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A NOTE ON THE TEXTURAL VARIATION OF BEACH SEDIMENTS IN THE VICINITY OF GANGAVALI RIVER MOUTH NEAR ANKOLA, WEST COAST OF INDIA

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ABSTRACT

Sediment samples collected from beaches in the vicinity of Gangavali river mouth over a period of 18 months between September 1985 and February 1987 revealed that the sediments are coarse to fine grained (0.27-2.67 ϕ), moderate to well sorted (0.03-0.97 ϕ), coarse (-ve) to fine (+ve) skewed and mesokurtic. The observed variations in textural parameters are both spatial and time dependent and gives signatures of changes in oceanographic conditions.

Key-words: Sediments, beach morphology, Gangavali, West Coast.

The stretch of coastline under investigation (Fig.1) is oriented in NNW-SSE direction. The coastal stretch on the southern side of the Gangavali river mouth (L_1 and L_2) is long and narrow while coastline in the southern side (L_3) of the river mouth is semi circular in outline which is sheltered by rocky cliff exposed to the NW of the beach. An attempt has been made to bring out relationship with the variation in grain size to beach morphology and wave dynamics under varying energy conditions.

Beach profiling has been carried out at three locations L_1, L_2 and L_3 (Fig.2) for 18 months at a monthly interval between September 1985 and February 1987 following Emery (1961). At each location a reference point unaffected by wave action established. Elevation of beaches with respect to reference point is measured at 5 m interval along the transect. Wave parameters like breaker height, wave period, longshore current direction and speed were noted during profiling. Longshore current direction and speed were measured by casting a floating body in surf zone and allowing it to drift freely for 180 seconds. The distance travelled by the floating body from the point of casting and direction of movement along the shoreline noted. Wave period was measured with stop watch by observing time elapsed during passage of 15 crests past a fixed point. Breaker height was visually measured by comparing the heights of the breaker with the staff kept in the surf zone. A total of 162 sediment samples were collected for grain size analysis by pressing (a plastic core liner) upto 8 cm deep into the beach. To remove organic materials, sediment samples were desalted and treated (Ingram, 1970) before subjecting to standard sieve analyses with Ro-Tap sieve shaker.

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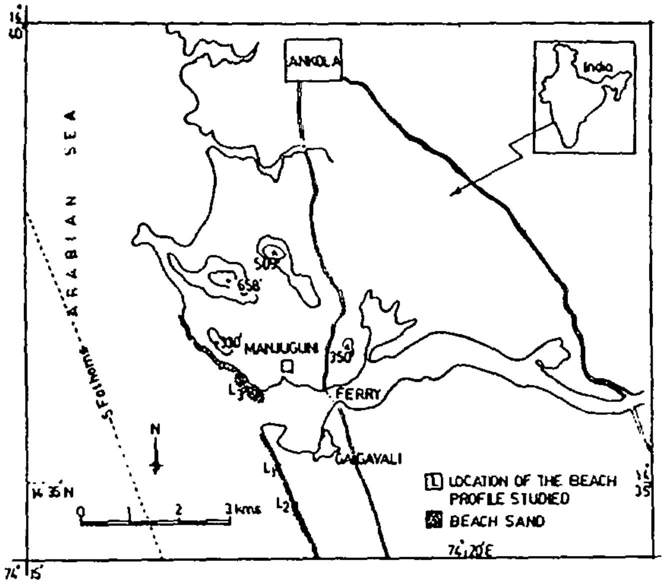

Fig.1. Map showing the area of study.

Textural parameters of the samples are presented in Table I. In general, the sands are medium to fine grained (1.11-2.67 ϕ at L_1 and 1.38-2.65 ϕ at L_2) in southern side of river mouth while they are coarse to fine grained (0.27-2.60 ϕ at L_3) on the norhtern side of the river mouth. During the monsoon the sands were coarser than those in premonsoon and postmonsoon. The standard deviation values varied from 0.25 ϕ to 0.87 ϕ in the case of southern side sands and in the case of northern side from 0.03 ϕ to 0.09 ϕ (well sorted to moderately sorted). The sands during premonsoon and postmonsoon are better sorted as compared to those in monsoon. Skewness varied from coarse (-ve) to fine (+ve) and majority of sands in all locations are mesokurtic in nature.

