Depositional Environmental studies of sediments near Arasalar river mouth, Karaikal region Pondicherry Union Territory, East coast of India

S. Venkatesan[1] , S.R. Singarasubramanian[2]
[1] *Ph.D Research Scholar, Department of Earth Sciences, Annamalai University Tamil Nadu, India*
[2] *Associate Professor, Department of Earth Sciences, Annamalai University Tamil Nadu, India*

---***---

Abstract - *Grain size and depositional pattern of sediment from Arasalar river mouth (ARM North and ARM South) in Karaikal region of Pondicherry Union territory and Southern part of Tamil Nadu have been carried to using the textural parameters. The samples were processed and sieved following standard procedures. Textural parameter like mean, standard deviation, skewness and kurtosis are calculated using standard methods to understand the transportation and the depositional environment of the sediments. Statistical parameters revealed that sediments are dominant in fine sand category, moderately well sorted, fine skewed to near symmetrical and falls under mesokurtic to platykurtic character. Linear discriminate function (LDF) value indicates that sediments deposited under aeolian and shallow agitated water process under Sh Marine and turbidity environment of the basin. CM diagram (C = one percentile in microns, M = medium in microns) of ARMN and ARMS sediments suggests that deposition was dominantly by bottom suspension and rolling.*

Key Words: Grain size, Sediments, LDF, Arasalar River, Beach.

1. INTRODUCTION

Grain size properties of sediment particles, affecting their environment, transport and deposition, therefore it provides important clues to the sediment provenance, transport history and depositional [1-3]. Several authors studied the textural characteristics of sediments from different environments of the East coast of India [4-21]. Jing-Zhang [22] observe that the river sediments and found that texturally, the river sediments are sand and silt and coarse grained. Whereas in an estuary the sediments are clayey silt and fine grained though at the head of the estuary, sand was dominant [23] Present investigation was carried out in the estuary of Arasalar River to understand the sediment textural characteristics and depositional condition.

2. STUDY AREA

Arasalar River in Karaikal union territory is located at the latitude 10°54′52′N Longitude 79°51′09′′E. The Cauvery River; located in the delta between the Cauvery and forms many tributaries. Arasalar River forms a tributary of Cauvery at Papanasam, near Kumbakonam. Geologically the study area comprises of Coastal alluvial soil. The Karaikal area is completely covered by a thick mantle of alluvium and no exposures are met. The major part of the study area is covered by black clay soils (matured) as per the classification of soil survey and land use shown an isolated patch of brown clay loam soil in the area bordering the north-western boundary of the Karaikal region. Geomorphologically the area in a flat terrain having no hills or forest. Along the coast sand dunes, tidal inlet and spit bars are present. Drainages are Arasalar, Nandalar, Nattar, Nular, Puravadaiyanar, Thirumalairayanar and Vanjiyar (Distributaries of Cauvery) Arasalar is one of the tributaries in Cauvery, having a total run of 24 km and enters Bay of Bengal near Karaikal. The general description of the various geological formations occurring in the study area are briefed in Table I and location map of the study area is shown in Fig.1

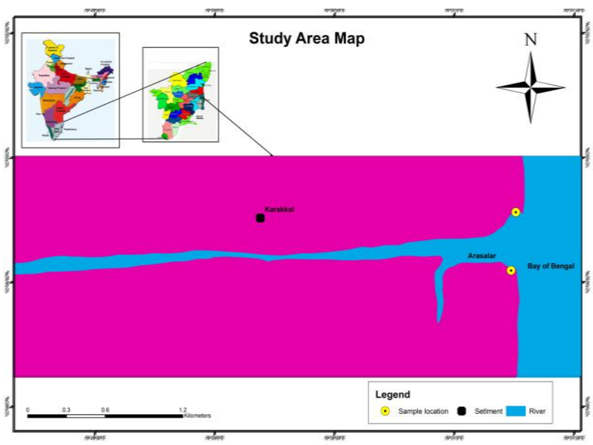

Fig. 1 showing location map of the study area

Table No 1 Stratigraphic succession of geological formations in the study area [24]

ERA	Period	Formation	Lithology
Quaternary	Recent to Pliestocene	Alluvium	Soils, coastal and river sand
Tertiary	Pliocene	Podakkal formation	Sand and clays
	Mio-Pliocene	Cuddalore	Sand, lignite, clay

3. METHODOLOGY

The sediment samples were collected from the North (ARMN) and South (ARMS) river mouth by making 1m x 1 m pit near the shore. Samples are sub sampled with an interval of 2cm. Samples were collected in clean dry polythene bags for laboratory analysis. The exact sample location are noted with the help of Global Positioning System (GPS) receiver. In order to obtained representative samples for the sieve analysis the dried samples were subject to coning and quartering. The samples were washed with 10% HCl to remove carbonates and washed with distilled water. Dried samples were subjected to ¼ phi interval ASTM sieves for sieving in Ro-tap sieve shaker. Analytical results were used to draw the cumulative frequency curves and the statistical parameters were calculated using standard methods of Folk, and Ward [1]. Linear Discriminant Function were calculated as suggested by Sahu [25] methods were used to interpret the depositional conditions of the sediments and CM plot prepared as suggested by suggested Passega [26] to understand the transportation mechanism.

4. RESULT AND DISCUSSIONS

The statistical parameters obtained from grain size analysis (Granulometric analysis) used for plotting the cumulative frequency and histogram. From the graph statistical parameters like mean (Mz), Standard deviation (σI), Sorting, Skewness (Ski) and Kurtosis (KG) were calculated using percentile values.

4.1. GRAPHIC MEAN (Mz)

It is an average size of the sediments and is influenced by the source of supply, transporting medium and the energy condition of the depositing environment. Mean size indicates the central tendency or the average size of the sediment. It indicates the average kinetic energy velocity of depositing agent [25]. Mean size of the sediment samples has been presented in Table (2A). The minimum and maximum mean size value varies from 1.000 Φ (72-74cm) to 2.540 Φ (42-44cm) (Fig. 2A) with an average of 1.724 Φ at ARMN. 70% of the sample exhibit medium sand and 30% fall under fine sand category. The mean size indicates that the medium sand were deposited at a moderate energy conditions [17]. At ARMS mean size varied between 2.083 Φ (88-90cm) and 2.667 Φ (48-50cm) (Fig. 2B) with an average of 2.37 Φ (Table 2). 100% of the sample indicating fine sand category. The mostly fine grained nature of sediments inferred that they were deposited by river process by low fluvial discharge and wave conditions [27].

