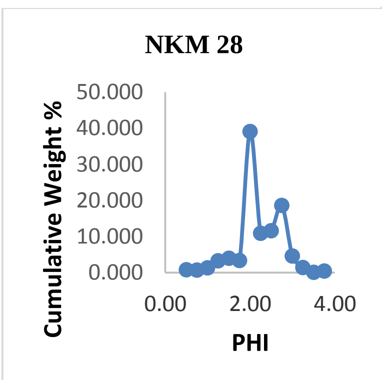
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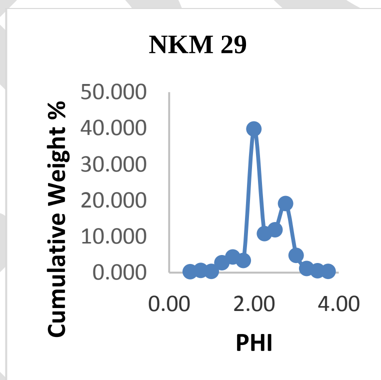
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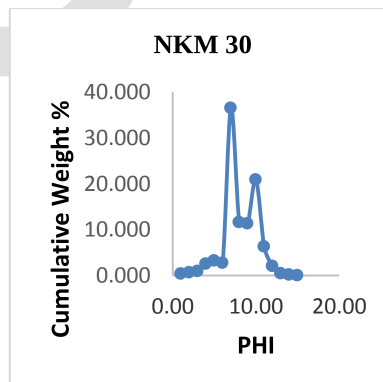
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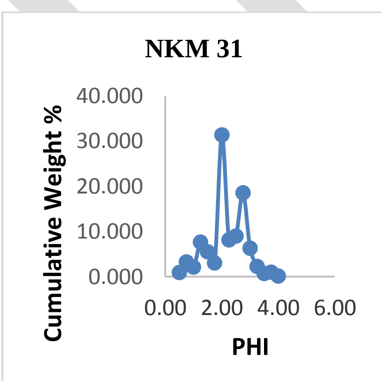
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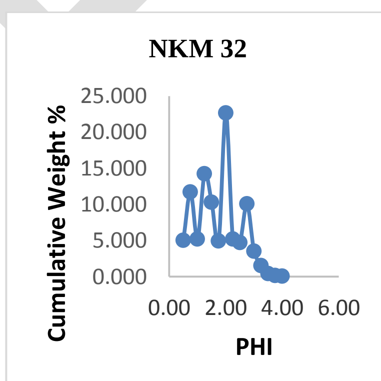
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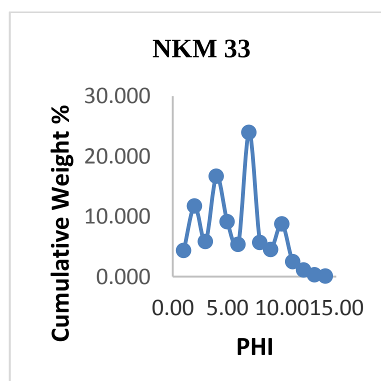
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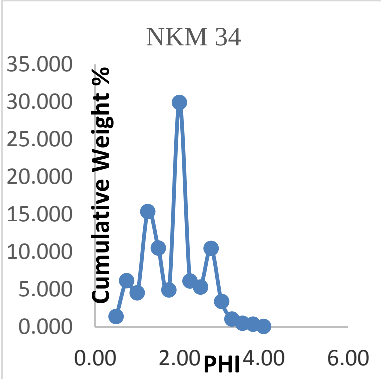