The binary plots (Folk and Ward, 1957) indicate that the slight improvement in sorting with decrease in grain size (Fig.3), changes the skewness from coarse (-ve) to fine (+ve) with increase in grains size (Fig.4). Samples at all the three transects are fine, +vely skewed through nearly symmetrical to coarse -vely skewed. At L_1 and L_2 midwater samples showed mesokurtic nature whereas at L_3 there was wide fluctuation (Fig.5). Fine grain sediments were observed when beaches experienced accretion and coarse grains during erosion; L_3 being an exception to this.

The grain size and sorting varied from month to month.

Generally, sheltered beaches are passive to changes in oceanographic conditions (Bryant, 1982). But exceptional morphological and textural variations were observed at L_3 — a sheltered beach. Coarser grains were observed at this beach in all the seasons. In order to check whether this could be due to river discharges, Friedman's (1967) test was employed

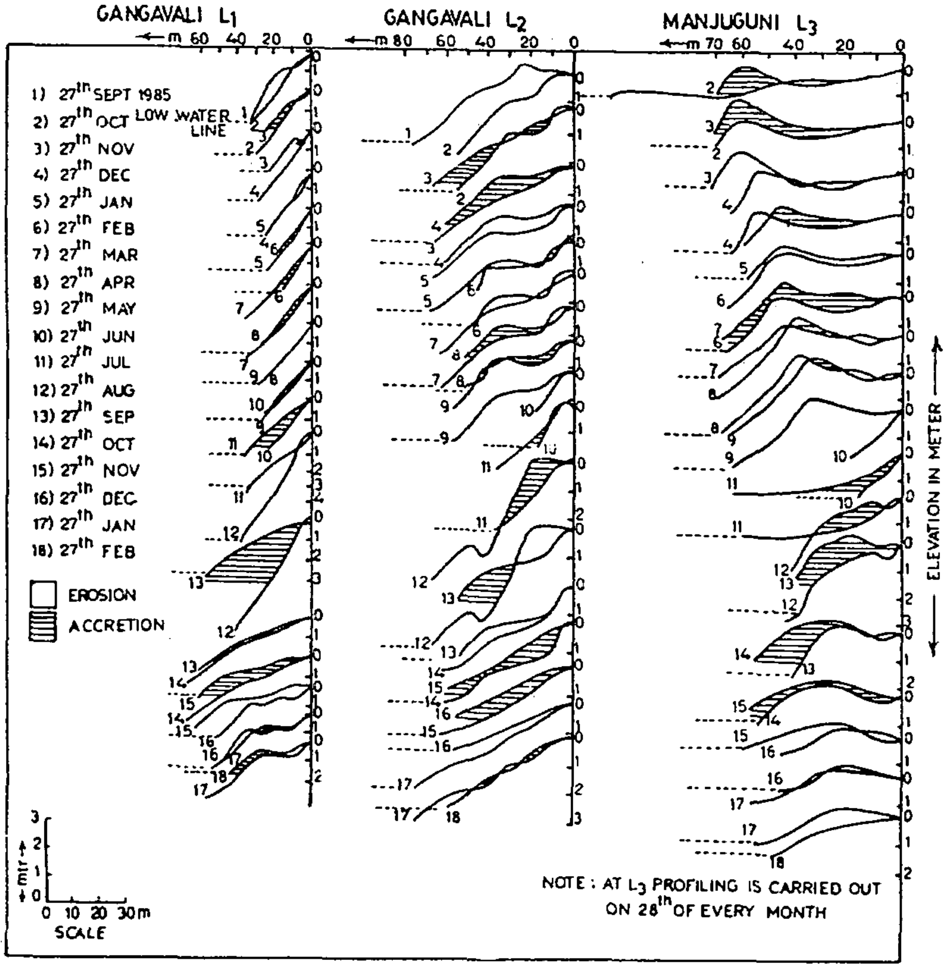

Fig.2. Beach profiles of Gangavali and Munjuguni.

(Figs.6 and 7). At L_3 particularly plunge point samples show riverine characters, Such contribution is minimum at L_1 and absent at L_2.

The sediments were bimodal to polymodal, corase (-ve) to fine (+ve) in skewness. Differential degree of sorting at all the three transects is both spatial and time dependent.