4.2. STANDARD DEVIATION (ϕI)

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 variation observed attributes to the difference in water turbulence and variability in the velocity of depositing current. It is expressed by inclusive graphic standard deviation of Folk & Ward [1] as it covers both the tails of the distribution. The standard deviation values of sediments from ARMN varies between 1.065 Φ (8-10cm) and 0.422 Φ (58-60cm) (Fig 3A) with an average of 0.685 Φ. Sediment sample are dominated by moderately well sorted (56%) and moderately sorted (32%), followed by well sorted (10%) and poorly sorted (2%). At ARMS the minimum and maximum standard deviation values are 0.322 Φ (18-20cm) and 0.761 Φ (88-90cm) (Fig. 3B) with an average of 0.505 Φ. The sediments types are dominated by well sorted (56%) and moderately well sorted (42%). Both are the location (ARMN and ARMS) dominant moderately well sorted and well sorted indicates the influences of stronger energy condition of depositing agents or prevalence of strong energy condition in the basin [28].

4.3. SKEWNESS (Ski)

The graphic skewness is the measure of symmetrical distribution, i.e. Predominance of coarse or fine sediments. Skewness value ranges from -0.581 Φ (0-2cm) to 0.825 Φ (38-40cm) (Fig.4 A) with an average of 0.085 Φ at ARMN. Skewness varied from fine-skewed (32%), near-symmetrical (26%), very fine skewed category (18%), coarse skewed category (14%) and very coarse skewed nature (10%). It was purely due to fair weather season and relatively dominant low energy regime. Strongly fine skewed to near symmetrical sediments generally implies the introduction of fine material or removal of coarser fraction and indicate the excessive riverine input [12]. At ARMS skewness ranges between -1.231 Φ (18-20cm) to 0.477 Φ (40- 42cm) (Fig.4 A) with an average of -0.024 Φ. Symmetry of the sample ranges from negative