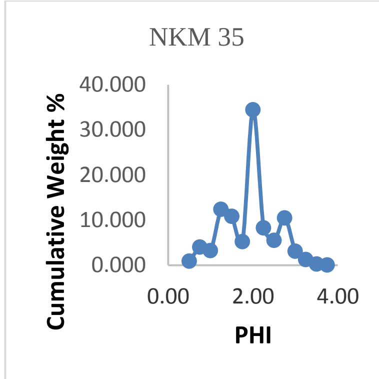

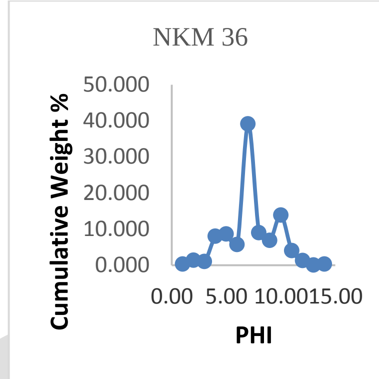

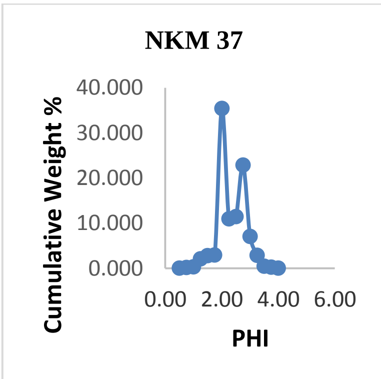

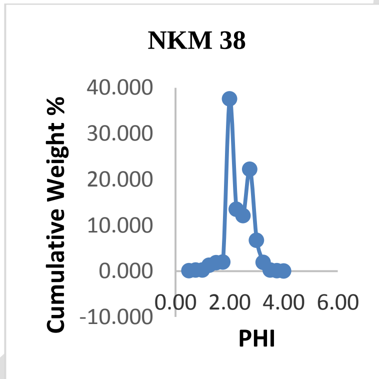

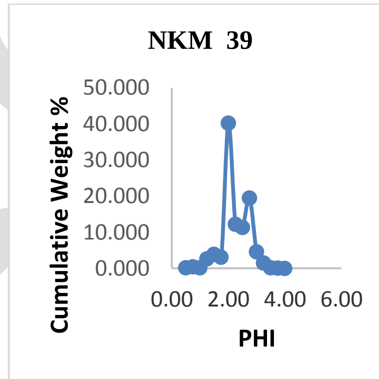

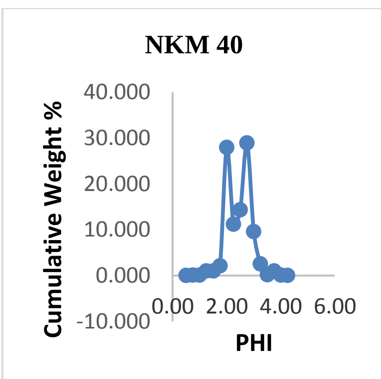

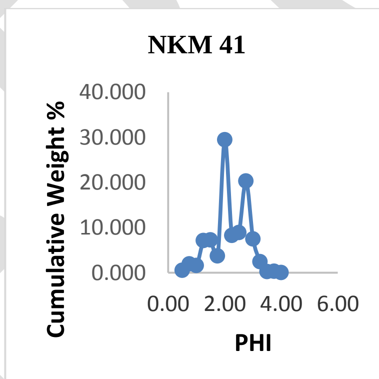

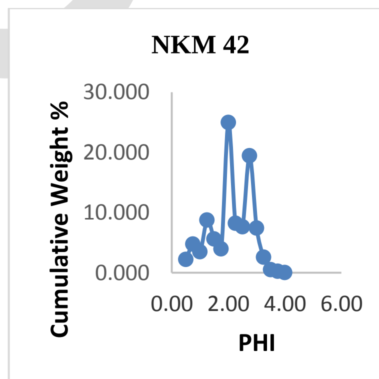

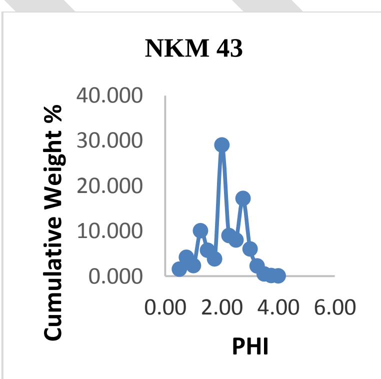

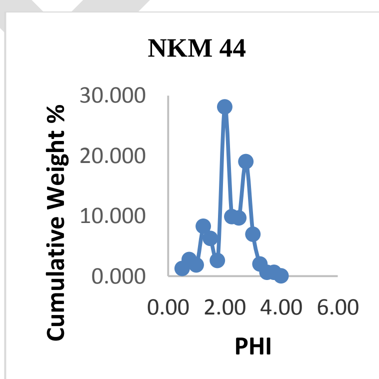

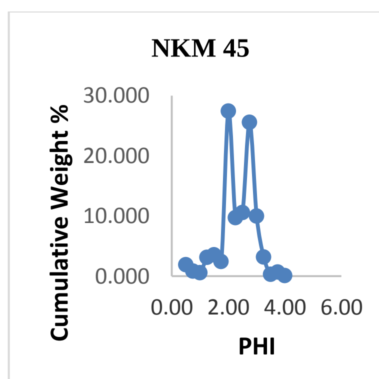

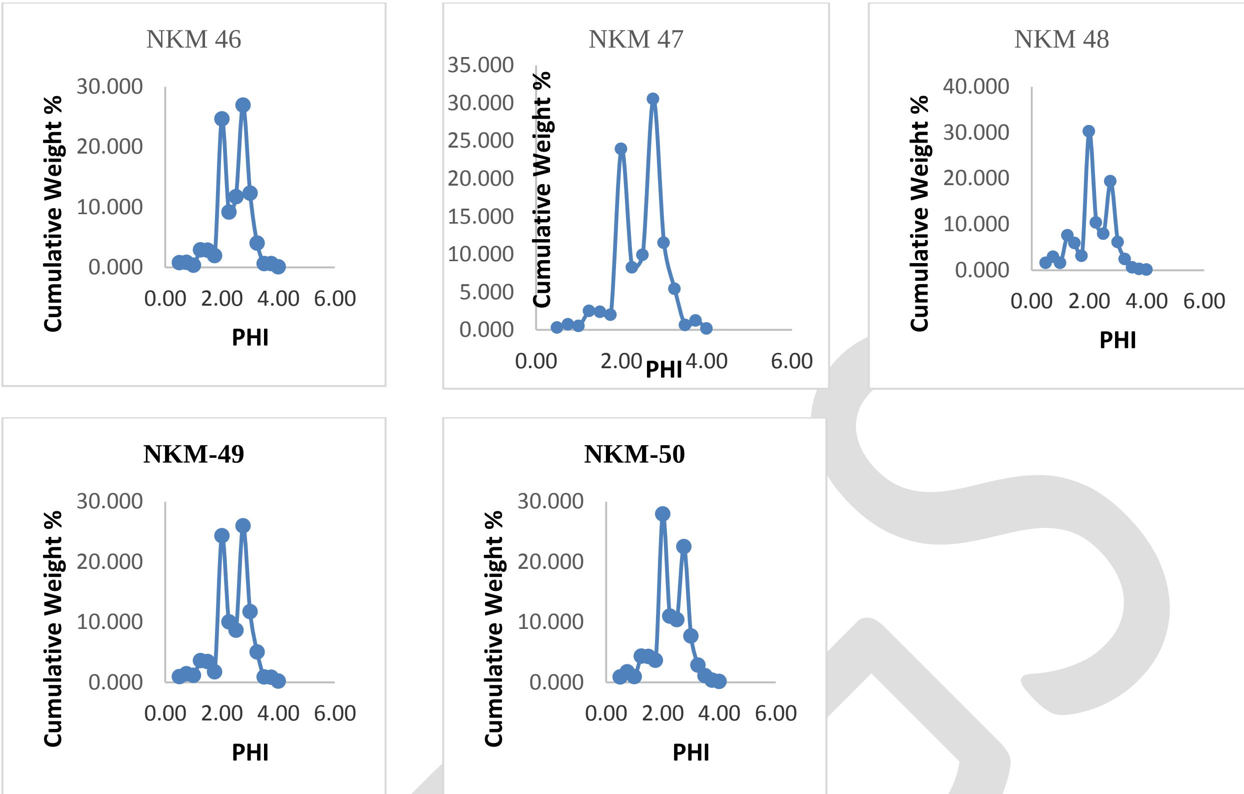

Fig-2: vertical size distribution of sediments

4.2 Statistical Analysis

Textural attributes of sediments and sedimentary rocks viz. mean (Mz), Standard deviation (σ_1), Skewness (Sk_I) and Kurtosis (K_G) are widely used to reconstruct the depositional environments of sediments and sedimentary rocks. Correlation between size parameters and transport processes or depositional mechanisms of sediments has been established by exhaustive studies from many modern and ancient sedimentary environments [6]. The table 1 displays all statistical parameters that were used to interpret our results.

Table-1: Statistical parameters and their corresponding remarks

Depth	Mean	Standard deviation	Skewness	Kurtosis	Remarks			
2	1.483	0.544	0.059	1.293	MS	MWS	NS	LK
4	1.533	0.537	-0.087	1.105	MS	MWS	NS	LK,
6	1.443	0.623	0.078	1.257	MS,	MWS	NS	LK
8	1.593	0.661	0.148	1.110	MS,	MWS	FS	LK
10	1.430	0.641	0.002	1.123	MS,	MWS	NS	LK
12	1.387	0.801	-0.168	0.978	MS,	MS	NS	MK
14	1.473	0.588	0.068	1.095	MS,	MWS	NS	MK
16	1.837	0.641	0.066	1.132	MS,	MWS	NS	LK
18	1.577	0.640	-0.044	1.052	MS,	MWS,	NS	MK
20	1.643	0.893	0.352	1.193	MS,	MWS,	VFSK	LK

22	1.467	0.697	0.135	0.948	MS,	MWS,	FSK	MK
24	1.853	0.702	0.046	1.138	MS,	MWS,	NS	LK
26	1.983	0.608	-0.058	0.888	MS,	MWS,	NS	PK