During monsoon wave regime is characterised by high breakers (2.25-2.7 m) and short period waves (7-8 sec) which gave rise to erosion. Along with high wave energy regime, influx of sediments (Sony, 1973) due to river discharge resulted in coarse grained, unsorted and +vely skewed nature of the sands. Poor sorting, strong wash, backwash and high turbulence result in bimodal to polymodal character.

During postmonsoon i.e. during October and November moderate wave energy (1.2-1.4 m) breaker height and 8-12 sec wave period the beach

Table I — Textural parameters calculated for beach sands of Gangavali River mouth (in φ scale)

Months	Tides	Mean size			Standard deviation			Skewness			Kurtosis		
		L_1	L_2	L_3	L_1	L_2	L_3	L_1	L_2	L_3	L_1	L_2	L_3
Sept. 1985	L.T.	1.48	1.96	1.48	0.41	0.36	0.46	-0.093	-0.22	-0.093	0.99	1.11	0.84
	M.T.	2.00	2.10	1.49	0.41	0.46	0.66	-0.150	-0.133	-0.017	1.08	1.12	0.69
	H.T.	1.68	2.42	1.70	0.51	0.36	0.51	-0.06	-0.33	+0.08	0.71	1.15	1.02
	Mean	1.72	2.16	1.56	0.44	0.39	0.61	-0.061	-0.230	-0.06	0.93	1.13	0.85
Oct	L.T.	1.53	1.96	1.29	0.44	0.41	0.63	0.04	-0.30	0.22	0.90	1.10	0.94
	M.T.	2.05	2.19	1.60	0.46	0.46	0.50	0.012	-0.20	-0.061	1.15	1.07	1.13
	H.T.	1.62	2.60	1.64	0.49	0.37	0.56	0.055	-0.19	+0.02	0.78	1.17	0.77
	Mean	1.73	2.25	1.51	0.45	0.41	0.56	0.035	-0.173	0.059	0.94	1.11	0.95
Nov.	L.T.	1.72	1.55	1.08	0.52	0.46	0.55	-0.08	-0.018	0.073	1.07	1.00	1.00
	M.T.	1.92	1.71	1.63	0.57	0.45	0.54	-0.31	0.099	-0.046	1.13	1.03	0.77
	H.T.	1.62	1.86	1.56	0.48	0.48	0.56	0.15	-0.35	0.16	0.82	0.95	0.84
	Mean	1.75	1.71	1.42	0.52	0.46	0.55	-0.027	-0.09	0.062	1.0	1.0	0.87
Dec.	L.T.	1.97	2.08	1.56	0.62	0.51	0.70	-0.324	-0.15	-0.12	0.87	1.81	0.88
	M.T.	2.61	2.08	1.98	0.33	0.45	0.66	-0.010	-0.18	-0.20	1.73	1.08	0.93
	H.T.	1.63	2.57	1.38	0.50	0.33	0.64	+0.058	-0.10	+0.26	0.75	1.87	1.15
	Mean	2.07	2.24	1.64	0.68	0.43	0.66	-0.092	-0.146	-0.20	1.11	1.25	0.99
Jan. 1986	L.T.	1.70	1.95	1.17	0.46	0.57	0.57	0.032	-0.34	0.31	1.10	1.09	1.13
	M.T.	1.71	1.73	2.00	0.47	0.49	0.47	0.045	+0.036	-0.17	1.09	1.07	1.09
	H.T.	1.72	2.48	2.03	0.45	0.31	0.47	0.019	-0.26	-0.14	1.12	0.95	1.07
	Mean	1.71	2.05	1.73	0.46	0.46	0.50	0.032	-0.188		1.10	1.04	1.09
Feb.	L.T.	1.87	1.53	1.13	0.65	0.46	0.78	-0.40	-0.009	+0.23	0.75	0.94	1.01
	M.T.	2.08	1.69	1.60	0.46	0.48	0.61	-0.54	+0.23	0.0	1.43	0.82	0.88
	H.T.	2.29	2.16	2.58	0.47	0.49	0.49	-0.69	-0.17	-0.20	2.12	1.19	1.17
	Mean	2.08 2.16	1.79	1.77	0.53	0.48	0.63	-0.54	0.017	+0.01	1.43	0.98	1.02
Mar. 1986	L.T.	1.69	1.89	1.93	0.62	0.54	0.58	-0.091	-0.38	-0.26	0.82	1.06	1.02
	M.T.	1.67	2.49	1.26	0.53	0.44	0.45	+0.044	-0.47	0.23	0.75	1.18	1.04
	H.T.	2.67	1.33	2.44	0.35	0.34	0.48	+0.05	0.40	-0.48	0.98	0.93	1.47
	Mean	2.01	1.90	1.88	0.50	0.44	0.50	+0.001	-0.15	-0.17	0.85	1.06	1.18
Apr.	L.T.	2.08	1.58	2.14	0.43	0.58	0.58	-0.18	-0.11	-0.20	0.73	0.87	1.17
	M.T.	2.12	1.71	1.69	0.35	0.47	0.51	-0.28	-0.015	+0.034	0.89	1.07	0.76
	H.T.	2.24	1.59	1.61	0.30	0.43	0.52	+0.077	-0.18	+0.075	0.98	0.68	0.78
	Mean	2.15	1.63	1.84	0.36	0.49	0.54	-0.127	-0.047	-0.03	0.86	0.87	0.90
May	L.T.	1.91	2.20	1.23	0.54	0.47	0.96	-0.19	-0.26	-0.41	0.79	0.79	1.51
	M.T.	2.16	1.81	1.68	0.53	0.36	0.50	-0.09	+0.29	-0.097	1.36	1.03	1.11
	H.T.	2.00	1.84	2.05	0.31	0.34	0.86	-0.27	+0.8	-0.43	0.84	1.02	1.81
	Mean	2.02	1.92	1.65	0.46	0.39	0.77	-0.18	+0.036	-0.299	1.00	0.95	1.47