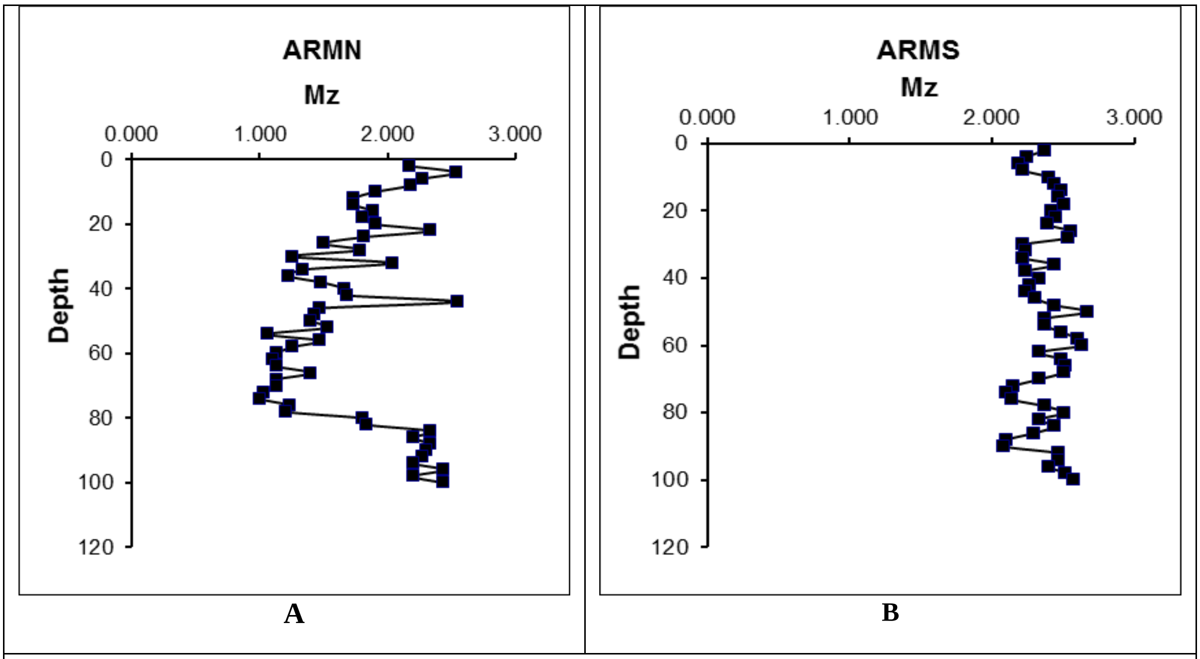

Fig. 2 showing vertical size distribution of depth vs mean

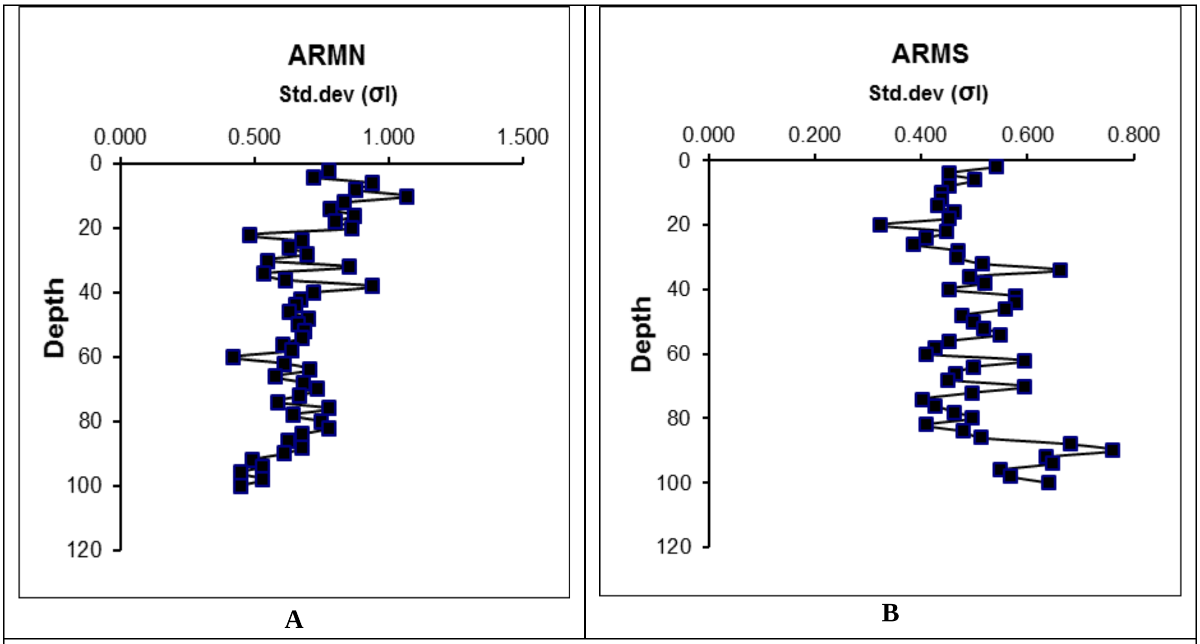

Fig 3 showing vertical size distribution of Depth vs Standard deviation

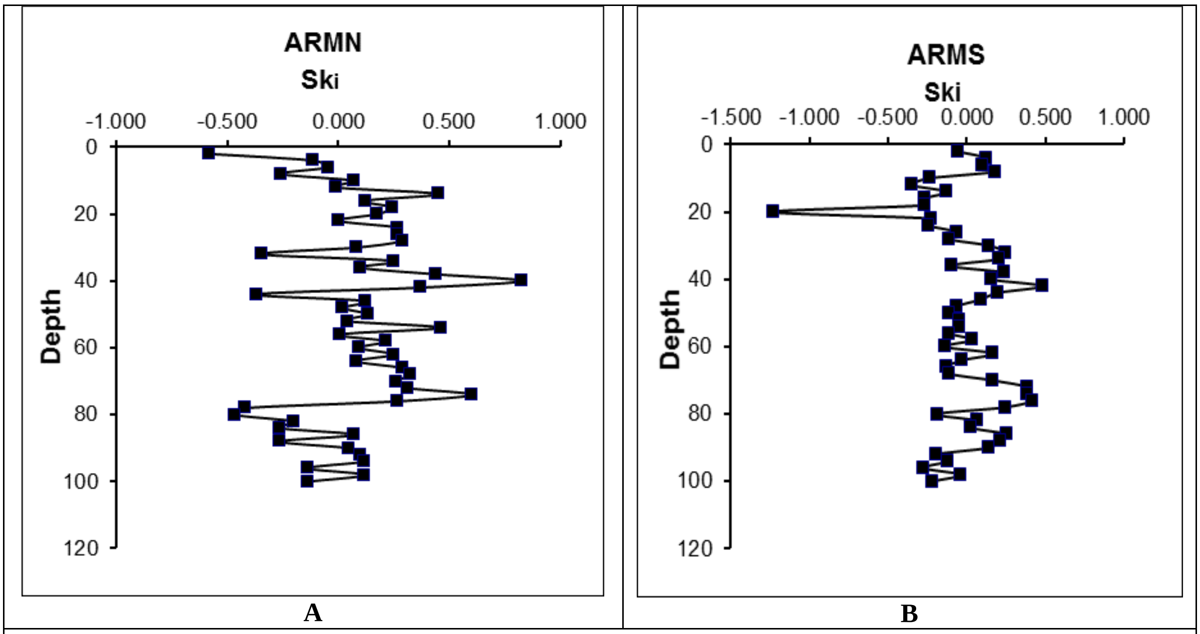

Fig 4. showing vertical size distribution of Depth vs Skewness

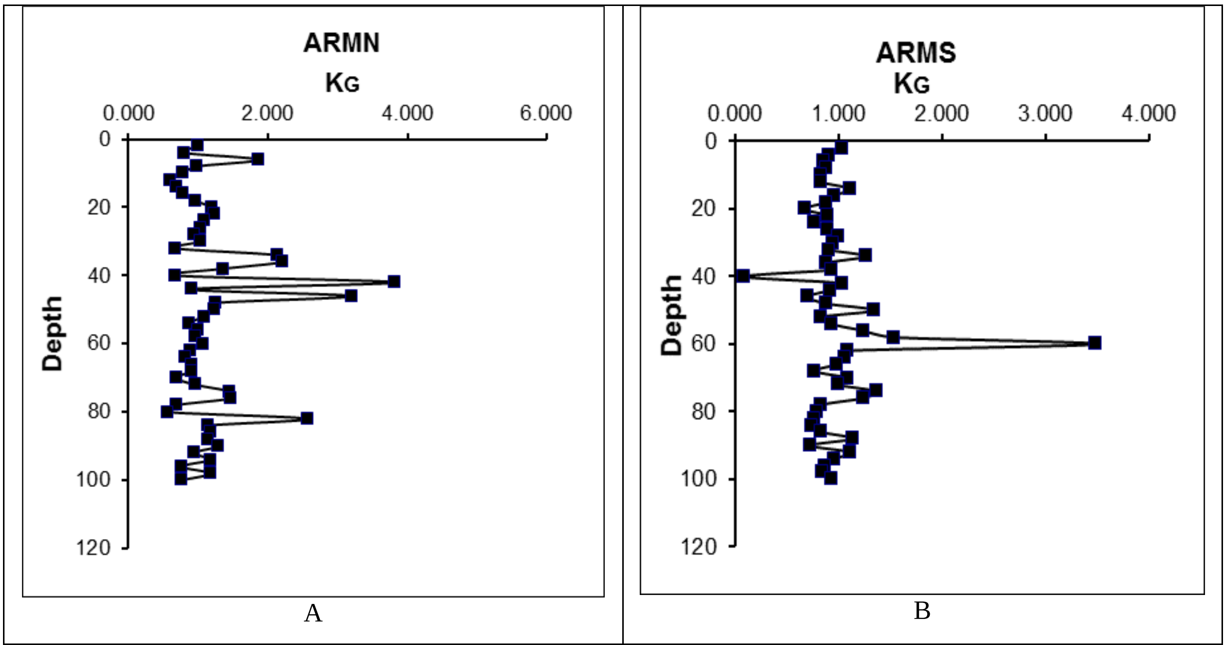

Fig 5. showing vertical size distribution of Depth vs Kurtosis

Table no 2 Graphic measures from the grain size analysis of the sediments at ARMN