28	1.823	0.653	0.013	0.977	MS,	MWS,	NS	MK
30	1.823	0.722	0.021	0.932	MS,	MS,	NS	MK
32	2.073	0.525	-0.081	1.166	FS,	MWS,	NS	LK
34	2.017	0.586	-0.106	1.218	FS,	MWS	CSK	LK
36	2.080	0.543	0.147	1.011	FS,	MWS	FSK,	MK
38	1.933	0.588	0.010	1.153	MS,	MWS,	NS,	LK
40	1.980	0.536	0.113	1.371	MS,	MWS,	FSK,	LK
42	1.903	0.577	-0.066	1.154	MS,	MWS,	NS,	LK
44	1.993	0.415	0.464	0.883	MS,	WS,	VFSK,	PK
46	1.337	0.603	-0.063	1.332	MS,	MWS,	NS,	LK
48	1.967	0.523	0.072	1.639	MS,	MWS	NS,	VLK
50	1.850	0.517	0.095	1.148	MS,	MWS,	NS,	LK
52	1.910	0.624	-0.033	1.318	MS,	MWS,	NS,	LK
54	2.010	0.515	0.190	0.929	FS,	MWS	FSK,	MK
56	2.110	0.455	0.308	1.040	FS,	WS,	VFSK	MK
58	2.133	0.421	0.332	0.893	FS,	WS,	VFSK	PK
60	2.117	0.492	0.131	0.863	FS,	WS,	FS	PK
62	2.003	0.643	-0.001	1.293	FS,	MWS	VCSK	LK
64	1.663	0.746	0.179	1.025	MS,	MS,	FSK	MK
66	1.597	0.664	-0.073	0.974	MS,	MWS,	NS	MK
68	1.750	0.653	0.182	1.025	MS,	MWS,	FSK	MK
70	1.807	0.599	0.141	2.967	MS,	MWS,	FSK	VLK
72	1.933	0.569	0.131	1.054	MS,	MWS,	FSK	MK
74	2.200	0.437	0.286	0.849	FS,	WS	FSK	PK
76	2.167	0.430	0.204	0.790	FS,	WS	FSK	PK
78	2.133	0.412	0.321	0.869	FS,	WS	VFSK	PK
80	2.320	0.414	-0.090	0.761	FS,	WS,	VCSK	PK
82	2.013	0.615	0.081	0.879	FS,	MWS	NS	PK
84	1.927	0.720	-0.074	0.914	MS,	MS,	NS	MK
86	1.897	0.699	-0.049	0.945	MS,	MWS,	NS	MK
88	2.043	0.583	0.080	1.066	FS,	MWS,	NS	MK
90	2.273	0.525	-0.137	1.067	FS,	MWS,	CSK	MK
92	2.243	0.501	0.267	0.926	FS,	MWS,	FSK	MK
94	2.357	0.519	-0.370	0.840	FS,	MWS	VCSK	PK
96	1.983	0.643	0.015	0.906	MS,	MWS,	NS,	PK
98	2.267	0.569	-0.023	0.876	FS,	MWS,	NS,	PK
100	2.203	0.523	0.059	1.097	FS,	MWS,	NS,	MK
Maximum	**2.357**	**0.893**	**0.464**	**2.967**				
Minimum	**1.337**	**0.412**	**-0.370**	**0.761**				
Average	**1.889**	**0.593**	**0.065**	**1.089**				