Months	Tides	Mean size			Standard deviation			Skewness			Kurtosis		
		L_1	L_2	L_3	L_1	L_2	L_3	L_1	L_2	L_3	L_1	L_2	L_3
Jun. 1986	L.T.	1.54	1.38	1.44	0.43	0.51	0.87	0.01	0.22	-0.27	0.89	1.08	0.97
	M.T.	1.70	1.68	1.62	0.43	0.47	0.60	0.92	0.008	-0.048	1.11	1.06	0.66
	H.T.	1.66	1.92	2.09	0.36	0.37	0.54	-0.125	-0.30	-0.025	0.82	1.04	0.89
	Mean	1.63	1.66	1.72	0.41	0.45	0.67	-0.007	-0.24	-0.114	0.94	1.06	0.84
Jul.	L.T.	1.57	1.91	1.54	0.25	0.57	0.48	-0.049	-0.23	-0.096	0.92	1.03	0.99
	M.T.	1.68	2.08	1.13	0.48	0.50	0.37	+0.11	-0.21	+0.20	0.56	1.28	1.21
	H.T.	1.59	1.65	1.23	0.43	0.34	0.30	0.026	+0.077	0.29	0.68	1.77	0.94
	Mean	1.61	1.88	1.30	0.39	0.47	0.38	+0.029	-0.121	0.131	0.72	1.36	1.05
Aug.	L.T.	1.11	1.97	0.27	0.86	0.70	0.88	0.12	-0.69	-0.141	0.90	1.23	0.95
	M.T.	1.66	1.60	1.60	0.46	0.53	0.51	0.031	-0.059	+0.054	0.93	0.76	0.76
	H.T.	1.94	1.61	0.69	0.56	0.51	0.45	-0.30	+0.079	+0.04	1.16	0.81	1.81
	Mean	1.57	1.73	0.85	0.62	0.58	0.61	-0.49	+0.22	-0.015	1.00	0.93	1.17
Sept.	L.T.	1.61	1.57	0.91	0.55	0.52	0.61	+0.046	+0.028	0.10	0.73	0.77	1.33
	M.T.	2.10	1.61	1.13	0.42	0.47	0.37	-0.35	+0.098	0.121	0.74	0.77	1.52
	H.T.	1.28	1.97	1.55	0.40	0.49	0.51	0.31	-0.30	0.073	1.01	1.12	0.72
	Mean	1.66	1.72	1.20	0.45	0.49	0.50	-0.001	0.06	0.098	0.83	0.89	1.19
Oct.	L.T.	1.53	1.82	0.36	0.57	0.52	0.56	0.089	-0.43	-0.25	0.76	1.08	0.87
	M.T.	1.65	1.67	0.65	0.50	0.50	0.41	0.20	-0.18	-0.125	0.70	0.78	1.64
	H.T.	1.28	1.59	1.53	0.48	0.42	0.46	0.359	+0.022	-0.063	0.95	0.74	0.90
	Mean	1.49	1.70	0.85	0.52	0.48	0.48	0.216	-0.196	-0.146	0.80	0.87	1.14
Nov.	L.T.	1.83	1.93	1.61	0.79	0.70	0.54	-0.29	-0.53	0.05	0.80	1.94	0.86
	M.T.	2.00	2.10	1.65	0.48	0.45	0.09	-0.16	-0.122	+0.214	1.10	1.49	2.86
	H.T.	2.46	1.69	2.60	0.35	0.50	0.03	-0.27	+0.004	-0.04	1.16	1.05	2.05
	Mean	2.10	1.91	1.95	0.54	0.55	0.22	-0.24	-0.22	0.07	1.02	1.49	1.92
Dec.	L.T.	1.64	2.06	1.25	0.65	0.75	0.80	-0.011	-0.33	0.74	0.82	0.92	0.60
	M.T.	1.58	2.64	1.45	0.59	0.35	0.54	+0.005	-0.052	0.073	0.98	1.53	1.23
	H.T.	1.53	2.18	1.69	0.54	0.45	0.49	+0.021	-0.23	0.072	1.15	1.06	1.87
	Mean	1.58	2.29	1.45	0.59	0.52	0.61	0.005	-0.20	0.073	0.98	1.17	1.23
Jan. 1987	L.T.	1.65	1.93	1.10	0.77	0.40	0.93	0.13	-0.33	0.09	0.84	1.17	1.21
	M.T.	2.49	2.65	1.28	0.45	0.45	0.44	-0.27	+0.18	0.18	1.31	1.15	1.04
	H.T.	1.26	2.39	1.52	0.46	0.74	0.58	0.18	+0.515	0.10	1.00	1.42	1.28
	Mean	1.80	2.32	1.30	0.56	0.53	0.65	+0.001	+0.122	0.12	1.05	1.25	1.18
Feb.	L.T.	1.52	1.56	0.40	0.53	0.51	0.90	-0.32	-0.25	0.041	1.35	0.69	1.09
	M.T.	1.73	1.61	1.38	0.41	0.51	0.54	+0.05	-0.063	0.098	1.12	0.75	1.26
	H.T.	2.00	1.52	1.63	0.45	0.45	0.51	-0.24	+0.075	+0.021	1.19	0.96	0.77
	Mean	1.75	1.56	1.13	0.46	0.49	0.65	-0.17	-0.079	-0.058	1.22	0.80	1.04