Depth	Mean	Std. devi	Skewness	Kurtosis	Remarks			
2	2.167	0.777	-0.581	0.990	FS,	MS	VCSK,	MK
4	2.533	0.719	-0.113	0.803	FS,	MS	CSK,	MK
6	2.267	0.940	-0.044	1.871	FS,	MS	NS,	LK
8	2.183	0.875	-0.256	0.982	FS,	MS	CSK	MK
10	1.900	1.065	0.067	0.774	MS,	PS	VFSK	PK
12	1.733	0.833	-0.014	0.601	MS,	MS	NS,	VPK
14	1.733	0.781	0.451	0.688	MS,	MS	VFSK,	PK
16	1.883	0.872	0.123	0.779	MS,	MS	FSK,	PK
18	1.800	0.799	0.243	0.956	MS,	MS	FSK,	MK
20	1.900	0.864	0.174	1.189	MS,	MS	FSK,	LK
22	2.330	0.481	0.001	1.237	FS,	WS	NS,	LK
24	1.817	0.676	0.265	1.093	MS,	MWS	FSK,	MK
26	1.500	0.628	0.265	1.025	MS,	MWS	FSK,	MK
28	1.783	0.698	0.287	0.934	MS,	MWS	FSK,	MK
30	1.250	0.548	0.083	1.025	MS,	MWS	NS,	MK
32	2.033	0.852	-0.347	0.679	FS,	MS	VCSK,	PK
34	1.340	0.533	0.247	2.131	MS,	MWS	FSK,	VLK
36	1.223	0.614	0.099	2.213	MS,	MWS	NS,	VLK
38	1.483	0.938	0.440	1.352	MS,	MS	VFSK,	LK
40	1.663	0.718	0.825	0.671	MS,	MS	VFSK,	PK
42	1.683	0.674	0.368	3.825	MS,	MWS	VFSK,	ELK
44	2.540	0.653	-0.369	0.902	FS,	MWS	VCSK,	MK
46	1.467	0.629	0.120	3.202	MS,	MWS	FSK,	ELK
48	1.427	0.701	0.020	1.255	MS,	MWS	NS,	LK
50	1.400	0.664	0.132	1.230	MS,	MWS	FSK,	LK
52	1.533	0.689	0.038	1.093	MS,	MWS	NS,	MK
54	1.067	0.676	0.460	0.864	MS,	MWS	VFSK	PK
56	1.467	0.605	0.005	0.993	MS,	MWS	NS,	MK
58	1.250	0.638	0.211	0.958	MS,	MWS	FSK,	MK
60	1.133	0.422	0.094	1.066	MS,	WS	NS,	MK
62	1.100	0.613	0.247	0.885	MS,	MWS	FSK,	PK
64	1.133	0.707	0.081	0.816	MS,	MWS	NS,	PK
66	1.400	0.578	0.286	0.911	MS,	MWS	FSK,	MK
68	1.133	0.683	0.325	0.902	MS,	MWS	VFSK,	MK
70	1.133	0.733	0.261	0.694	MS,	MS	FSK,	PK
72	1.033	0.668	0.310	0.956	MS,	MWS	VFSK,	MK
74	1.000	0.587	0.600	1.457	MS,	MWS	VFSK,	LK
76	1.233	0.779	0.265	1.464	MS,	MS	FSK,	LK
78	1.200	0.642	-0.418	0.683	MS,	MWS	VCSK,	PK
80	1.800	0.748	-0.468	0.567	MS,	MS	VCSK,	VPK
82	1.833	0.779	-0.203	2.561	MS,	MS,	CSK,	VLK
84	2.333	0.679	-0.263	1.138	FS,	MWS	CSK,	LK
86	2.200	0.623	0.071	1.178	FS,	MWS,	NS,	LK
88	2.333	0.679	-0.263	1.138	FS,	MWS,	CSK,	LK
90	2.300	0.608	0.045	1.288	FS,	MWS,	NS,	LK
92	2.267	0.492	0.100	0.937	FS,	WS,	NS,	MK
94	2.200	0.528	0.117	1.171	FS,	MWS,	FSK,	LK
96	2.433	0.447	-0.138	0.761	FS,	WS,	CSK,	PK
98	2.200	0.528	0.117	1.171	FS,	MWS,	CSK,	LK
100	2.433	0.447	-0.138	0.761	FS,	WS,	FSK,	PK
Max	2.540	1.065	0.825	3.825				
Mini	1.000	0.422	-0.581	0.567				
Ave	1.724	0.682	0.085	1.176				

Table no 3 Graphic measures from the grain size analysis of the sediments at ARMS

Depth	Mean	Std. devi	Skewness	Kurtosis	Remarks			
2	2.367	0.540	-0.060	1.025	FS	MWS	NS	LK
4	2.243	0.452	0.123	0.907	FS	WS	FS	MK
6	2.183	0.500	0.095	0.845	FS	WS	NS	PK
8	2.217	0.452	0.178	0.878	FS	WS	FS	PK
10	2.400	0.437	-0.238	0.820	FS	WS	CS	PK
12	2.433	0.437	-0.349	0.820	FS	WS	VCS	PK
14	2.483	0.430	-0.130	1.107	FS	WS	CS	LK
16	2.467	0.462	-0.271	0.956	FS	WS	CS	MK
18	2.500	0.452	-0.267	0.878	FS	WS	CS	PK
20	2.417	0.322	-1.231	0.666	FS	VWS	VCS	PK
22	2.450	0.447	-0.227	0.888	FS	WS	CS	PK
24	2.383	0.409	-0.244	0.761	FS	MWS	CS	PK
26	2.550	0.384	-0.062	0.888	FS	WS	NS	PK
28	2.533	0.470	-0.117	0.990	FS	WS	CS	MK
30	2.217	0.467	0.142	0.937	FS	WS	FS	MK
32	2.233	0.515	0.243	0.897	FS	MWS	FS	PK
34	2.217	0.661	0.205	1.257	FS	MWS	FS	LK
36	2.433	0.492	-0.100	0.874	FS	WS	NS	PK
38	2.233	0.520	0.237	0.929	FS	MWS	FS	MK
40	2.333	0.452	0.156	0.088	FS	WS	FS	PK
42	2.267	0.578	0.477	1.025	FS	MWS	VFS	MK
44	2.233	0.578	0.195	0.911	FS	MWS	FS	MK
46	2.300	0.558	0.088	0.697	FS	MWS	NS	PK
48	2.433	0.477	-0.067	0.878	FS	WS	NS	PK
50	2.667	0.498	-0.111	1.341	FS	WS	CS	LK
52	2.367	0.517	-0.045	0.820	FS	MWS	NS	PK
54	2.367	0.548	-0.045	0.922	FS	MWS,	NS	MK
56	2.483	0.452	-0.110	1.230	FS	WS	CS	LK
58	2.600	0.427	0.033	1.537	FS	WS	NS	VLK
60	2.633	0.408	-0.137	3.484	FS	WS	CS	ELK
62	2.333	0.593	0.165	1.076	FS	MWS	FS	MK
64	2.483	0.498	-0.028	1.054	FS	WS	NS	MK
66	2.517	0.465	-0.132	0.976	FS	WS	CS	MK
68	2.500	0.450	-0.115	0.765	FS	WS	CS	PK
70	2.333	0.593	0.165	1.076	FS	MWS	FS	MK
72	2.150	0.495	0.384	0.995	FS	WS	VFS	MK
74	2.100	0.402	0.381	1.366	FS	WS	VFS	LK
76	2.133	0.427	0.417	1.230	FS	WS	VFS	LK
78	2.367	0.462	0.243	0.820	FS	WS	FS	PK
80	2.500	0.495	-0.188	0.792	FS	WS	CS	PK
82	2.330	0.409	0.067	0.761	FS	WS	NS	PK
84	2.433	0.479	0.022	0.733	FS	WS	NS	PK
86	2.293	0.512	0.255	0.820	FS	MWS	FS	PK
88	2.100	0.681	0.211	1.133	FS	MWS	FS	LK
90	2.083	0.761	0.141	0.725	FS	MS	NS	PK
92	2.467	0.636	-0.196	1.109	FS	MWS	CS	LK
94	2.467	0.646	-0.123	0.949	FS	MWS	CS	PK
96	2.400	0.548	-0.275	0.868	FS	MWS	CS	MK
98	2.517	0.568	-0.041	0.842	FS,	MWS	NS	PK
100	2.567	0.641	-0.222	0.922	FS	MWS	CS	MK
Max	2.667	0.761	0.477	3.484				
Mini	2.083	0.322	-1.231	0.088				
AVG	2.374	0.504	-0.024	1.016				