MS-Medium Sand, FS-Fine Sand, MWS-Moderately well sorted, MS-Moderately Sorted

WS-Well Sorted, NS-Near Symetrical, FSK-Fine Skewed, VFSK-Very fine skewed

VCSK-Very coarse skewed, PK-Platy kurtic, MK-Mesokurtic, VLK-Very leptokurtic

LK-Leptokurtic

4.2.1 Mean (Mz)

It is the average size of the sediments and is influenced by the source of supply, transporting medium and the energy conditions of the depositing environment. Mean size indicates the central tendency or the average size of the sediment in terms of energy; it indicates the average kinetic energy / velocity of depositing agent. [9] The vertical mean size (Fig-3) ranges between 1.337Φ (44-46 cm) to 2.357 Φ (92-94 cm) in the Nayakkankuppam. The average mean size is 1.889. Predominantly 62% of the samples fall in medium sand category and remaining 38% samples are falls in fine sand category. The fine grain nature indicates the moderately low energy condition in the basin of deposition. The mean size indicates that the medium sand was deposited at a moderate energy conditions whereas the fine sand was deposited at a moderately low energy conditions. The variation in phi mean size, therefore, reveals the differential energy conditions leads to the deposition of these kinds of sediments in different locations [7].

Sands deposited by rivers almost invariably contain fine particles from suspended load. Sands deposited on the parts of beaches where the breaking waves continuously wash thin sheets of back and forth invariably lack admixtures of fine grained sediments [8]. Fine grained nature of sediments in the study region shows that they were deposited by river processes. But when the shelf was emergent during the last ice age, streams deposited sands there. The analysis of vertical sediments generally reveals a fine grained nature in the top and medium sand at the bottom indicating the general fining up of sediments.

4.2.2 Standard Deviation

It is expressed by inclusive graphic standard deviation (σ_1) as it covers both the tails of the distribution. Standard deviation is a poorly understood measure that depends on the size range of the available sediments, rate of depositing agent and the time available for sorting. The sorting variations observed attribute ~~to~~ the difference ~~in~~ from water turbulence and variability in the velocity of depositing current. The moderately well sorted character of the sediments indicates the influence of stronger energy conditions of the depositing agents or prevalence of strong energy conditions in the basin.

In the Nayakkankuppam coast the mean size varies ranges 0.893ϕ (20-22cm) to 0.412ϕ (78-80cm) with an average of 0.593ϕ. About 76% of all samples were moderately well sorted whereas 16% and 8% were respectively well sorted and moderately sorted in their natures. This indicates the influences of stronger energy condition of depositing agents or prevalence of strong energy condition in the basin. The variation in mean size reveals the differential energy conditions, resulting in their deposition.

4.2.3 Skewness

It is used to determine the symmetry of the central part of the distribution. It reflects the symmetry or asymmetry of the frequency distribution of the sediments. It is the measure of particle size sizes as it indicates that particles in excess of the normal distribution are present in coarser fraction or finer fraction, extremes of the distribution. If the skewness is negative, the sample is coarsely skewed, that is the mean is towards the coarser side of the median. When the skewness value is positive the sample is described as finely skewed. Coarsely skewed sample implies that the velocity of the depositing agent operated at a higher value than the average velocity for a greater length of time than normal and / or the velocity fluctuations towards the higher values occurred more often than normal [9].

In the present study, the minimum and maximum skewness values are –0.370 ϕ (94-96 cm) to 0.464 ϕ(44-46 cm) respectively with an average value of 0.065 ϕ with representation of 36% near symmetrical, 30% of the sample fine skewed and 14% very fine skewed and 10% very coarse skewed and the rest of them are coarse skewed. From the analysis it was inferred that the middle and some bottom set of the sediments show slightly negative skewness values. The top sets show positive skewness. Thus it reflects the fluctuation of the energy conditions in the depositional environment. The positive skewness of sediments points to unidirectional transport (channel flow) or the deposition of sediments in sheltered low energy environment. Majority of negative values indicating near symmetrical multi direction of transport are deposition of sediments in agitated moderately energy environment.