* Tides - Low Tide (LT), Mid Tide (MT), High Tide (HT). Locations - *L_1, *L_2, *L_3 refer Fig.1.

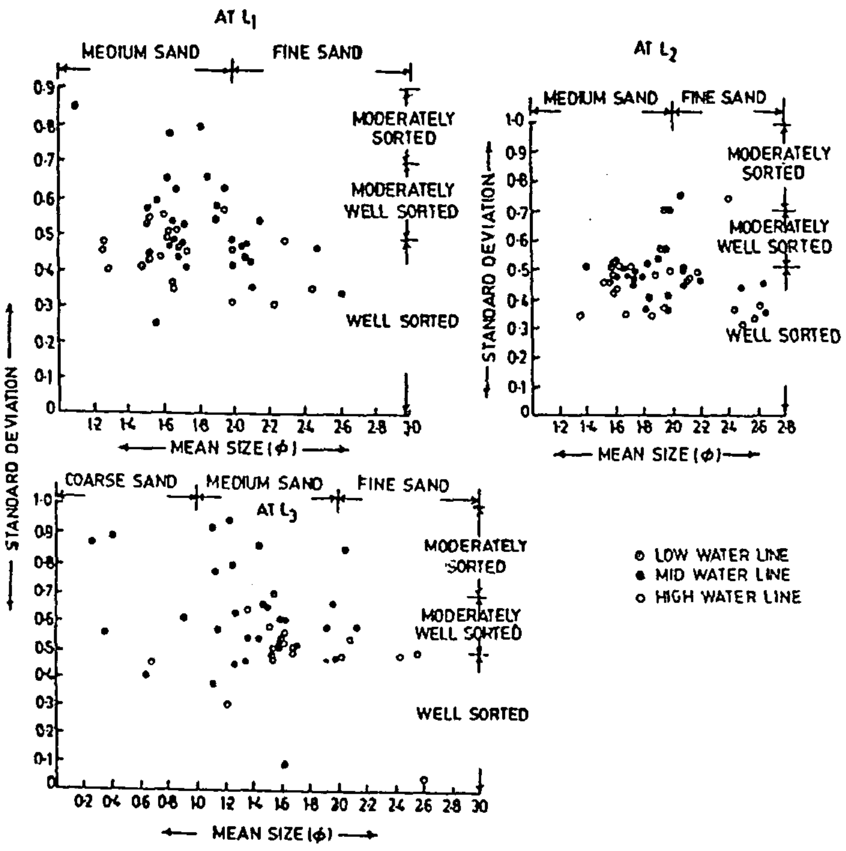

Fig.3. Bivariant plot for mean size versus standard deviation.

Table II – Monthwise variation in wave characteristics

		Breaker height (m)		Wave period (sec.)	Direction	Longshore current speed cm/sec
		L1	L2			
Sep	1985	2.25	2.25	8-10	South	8.8 cm/sec.
Oct	"	1.5	1.6	10-12	South	9 "
Nov	"	1.3	1.4	10-12	North	8 "
Dec	"	1.2	1.3	8-10	South	8-9 "
Jan	1986	1.01	1.07	10	South	6 "
Feb	"	1.05	1.1	10-12	North	10.4 "
Mar	"	1.15	1.12	12-14	North	1.3 "
Apr	"	1.25	1.3	10-12	North	13.8 "
May	"	1.48	1.5	8-10	South	10 "
Jun	"	1.65	1.7	8	South	32 "
Jul	"	2.17	2.3	7-8	South	50 "
Aug	"	2.5	2.7	8	North	18 "