Table No. 4 L1 ARMN SHOWING LINEAR DISCRIMINANT FUNCTION VALUES (Sahu, 1964)

S. No	Depth	Y1	Remarks Y1	Y2	Remarks-Y2	Y3	Remarks-Y3	Y4	Remarks-Y4
1	2	-5.498	Aeolian	73.575	Sh.Agitated water	-4.670	Sh Marine	1.320	turbidity
2	4	-7.130	Aeolian	73.583	Sh.Agitated water	-3.801	Sh Marine	1.620	turbidity
3	6	-4.820	Aeolian	93.514	Sh.Agitated water	-7.090	Sh Marine	1.279	turbidity
4	8	-4.958	Aeolian	84.485	Sh.Agitated water	-6.084	Sh Marine	1.267	turbidity
5	10	-2.581	Beach	104.292	Sh.Agitated water	-9.397	Fluvial(deltaic)	0.914	turbidity
6	12	-3.615	Aeolian	72.764	Sh.Agitated water	-5.589	Sh Marine	0.971	turbidity
7	14	-3.928	Aeolian	67.219	Sh.Agitated water	-4.850	Sh Marine	1.005	turbidity
8	16	-3.909	Aeolian	79.398	Sh.Agitated water	-6.118	Sh Marine	1.053	turbidity
9	18	-4.059	Aeolian	70.150	Sh.Agitated water	-5.083	Sh Marine	1.041	turbidity
10	20	-4.015	Aeolian	78.838	Sh.Agitated water	-6.004	Sh Marine	1.070	turbidity
11	22	-7.459	Aeolian	51.679	Beach	-1.363	Sh Marine	1.588	turbidity
12	24	-4.791	Aeolian	58.477	Beach	-3.487	Sh Marine	1.126	turbidity
13	26	-3.893	Aeolian	49.397	Beach	-3.027	Sh Marine	0.923	turbidity
14	28	-4.560	Aeolian	59.939	Beach	-3.761	Sh Marine	1.090	turbidity
15	30	-3.351	Aeolian	39.280	Beach	-2.272	Sh Marine	0.781	turbidity
16	32	-4.573	Aeolian	79.473	Sh.Agitated water	-5.772	Sh Marine	1.175	turbidity
17	34	-3.732	Aeolian	39.618	Beach	-2.103	Sh Marine	0.852	turbidity
18	36	-2.970	Aeolian	43.929	Beach	-2.955	Sh Marine	0.731	turbidity
19	38	-2.040	Beach	80.971	Sh.Agitated water	-7.277	Sh Marine	0.716	turbidity
20	40	-4.030	Aeolian	59.879	Beach	-4.037	Sh Marine	0.993	turbidity
21	42	-4.325	Aeolian	56.221	Beach	-3.502	Sh Marine	1.031	turbidity
22	44	-7.485	Aeolian	67.807	Sh.Agitated water	-3.015	Sh Marine	1.661	turbidity
23	46	-3.771	Aeolian	48.938	Beach	-3.045	Sh Marine	0.899	turbidity
24	48	-3.271	Aeolian	54.641	Beach	-3.901	Sh Marine	0.831	turbidity
25	50	-3.366	Aeolian	50.854	Beach	-3.459	Sh Marine	0.833	turbidity
26	52	-3.717	Aeolian	55.162	Beach	-3.717	Sh Marine	0.915	turbidity
27	54	-2.116	Beach	46.703	Beach	-3.696	Sh Marine	0.586	turbidity
28	56	-3.878	Aeolian	47.034	Beach	-2.791	Sh Marine	0.911	turbidity
29	58	-2.953	Aeolian	46.335	Beach	-3.212	Sh Marine	0.738	turbidity
30	60	-3.386	Aeolian	29.441	Beach	-1.237	Sh Marine	0.746	turbidity
31	62	-2.535	Beach	41.900	Beach	-2.977	Sh Marine	0.642	turbidity
32	64	-2.195	Beach	50.568	Beach	-4.053	Sh Marine	0.616	turbidity
33	66	-3.760	Aeolian	43.869	Beach	-2.528	Sh Marine	0.875	turbidity
34	68	-2.316	Beach	48.423	Beach	-3.767	Sh Marine	0.630	turbidity
35	70	-2.054	Beach	53.077	Beach	-4.388	Sh Marine	0.601	turbidity
36	72	-2.035	Beach	45.512	Beach	-3.617	Sh Marine	0.566	turbidity
37	74	-2.293	Beach	38.304	Beach	-2.735	Sh Marine	0.583	turbidity
38	76	-2.156	Beach	59.159	Beach	-4.962	Sh Marine	0.645	turbidity
39	78	-2.758	Aeolian	45.839	Beach	-3.265	Sh Marine	0.700	turbidity
40	80	-4.354	Aeolian	64.914	Beach	-4.385	Sh Marine	1.073	turbidity
41	82	-4.298	Aeolian	68.551	Sh.Agitated water	-4.790	Sh Marine	1.078	turbidity
42	84	-6.622	Aeolian	66.800	Sh.Agitated water	-3.371	Sh Marine	1.498	turbidity
43	86	-6.412	Aeolian	59.981	Beach	-2.778	Sh Marine	1.431	turbidity
44	88	-6.619	Aeolian	66.814	Sh.Agitated water	-3.374	Sh Marine	1.497	turbidity
45	90	-6.838	Aeolian	60.320	Beach	-2.586	Sh Marine	1.510	turbidity
46	92	-7.192	Aeolian	51.414	Beach	-1.478	Sh Marine	1.538	turbidity
47	94	-6.819	Aeolian	52.758	Beach	-1.815	Sh Marine	1.475	turbidity
48	96	-7.945	Aeolian	51.217	Beach	-1.056	Sh Marine	1.675	turbidity
49	98	-6.819	Aeolian	52.758	Beach	-1.815	Sh Marine	1.475	turbidity
50	100	-7.945	Aeolian	51.217	Beach	-1.056	Sh Marine	1.675	turbidity