4.2.4. Kurtosis

Kurtosis is a quantitative measure used to describe the departure from normality of distribution. Many curves designated as 'normal' by the skewness measure turns out to markedly non-normal when the kurtosis is computed. It is the ratio between the sorting in 'tails' of the curve to that of the central portion. Values of the fourth moment Kurtosis ranges between 0.761ϕ (80-82cm) to 2.961ϕ (70-72cm) with an average 1.089ϕ. 38% of the samples falls under mesokurtic, 34% are leptokurtic and 24% of the sample indicating platykurtic and rest of the samples very leptokurtic in nature of distribution. Characters infer that this part of the sediments is keeping the original character of sediments existed during deposition without any mixing of population or otherwise a single supply is maintained in this period of deposition. The mesokurtic to leptokurtic nature of sediments refers to the continuous addition of finer or coarser materials after the winnowing action and retention of their original characters during deposition.

According to Cadigan's verbal scale most of the sediments are moderately peaked. The leptokurtic nature of the sediments indicates the higher kurtosis values and the mixing of a predominant population with very minor amounts of coarser and finer materials [10]. The leptokurtic behavior of the sediments also indicates the variations of the energy conditions of the environmental setup of depositions of the sediments. The leptokurtic character reflects the extreme skewness values, either positive or negative, indicating concentration of coarser and finer grained materials finally showing the impact of fluctuation of energy condition in the deposition of the sediments from most of the formations. The accumulation of finer materials was by the influence of moderate to low energy conditions in the environmental setup showing the leptokurtic character of the sediments.

The mesokurtic character of the sediments indicates moderate winnowing action of the depositing agent. The mesokurtic nature of the sediments in the study area suggests that the sediments achieved good sorting in the high energy environment. The dominance of mesokurtic and leptokurtic characters of sediments in the study area revealed that the better sorted sediments were deposited by unidirectional flow of current and allows the sediments to settle in high energy environment.