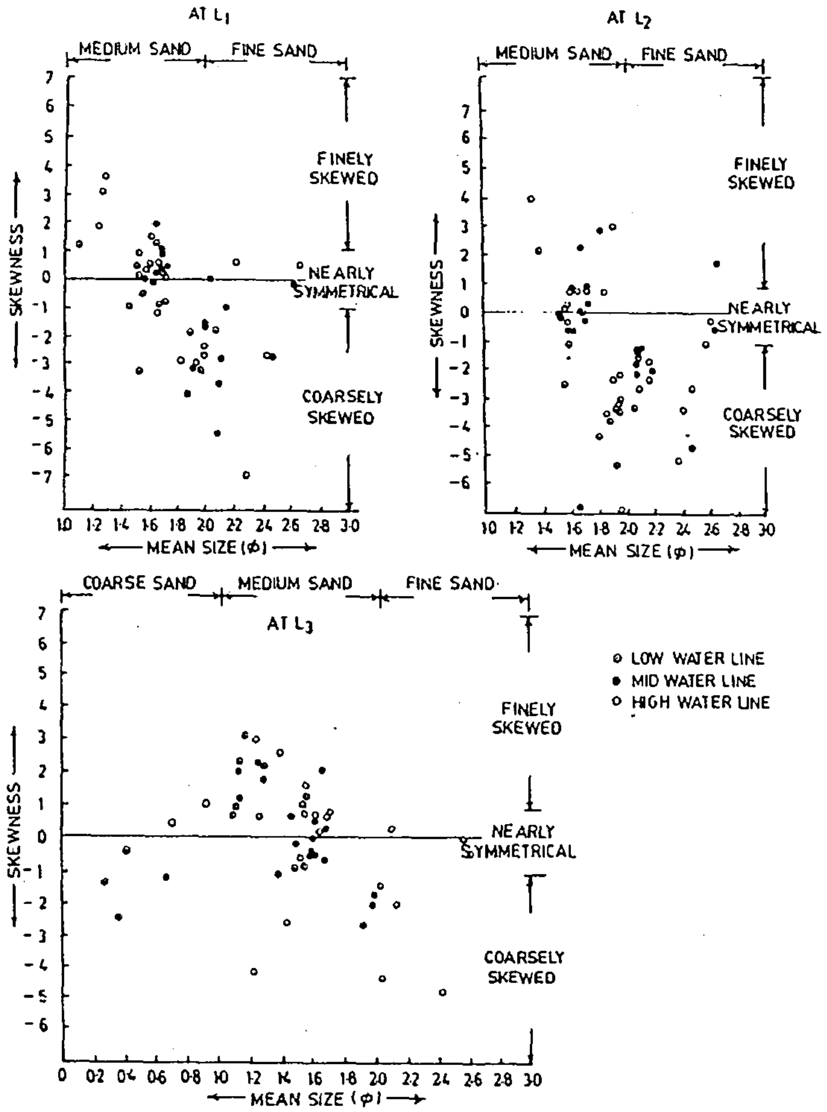

Fig.4. Scatterplot of skewness versus mean size.

experiences accretion. The existing selective transportation (Fox, 1978) is due to a weak (9 cm/sec) southerly longshore current (Table II). As a result of this selective transportation and influx of sediments from offshore (Chakrabarthi, 1977), the sands are medium grained and moderately sorted. During November/December due to reversal of longshore current from north to south, sands are removed from the beach and deposited towards south. This leads to erosion at L_1 and accretion at L_2. Turbulent sheet of flow in the foreshore zone and prolonged winnowing action in wave results in better sorted and medium grained sand at L_1 while at L_2 due to the mixing of two population, sands are poorly sorted as compared to L_1.