Table No. 5 L2 ARMS SHOWING LINEAR DISCRIMINANT FUNCTION VALUES (Sahu, 1964)									
Sl.No.	Depth	Y1	Remarks-Y1	Y2	Remarks-Y2	Y3	Remarks-Y3	Y4	Remarks-Y4
1	2	-7.366	Aeolian	56.218	Beach	-1.881	Sh Marine	1.590	turbidity
2	4	-7.249	Aeolian	48.535	Beach	-1.150	Sh Marine	1.536	turbidity
3	6	-6.865	Aeolian	50.599	Beach	-1.568	Sh Marine	1.474	turbidity
4	8	-7.156	Aeolian	48.128	Beach	-1.157	Sh Marine	1.517	turbidity
5	10	-7.858	Aeolian	50.117	Beach	-0.988	Sh Marine	1.655	turbidity
6	12	-7.976	Aeolian	50.633	Beach	-0.979	Sh Marine	1.678	turbidity
7	14	-8.177	Aeolian	51.017	Beach	-0.912	Sh Marine	1.717	turbidity
8	16	-8.014	Aeolian	52.642	Beach	-1.166	Sh Marine	1.694	turbidity
9	18	-8.166	Aeolian	52.558	Beach	-1.077	Sh Marine	1.721	turbidity
10	20	-8.242	Aeolian	44.647	Beach	-0.219	Sh Marine	1.702	turbidity
11	22	-8.004	Aeolian	51.480	Beach	-1.052	Sh Marine	1.687	turbidity
12	24	-7.885	Aeolian	48.294	Beach	-0.786	Sh Marine	1.652	turbidity
13	26	-8.555	Aeolian	49.605	Beach	-0.565	Sh Marine	1.780	turbidity
14	28	-8.222	Aeolian	54.165	Beach	-1.213	Sh Marine	1.739	turbidity
15	30	-7.105	Aeolian	49.034	Beach	-1.278	Sh Marine	1.512	turbidity
16	32	-6.987	Aeolian	52.382	Beach	-1.687	Sh Marine	1.504	turbidity
17	34	-6.295	Aeolian	63.413	Beach	-3.195	Sh Marine	1.423	turbidity
18	36	-7.787	Aeolian	53.991	Beach	-1.427	Sh Marine	1.658	turbidity
19	38	-6.968	Aeolian	52.722	Beach	-1.732	Sh Marine	1.502	turbidity
20	40	-7.570	Aeolian	49.944	Beach	-1.124	Sh Marine	1.601	turbidity
21	42	-6.854	Aeolian	57.439	Beach	-2.280	Sh Marine	1.501	turbidity
22	44	-6.732	Aeolian	56.906	Beach	-2.290	Sh Marine	1.476	turbidity
23	46	-7.056	Aeolian	56.462	Beach	-2.072	Sh Marine	1.534	turbidity
24	48	-7.841	Aeolian	53.035	Beach	-1.299	Sh Marine	1.664	turbidity
25	50	-8.600	Aeolian	58.044	Beach	-1.412	Sh Marine	1.824	turbidity
26	52	-7.458	Aeolian	54.615	Beach	-1.666	Sh Marine	1.600	turbidity
27	54	-7.336	Aeolian	56.784	Beach	-1.956	Sh Marine	1.587	turbidity
28	56	-8.105	Aeolian	52.292	Beach	-1.082	Sh Marine	1.709	turbidity
29	58	-8.604	Aeolian	52.680	Beach	-0.856	Sh Marine	1.802	turbidity
30	60	-8.780	Aeolian	52.154	Beach	-0.707	Sh Marine	1.833	turbidity
31	62	-7.024	Aeolian	59.626	Beach	-2.415	Sh Marine	1.542	turbidity
32	64	-7.943	Aeolian	55.164	Beach	-1.464	Sh Marine	1.692	turbidity
33	66	-8.182	Aeolian	53.608	Beach	-1.176	Sh Marine	1.729	turbidity
34	68	-8.172	Aeolian	52.440	Beach	-1.061	Sh Marine	1.722	turbidity
35	70	-7.024	Aeolian	59.626	Beach	-2.415	Sh Marine	1.542	turbidity
36	72	-6.766	Aeolian	49.755	Beach	-1.533	Sh Marine	1.452	turbidity
37	74	-6.896	Aeolian	43.491	Beach	-0.817	Sh Marine	1.450	turbidity
38	76	-6.937	Aeolian	45.369	Beach	-0.989	Sh Marine	1.465	turbidity
39	78	-7.657	Aeolian	51.077	Beach	-1.195	Sh Marine	1.622	turbidity
40	80	-8.015	Aeolian	55.234	Beach	-1.434	Sh Marine	1.705	turbidity
41	82	-7.696	Aeolian	47.464	Beach	-0.801	Sh Marine	1.614	turbidity
42	84	-7.834	Aeolian	53.161	Beach	-1.316	Sh Marine	1.663	turbidity
43	86	-7.213	Aeolian	53.118	Beach	-1.643	Sh Marine	1.549	turbidity
44	88	-5.778	Aeolian	63.345	Beach	-3.464	Sh Marine	1.328	turbidity
45	90	-5.290	Aeolian	70.660	Sh. Agitated water	-4.479	Sh Marine	1.269	turbidity
46	92	-7.307	Aeolian	65.196	Beach	-2.840	Sh Marine	1.617	turbidity
47	94	-7.259	Aeolian	66.038	Sh. Agitated water	-2.952	Sh Marine	1.612	turbidity
48	96	-7.454	Aeolian	57.301	Beach	-1.946	Sh Marine	1.611	turbidity
49	98	-7.788	Aeolian	60.599	Beach	-2.108	Sh Marine	1.686	turbidity
50	100	-7.640	Aeolian	67.181	Sh. Agitated water	-2.867	Sh Marine	1.687	turbidity