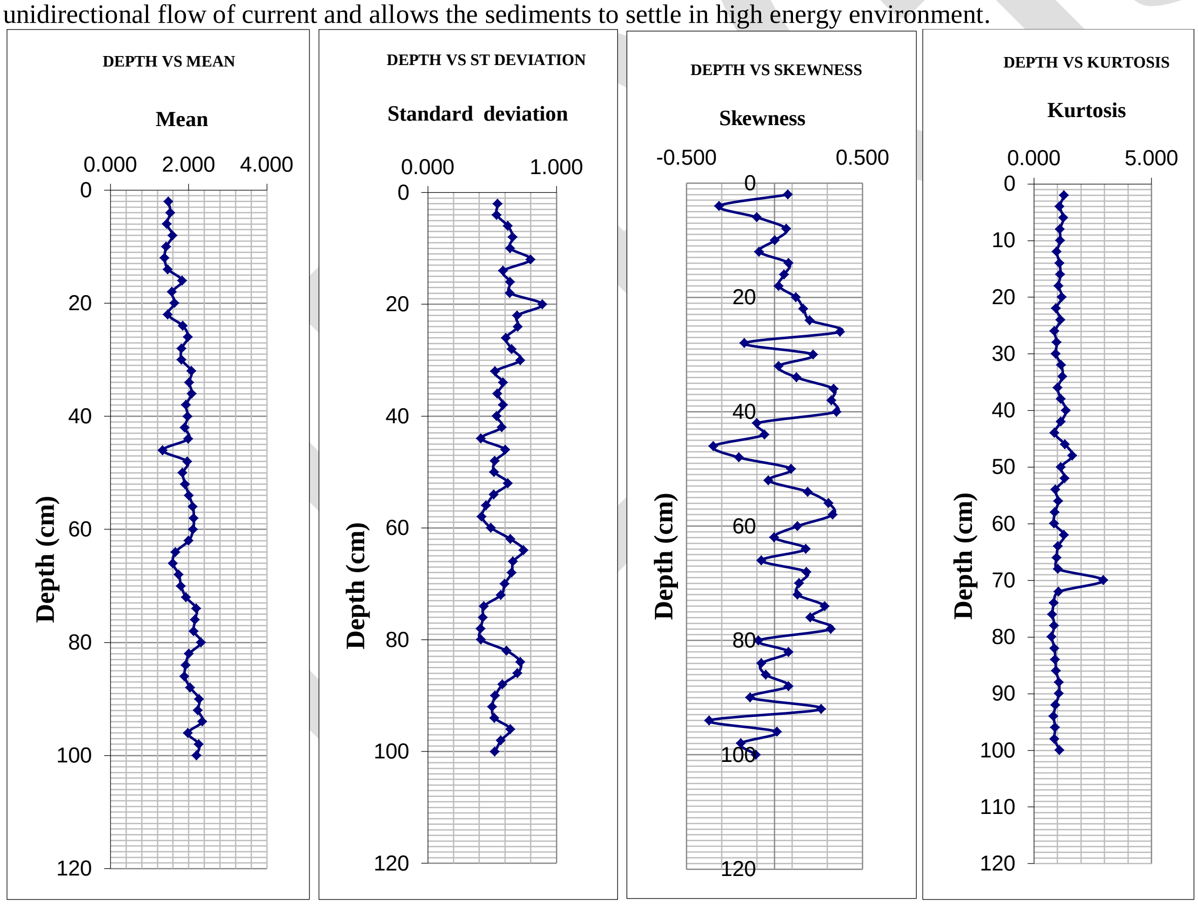

Fig-3. Vertical variation of Mean, Std. dev, Skewness and Kurtosis

The size analyses of the sediments from various locations show one surface creep, either one or two siltation and one suspension. About 95% of the samples exhibit the fine truncation at less than 95% and coarse truncation at about 5% and others exhibit the fine truncation more than 90% and coarse truncation below 10%. The steepness and truncation points of the sediments exhibit that they were deposited mostly by the back and forth motion of water. On the basis of probability curves the samples indicate that the coarser grains are lacking and indicate a moderately high energy condition. The steepness of the curves of samples indicates that they were well sorted to very well sorted. The bottom sets of sediments clearly gives two well-defined saltated populations and having sharp contacts of curves in the fine and coarse truncation. This indicates that the sediments were deposited by the seasonal cyclic tidal waves by back and forth action. The histogram of size frequency distribution shows a bimodal or polymodal distribution (Fig-2) which in turn indicates a wide range of size distribution and asymmetrical nature of sediments. Some of the samples exhibit unimodal distribution also indicating good sorting, it means dominant of one fraction over the others. This also infers that the samples have received the sediments from different sources during seasonal and tidal variations.

4.3. Depositional Environment

Depositional sedimentary environment has been variously defined. A depositional environment can be defined in terms of physical, biological, chemical or geomorphic variables. Thus, a depositional sedimentary environment is a geomorphic unit in which deposition takes place. This is characterized by an unset of physical, biological and chemical processes operating at a specified rate and intensity which imparts sufficient imprint on the sediment. The character of a sediment so produced is determined both by the intensity of the formative processes operating on it and by the duration through which such action is continued .The study of physical factors (hydrodynamic condition), if combined with the study of biological and chemical factors provides a more complete picture of the sedimentary depositional environment [11].

A broad depositional environment may be subdivided into smaller, essentially uniform sub environment or sedimentation units, where sediments with their own characteristic features are deposited. These units in ancient sediments are lithosomes. As sedimentation proceeds, with time facial boundaries migrate laterally under the influence of transgression and regression, and different facies are arranged in an orderly sequence. Scientist Curray gives a thorough discussion on transgression-regression processes and their effect on coastal sediments. The products of transgression and regression depends upon various factors, such as rate and supply of sediments, intensity of hydrodynamic processes, configuration of basin of sedimentation, local tectonics and rate and direction of relative sea level changes. All these factors can be grouped into two parameters-(a) rate of deposition, and (b) rate and direction of relative sea level change. Curray constructed a diagram, that clearly shows that deposition and erosion can control the trangression-regression processes (Fig-3). In general rising of relative sea level results in transgression; falling relative sea level, in regression. Rapid rate of sedimentation as in the deltaic regime can forced regression or delta progradation.

The variation in the energy and the fluidity factors seems to have excellent correlation with different processes and the environments of deposition. In littoral (beach) zone there is constant pounding of waves making the beach deposits better sorted and more uniformly distributed than the shallow marine deposits where the wave action is less prominent and more variable. [9] introduced the linear discriminant functions for environmental interpretation and the method was the combination of all the grain size parameters into a single linear equation. Results of the functions were tabulated in Grain size parameters of all the sediments were substituted into the following equations.

Table- 2: Linear Discriminant Function Values according to Sahu

Sl. No	Depth	Y1	Remarks-Y1	Y2	Remarks-Y2	Y3	Remarks-Y3	Y4	Remarks-Y4
1	2	-4.197	Aeolian	42.660	Beach	-2.170	Shallow Marine	0.951	turbidity
2	4	-4.404	Aeolian	42.945	Beach	-2.089	Shallow Marine	0.990	Turbidity
3	6	-3.713	Aeolian	48.091	Beach	-2.989	Shallow Marine	0.885	Turbidity
4	8	-4.068	Aeolian	53.646	Beach	-3.373	Shallow Marine	0.973	Turbidity
5	10	-3.582	Aeolian	49.383	Beach	-3.192	Shallow Marine	0.866	Turbidity
6	12	-2.575	Beach	63.870	Beach	-5.225	Shallow Marine	0.742	Turbidity