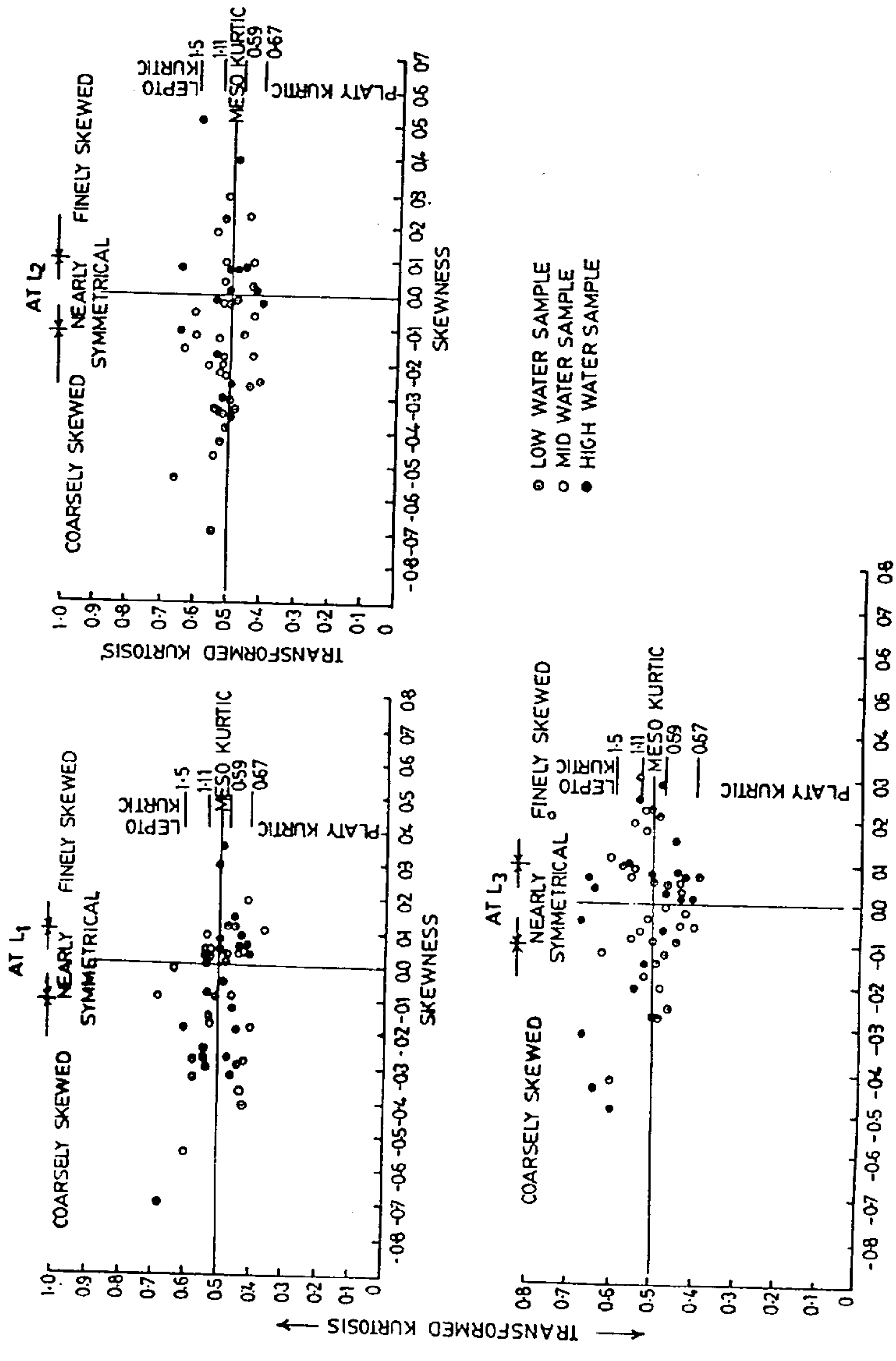

Fig.5. Scatterplot of skewness versus kurtosis.

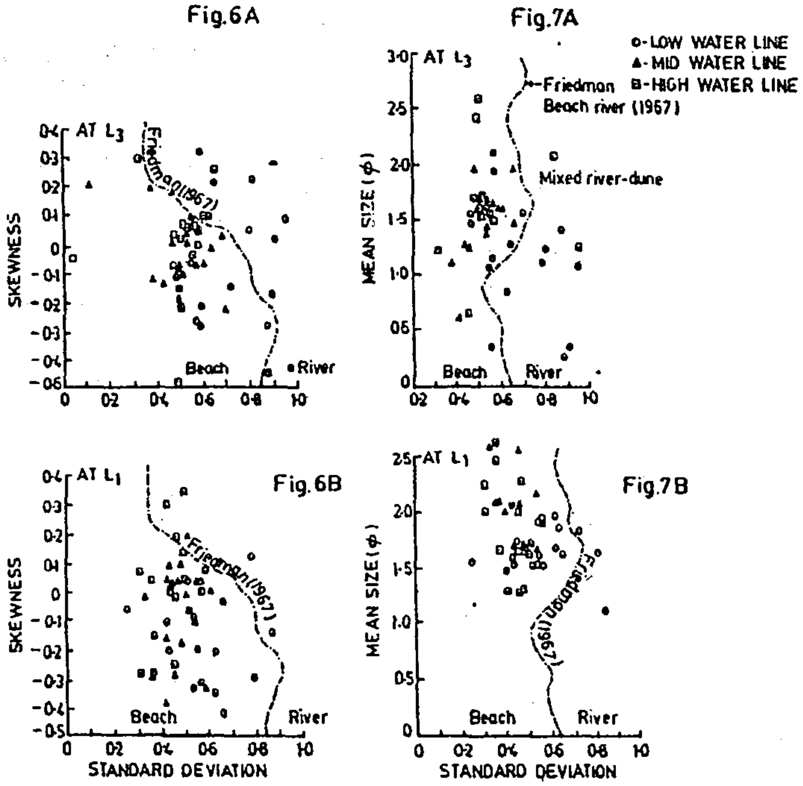

Fig.6 & 7. Bivariant plot of skewness and mean size versus standard deviation respectively.

During premonsoon due to limited inputs, weak wave energy and near normal approach of waves result in better sorted and fine grained sands. Because of better sorting and resultant weak backwash, beach experiences accretion.

In all the seasonal exceptional morphological and textural variations are observed at L_3 which would be due to nearness to source (Engstorm, 1974), erosion of coastal dunes and river discharge. The study has revealed that sediment characters change as the characters of wave dynamic changes.

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