to positive skewness values. ARMS sediment exhibit dominant of coarse skewed values are 34%, near symmetrical 28%, fine skewed category 28%, very fine skewed nature 6% and 4% are very coarse skewed. It implies that the velocity of the depositing agent operated at higher value than the average velocity for a long duration of time than normal [25].

4.4. GRAPHIC KURTOSIS (KG)

The graphic kurtosis (KG) is the peakedness of the distribution and measures the ratio between the sorting in the tails and central portion of the curve. It is also a function of internal sorting or distribution. Kurtosis value of the sediments in ARMN ranged from 0.567Φ (78-80cm) to 3.825Φ (40-42cm) (Fig.5 A) with an average value is 1.176Φ. Samples fall under mesokurtic 36%, Leptokurtic 26%, platykurtic 24%, very leptokurtic 6%, very platykurtic and extremely platykurtic category 4%. 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 [29]. The kurtosis values varied between 0.088Φ (38-40cm) and 3.484Φ (60-62cm) (Fig.5 B) with an average of 1.020Φ at ARMS. The samples fall under platykurtic (48%), mesokurtic 28%, and leptokurtic 20%, very leptokurtic (2%) and extremely leptokurtic (2%). Higher platykurtic indicates poor winnowing without and sorting (i.e. all size fraction jumbled up) and higher mesokurtic values are mixing of predominant population with minor amount of coarser and fine materials [30 -31].

5. LINEAR DISCRIMINATE FUNCTION (LDF)

Variations in the energy and fluidity factors seem to have excellent correlation with the different processes and the environment of deposition [25]. The process and environment of deposition were deciphered by Sahu's linear discriminate functions of Y1 (Aeolian, beach), Y2 (Beach, shallow agitated water), Y3 (Sh Marine, fluvial) and Y4 (Fluvial Deltaic and Turbidity). With reference to Y1 value Aeolian process contributes 80% and 20% by beach at ARMN. With reference to Y2 value 68% beach and shallow agitated water process contributes 32% respectively. 100% of the sample fall under Sh Marine and turbidity condition with reference to Y3and Y4 respectively (Table No 3). At ARMS 100% of the sample fall under aeolian process with reference to Y1. 94% fall under beach and the rest of the under shallow agitated water with reference to Y2. Y3 and Y4 values referred to 100% Sh Marine environment and turbidity condition respectively. (Table No 4).

6. C-M plot

The CM pattern of the sediment samples of Arasalar river estuaries were plotted using the values of first percentile (C) and medium (M) of size distribution (in microns). CM pattern represents a complete model of tractive current (depositional process) as shown by Passega [26] which consists of several segments such as NO, OP, PO, OR and RS indicating different modes of sediment transport. ARMN most of the samples (84%) fall in OP segment, sector IV indicate sediments are mostly of <200m size. They deposited as suspension and rolling sediments. At ARMS almost all the samples fall under PQ segment in sector V infers suspension and rolling category

CONCLUSIONS

Araslar river tributary of Cauvery river confluence at Karaikkal. The grain size characteristics near Arasalar River infers dominant fine sand category from ARMN and ARMS. The dominant fine sand character indicates tha they were deposited by low fluvial process and wave condition in the mouth. The sorting varies in both location from moderately well sorted to well sorted due to continuous action of waves. Dominant positive skewness values in both the locations indicate a unidirectional flow with the dominance of wave at times leads to negative values. The sediment deposited in both the locations as suspended load by Aeolian process under turbidity environment.

REFERENCES

[1] Folk RL, Ward WC (1957). Brazos River bar: a study in the significance of grain size parameters. J Sedi Petrol; 27: 3-26. http://dx.doi.org/10.1306/74D70646-2B21-11D7-8648000102C1865D.

[2] Friedman GM. Differences in size distributions of populations of particles among sands of various origins. Sedimentology 1979; 26: 3-32. http://dx.doi.org/10.1111/j.1365-3091.1979.tb00336.x.

[3] Flemming BW. The influence of grain-size analysis methods and sediment mixing on curve shapes and textural parameters: Implications for sediment trend analysis. SediGeol 2007; 202: 425-35. http://dx.doi.org/10.1016/j.sedgeo.2007.03.018.

[4] Seetharamaswamy, A., (1970). Studies on some aspects of modern deltaic sediments of the Krishna River, India. Ph.D. Thesis, Andhra University, Waltair.

[5] Jagannadha Rao, M., and Krishna Rao, J.S.R., 1984. Textural and mineralogical studies on red sediments of VisakhapatnamBheemunipatnam coast. Geo views, Vol.XII, No.2, pp.57-64.

[6] Dhanunjaya Rao, G., KrishnaiahSetty, B., and Raminaidu, Ch., 1989. Heavy mineral content and textural characteristics of coastal sands in the Krishna- Godavari, Gosthani- Champavati, and Penna river deltas of Andhra Pradesh, India: a comparative study. . Journal of Atomic Mineral Science (Joams), Earfam. v.2.

[7] Krishana Rao, B., Bhanumurty, P. and Swamy, A.S.R., 1990. Sedimentary characteristics of Holocene beach ridges on western delta of Krishna River, sea level variation and its impact on coastal environment. Edited by Victor Rajamanickam G., (Tamil university publication no.131, Tamil University press), pp.133-143.

[8] Ramesh, R., and Subramanian, V., 1992. Textural characteristics of the Krishna river sediments, Ind. Geo. jour., v.28.4, pp. 449-455.

[9] Vaithiyanathan, P., Ramanathan, Al., and Subramanian, V., 1992. Sediment transport in the Cauvery River basin: sediment characteristics and controlling factors. Journal of Hydrology, v. 139, Iss. 1-4, pp. 197-210.