7	14	-3.977	Aeolian	45.776	Beach	-2.609	Shallow Marine	0.923	turbidity
8	16	-5.035	Aeolian	55.754	Beach	-3.076	Shallow Marine	1.160	turbidity
9	18	-4.112	Aeolian	51.600	Beach	-3.138	Shallow Marine	0.973	turbidity
10	20	-2.912	Aeolian	78.118	Sh. Agitated water	-6.517	Shallow Marine	0.864	turbidity
11	22	-3.437	Aeolian	54.886	Beach	-3.837	Shallow Marine	0.863	turbidity
12	24	-4.789	Aeolian	61.387	Beach	-3.789	Shallow Marine	1.138	turbidity
13	26	-5.709	Aeolian	55.331	Beach	-2.673	Shallow Marine	1.282	turbidity
14	28	-4.928	Aeolian	56.555	Beach	-3.216	Shallow Marine	1.143	turbidity
15	30	-4.576	Aeolian	62.789	Beach	-4.047	Shallow Marine	1.105	turbidity
16	32	-6.378	Aeolian	50.561	Beach	-1.823	Shallow Marine	1.385	turbidity
17	34	-5.927	Aeolian	54.137	Beach	-2.433	Shallow Marine	1.317	turbidity
18	36	-6.332	Aeolian	51.933	Beach	-1.990	Shallow Marine	1.382	turbidity
19	38	-5.619	Aeolian	52.977	Beach	-2.478	Shallow Marine	1.255	turbidity
20	40	-6.003	Aeolian	49.872	Beach	-1.952	Shallow Marine	1.313	turbidity
21	42	-5.559	Aeolian	51.665	Beach	-2.374	Shallow Marine	1.239	turbidity
22	44	-6.475	Aeolian	42.514	Beach	-0.940	Shallow Marine	1.369	turbidity
23	46	-3.426	Aeolian	44.821	Beach	-2.804	Shallow Marine	0.818	turbidity
24	48	-6.007	Aeolian	48.764	Beach	-1.835	Shallow Marine	1.309	turbidity
25	50	-5.613	Aeolian	46.525	Beach	-1.814	Shallow Marine	1.227	turbidity
26	52	-5.374	Aeolian	55.497	Beach	-2.868	Shallow Marine	1.221	turbidity
27	54	-6.191	Aeolian	48.896	Beach	-1.751	Shallow Marine	1.343	turbidity
28	56	-6.764	Aeolian	46.632	Beach	-1.212	Shallow Marine	1.439	turbidity
29	58	-6.957	Aeolian	45.052	Beach	-0.946	Shallow Marine	1.468	turbidity
30	60	-6.656	Aeolian	49.066	Beach	-1.521	Shallow Marine	1.429	turbidity
31	62	-5.619	Aeolian	58.535	Beach	-3.052	Shallow Marine	1.279	turbidity
32	64	-3.875	Aeolian	62.600	Beach	-4.401	Shallow Marine	0.976	turbidity
33	66	-4.067	Aeolian	53.969	Beach	-3.407	Shallow Marine	0.975	turbidity
34	68	-4.667	Aeolian	55.412	Beach	-3.236	Shallow Marine	1.091	turbidity
35	70	-5.121	Aeolian	51.862	Beach	-2.628	Shallow Marine	1.159	turbidity
36	72	-5.700	Aeolian	51.532	Beach	-2.285	Shallow Marine	1.264	turbidity

37	74	-7.144	Aeolian	46.986	Beach	-1.046	Shallow Marine	1.510	turbidity
38	76	-7.049	Aeolian	46.071	Beach	-1.002	Shallow Marine	1.489	turbidity
39	78	-6.984	Aeolian	44.542	Beach	-0.879	Shallow Marine	1.471	turbidity
40	80	-7.645	Aeolian	47.578	Beach	-0.840	Shallow Marine	1.605	turbidity
41	82	-5.784	Aeolian	56.363	Beach	-2.739	Shallow Marine	1.300	turbidity
42	84	-4.958	Aeolian	64.228	Beach	-3.992	Shallow Marine	1.181	turbidity
43	86	-4.961	Aeolian	61.800	Beach	-3.739	Shallow Marine	1.172	turbidity
44	88	-6.033	Aeolian	54.314	Beach	-2.395	Shallow Marine	1.337	turbidity
45	90	-7.092	Aeolian	53.691	Beach	-1.766	Shallow Marine	1.529	turbidity
46	92	-7.076	Aeolian	51.604	Beach	-1.559	Shallow Marine	1.517	turbidity
47	94	-7.415	Aeolian	54.595	Beach	-1.687	Shallow Marine	1.592	turbidity
48	96	-5.547	Aeolian	58.208	Beach	-3.056	Shallow Marine	1.264	turbidity
49	98	-6.892	Aeolian	56.760	Beach	-2.190	Shallow Marine	1.505	turbidity
50	100	-6.850	Aeolian	52.458	Beach	-1.768	Shallow Marine	1.479	Turbidity

a. Y_1 (Aeolian; Beach): $-3.5688Mz+3.7016\sigma_1^2-2.0766Ski+3.1135K_G$

b. Y_2 (Beach; Sh.Marine): $15.6534Mz+65.7091\sigma_1^2+18.1071Ski+18.5043K_G$

c. Y_3 (sh.marine; fluvial): $0.2852\ M_Z - 8.7604\ \sigma_1^2 - 4.8932\ Sk_i + 0.0482\ K_G$

d. Y4 (Fluvial; turbidity): $0.7215\ M_Z - 0.4030\ \sigma_1^2 + 6.7322\ Sk_i + 5.2927\ K_G$

According to [9] the variations in the energy and fluidity factors seem to have excellent correlation with the different processes and the environment of deposition. Sahu's linear discriminant functions of Y1 (Aeolian, beach), Y2 (Beach, Shallow agitated water), Y3 (Shallow Marine, Fluvial) and Y4 (Turbidity, Fluvial) were used to decipher the process and environment of deposition. With reference to the Y1 values, 98% fall in Aeolian process and 2% fall in beach process. Y2 values 98% of the sample fall in Beach process and rest of the (2%) sample shallow agitated water. Further the samples (100%) Y3 indicate that they were the combination of shallow marine. Then Y4 values show that about 100% of the sample in Turbidity action. The results indicate that most of the sediments were deposited under shallow marine environment by beach and fluvial processes by a near shore whirlpool agitating turbidity action of water.

4.4. CM Pattern

[12] established the relation between texture of sediments and process of deposition using C – the coarsest 1 percentile grain size and M- the median. The C and M plotter in logarithmic paper enabled to distinguish the mode of transportation by means of sub population such as rolling, saltation and suspension. The time gap in the mode of transportation and the agent of deposition which also inferred. Passega divided the CM pattern into different sector namely NO, OP, PQ, QR and RS for different mode of transportation [12].

The plotted result of Nayakkankuppam coast sediments (Fig-4) shows that most of the samples fall in bottom suspension and rolling to rolling condition except in low tideline samples where it falls in rolling to bottom suspension condition. The comparison with the tractive current diagram, the berm samples fall in beach environment, the remaining samples fall in beach and tractive current environment, that is by interaction with wave actions.

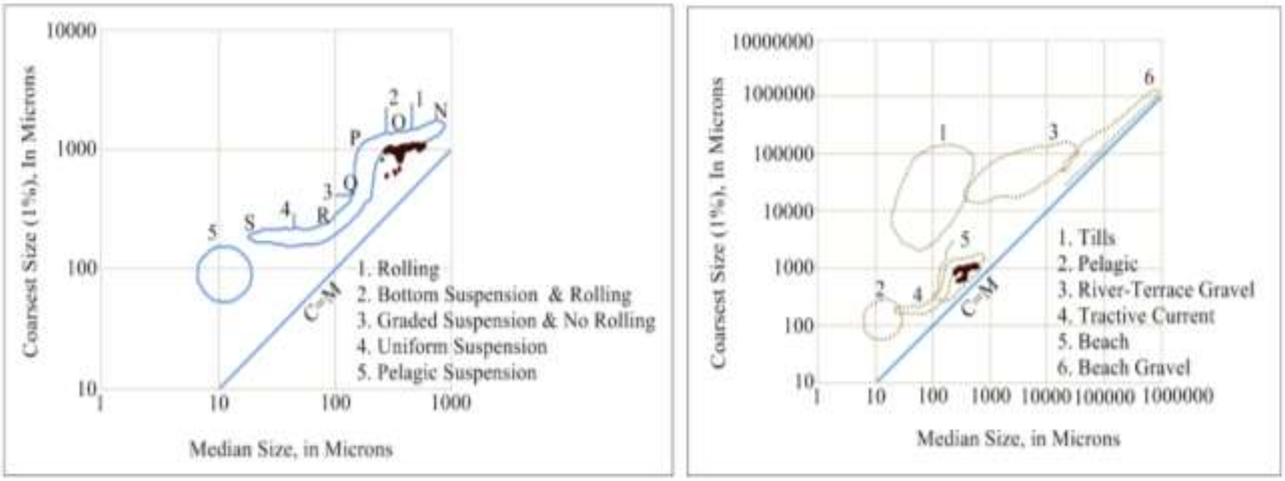

Fig-4: CM diagram (Passega, 1964) and tractive currents deposit plot for Nayakkankuppam coast Samples

5. CONCLUSION

The coastal zone of Tamilnadu is endowed with varied landscapes such as sandy beaches, backwaters, deltas, lagoons, mangrove forests and coral reef ecosystems. The coast has been constantly undergoing physical changes in the geological past and the present. The Tamilnadu coast is nearly 850 km long and has many major rivers draining into the Bay of Bengal and these rivers bringing in considerable sediments, both natural and anthropogenic in nature affecting the shore processes significantly. Thus the land-ocean interaction in the coastal zone is important in determining the sedimentation and erosion pattern of the coastline. With a view to observe the past sharp changes taken place in the coastal sediment characteristics, the sediments were analyzed by taking vertical pits at Nayakkankuppam coast. Granulometric analyses were carried out for the sediments collected at a vertical interval of 2 cm in each pit.

Textural analysis carried out for the sediments of the Nayakkankuppam coast reveals that inlet part is dominated by fine sand, central part is dominated by medium sand and outlet part is dominated by coarse sand. The grain size diagram to spatially highly distribute in the medium sand to fine sand. The standard deviation is the measure of sorting sediments and indicates the fluctuations in kinetic energy of the depositing agent about its average velocity. The Nayakkankuppam coast it is observed that most of the samples were falls in the moderately well sorted to well sorted nature. Skewness measures asymmetry of frequency distribution and marks the position of mean with respect to median. The fine skewed nature of the sediments clearly exhibits sediment input from various sources of tributaries. The finely skewed nature is also implies a low velocity than normal. This skewness data indicate that in the sediments nearly symmetrical to fine skewed the median class of the sediments dominate almost throughout their distribution. The kurtosis data indicate Mesokurtic to platykurtic. The CM pattern divulges that the sediments are transported bottom suspension and rolling as well as graded suspension. The comparison with the tractive current diagram, the berm samples fall in beach environment, the remaining samples fall in beach and tractive current environment.

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