[10] Seetharamaiah, J., and Swamy, A.S.R., 1994. Texture of inner shelf sediments off Pennarriver, east coast of India. Ind. Jour. Mar. Sci, v. 23, no. 4, pp. 195-198.

[11] Bragadeeswaran, S., Rajasekar, M., Srinivasan, M., and KanagaRajan, U., 2007. Sediment texture and nutrients of Arasalar estuary, Karaikkal, south-east coast of India. Journal of Environmental Biology, v. 28(2), pp. 237-240.

[12] Rajasekhara Reddy, D., KarunaKarudu, T., and Deva Varma, D., (2008). Textural characteristics of south western part of Mahanadi Delta, east coast of India. Jour. Ind. Assoc. Sed., v.27, no.1, pp.111-121.

[13] Ramanathan, A.L., Raj Kumar, K., JayjitMajumdar., Gurmeet Singh., Behera, P.N., Santra, S.C., and Chidambaram, S., 2009. Textural characteristics of the surface sediments of a tropical mangrove Sundarban ecosystem India. Indian journal of marine sciences, v.38 (4), December, pp. 397-403.

[14] RajaniKumari, V., and Mrutyunjaya Rao, I., 2009. Estuarine characteristics of lower Krishna River, Indian journal of marine sciences. Pp.215-223.

[15] Venkatramanan, S., Ramkumar, T., and Anithamary, I., 2010. Textural characteristics and `organic matter distribution patterns in Tirumalairajanarriver Estuary, Tamil Nadu, east coast of India. International journal of geomatics and geosciences, v.1, No.3, pp. 552-562.

[16] I. Anithamary, T.Ramkumar and S.Venkatramanan 2011. Grain Size characteristics of The Coleroon Estuary Sediments, Tamil Nadu, and east coast of India. In Carpathian journal of earth and environmental sciences, v.6, no.2, pp.151-157.

[17] Singarasubramanian.S.R, Mukesh.M.V, Manoharan.K.,Bakkiraj.D., Murugan.S., John Peter.A and Seralathan.P. (2006) Sediment characteristics of the M9 tsunami event between Rameswaram and Thoothukudi, Gulf of Mannar, Southeast coast of India. International Jour. of Science of Tsunami hazards. Vol.25 (3). pp.160-172.

[18] Singarasubramanian.S.R.,Mukesh.M.V.,Manoharan .K., Seralathan.P., Sujatha K and Bakkiaraj.D. (2009) Geomorphological and Sedimentological changes during and after the

December-2004 Indian Ocean Tsunami near the Vellarriver and the M.G.R. island area of the central Tamilnadu coast. International Jour. of science of Tsunami hazards. Vol.28 (1). Pp.67-74.

[19] Singarasubramanian.S.R, Mukesh.M.V., Manoharan.K., Seralathan.P and Srinivasulu.S. (2011) Geological and geomorphological perspectives of the tsunami on the Tamilnadu Coast, India- "Indian Ocean Tsunami, The Global response to a Natural Disaster", (Ed).PradyumnaP.Karan and Shanmugam P. Subbiah. University press of Kentuky, US. Pp.65-97.

[20] Rajmohan. S, Singarasubramanian. S. R., (2013). Granulometric Studies of Beach Sediments between Ponnaiyar and Gadilam Rivers, Cuddalore, East Coast of India. International journal of earth sciences and engineering. ISSN 0974-5904, Volume 06, No. 02.

[21] Suganraj, K., Singarasubramainian. S. R., (2013) textural characteristics of coastal sediments between Parathaparamapuram and Poovathadi, Tamil Nadu, East coast of India.

[22] Jing-Zhang (1988). Weiwen Huang and Jean Marie Martin, Trace metals distribution in Huange (Yellow River) Estuarine sediments Estuarine coastal and Shelf Sci., 26, 499-516.

[23] Muraleedharan Nair M.N., (2002). Ramachandran K.K., Textural and trace metal distribution in sediments of Beypore estuary, Indian J. of Mari Science, 31, 295-304.

[24] Chidambaram et al., (2015). Stable isotopic signature for Hydro geochemical characterization of ground water from Pondicherry to Nagapattinam, Tamilnadu. Management of water, energy and Bio-resources in the Era of climate change: emerging issues and challenges. DOI 10.1007/978-3-31-05969-3-9.

[25] Sahu, B.K., (1964). Depositional mechanisms from the size analysis of classic sediments. J. Sed. Petol., v.34, pp. 73-83.

[26] Passega, R., (1964). Grain size representation by CM patterns as a geological tool. Jour. Sed. Pet., v.34, pp. 830- 847.

[27] Venkatramanan, Ramkumar, Anithamary, and Ramesh (2011). Variations in texture of beach sediments in the vicinity of the Tirumalairajanarriver mouth of India. International Journal of Sediment Research 26 (2011) 460-470.

[28] Lahkar. A.C. and Hazarika. I.M. (2000) Significance of grain size parameters in the environmental interpretation of the Tipam Sandstones, Jaipur Area, Dibrugarh district, Assam. Jour. Ind. Asso. Sed. 19 (1&2), 69-78.

[29] Avramidis P., Samiotis A., Kalimani E., Papoulis D., Lampropoulou P., Bekiari V., Sediment characteristics and water physicochemical parameters of the Lysimachia Lake, Western Greece, Environ Earth Sci., (2012).

[30] Mason, C. C., and Folk, R. L., 1958. Differentiation of beach dune, and aeolian flat environments by size analysis. Mustang Island, Texas, Jour. Sed. Pet., v.28, pp.211-226.

[31] Prabhakara Rao, Kumar A., Yugandhar Rao A.K. A. Ravi.G.S. andKrishnan.S. (2001) Grain size parameters in the interpretation of depositional environments of coastal sediments between Bendi Creek and Vamsadharariver, east coast. India Jour.Ind.Assoc.Sed., 20(1), 109-116.

BIOGRAPHIES

S.Venkatesan is Ph.D Research scholar in Department of Earth Sciences, Annamalai University. He was awarded with research fellowship by the DST for his research work.
Email:csvenkat@gmail.com

S.R.Singarasubramanian is Assoicate professor of Earth Sciences, from Annamalai university, India. He was awarded Ph.D. in Sedimentology and hydrogeology by Annamailai university in 2003.He has completed three major research projects funded by DST and CSIR. He has published more than 16 research papers in National and International journals. He was awarded" Bharat Joti Award" and best citizens of India award-2012".

