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VARIATION IN TEXTURE AND MORPHOLOGY OF A SHELTERED KILLEBAG BEACH NEAR KARWAR, WEST COAST, INDIA

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ABSTRACT

The morphology and grain size parameters of the sediments of Killebag beach have been studied over a period of thirteen months with an interval of 30 days. It is clear from this study that, though the variation in morphology and range of mean size and standard deviation is small, the pattern in the changes due to seasons is maintained. The study reveals that during south-west monsoon, erosion of the beach is associated with coarser mean size sediments which are relatively less sorted as compared to fair weather season.

INTRODUCTION

Beach studies have gained considerable importance in India in view of the coastal erosion which cause loss of land and property on one hand and presence of economic placer mineral deposits on the other. The coast of northern Karnataka near Karwar is oriented in a NNW-SSE direction and consists of small sandy beaches in between rocky promontories. Studies have shown that the beaches are fairly stable although they undergo a series of short term cuts and fills during the monsoon and non-monsoon seasons respectively (Chavadi and Nayak, 1985). The Killebag, which is about 5 km south of Karwar town (Long 74°7'42" and Lat 14°48'27"), has a small beach trending E-W and sheltered by rocky promontories (Fig.-1). The promontories and cliffs on either side of this beach are composed of granitic gneisses with numerous basic dykes of doleritic character. No geological information on these beaches is available. This study is aimed at in understanding the behaviour of grain size and morphology within a cliff locked Killebag beach which subsequently helps in understanding the stability of the beach.

METHODOLOGY

Field studies

A study of the beach profile has been undertaken for a period of thirteen months from Dec. 1982 to December 1983. A reference point was fixed well behind the backshore of the beach where the changes either by waves or wind action have been observed to be negligible. The beach elevations were measured from this fixed reference point to low water line at every six meter interval, perpendicular to the length of the beach. The profiles were measured at the time of low tide, once in a month following the method described by Emery (1961).

Sediment samples have been collected from foreshore (high, mid and low tide strands) by pressing a plastic core liner of 5 cm. diameter in to the beach surface to a depth of 4 cm. Besides these, visual observations have also been made on environmental parameters viz. waves, winds and currents during each of the field surveys.

Laboratory analysis

The sediment samples were treated following the method of Ingram (1970) to remove shell fragments, iron coating and organic matter after washing with fresh water for desalination. The treated samples were later sieved on a Ro-Tap sieve shaker using ASTM sieve at intervals of ¼ Ø (0.25 phi). The weights obtained were converted to weight and cumulative percentages. The weight and cumulative frequency curves were drawn and the statistical parameters were computed (Folk and Ward, 1957) using the values obtained from cumulative frequency curves.

RESULTS

Morphological variations

Morphological changes of Killebag beach measured during the study period have been presented in Fig.-2. This figure demonstrates that during the period from Decemeber to May considerable deposition occurs except minor erosion during March. During June and August beach material gets completely eroded, as could be seen from the lowered elevation or cut of the beach. During July, however, considerable deposition is observed. Following the initial higher rate of removal of beach material during June, the beach exhibits greater resistance for further erosion during months of July/August as deduced from less changes (deposition/erosion) in the morphology (Fig.2). From September onwards, however the beach shows a trend of deposition. The accretional feature remains till November, while the beach shows erosion during Decemeber. The volume (m^3/m) variation at this beach during the study period have been calculated (Table-1). To check the net change (erosion/deposition), also included in this table, the volume calculated from the initial profile superimposed on the profile at the end of the thirteenth survey (Fig.2). For easy reference volume is also calculated considering April as zero.

Variations in size characteristics

The results of the grain size analysis of the sediments are presented in Table-2. Monthly variation in mean size and standard deviation are presented in Fig.-3. The bivariate plot have been drawn to know the inter-relationship between mean and standard deviation (Fig.-4). The average weight frequency diagrams (Fig.-5 & Fig.-6) were utilised to separate different energy environments.

The sediments of Killebag beach have their mean size in the range of 1.98 Ø - 3.09 Ø (medium to very fine sand grade), majority of the values being in the category of fine sand class (Table-2). It is clear from Fig.-3 that there is a considerable variation of grain size from season to season. The coarser sands are observed during monsoon as compared to fair weather season (Fig.-5).

The standard deviation values range from 0.246 to 0.733, which are within the range of very well to moderately well sorted sand class (Folk, 1961). The relatively better sorted sediments are observed during fair weather season (Fig.-3).

Table-2 reveals that the skewness values of 39 samples vary from -0.343 to +0.573, majority of the values being in the category of symmetrical to negatively skewed class.

Bivariate plot of meansize and standard deviation gives useful information about sedimentary environment (Inman, 1949). The plot (Fig.4) reveals that there is an inverse relation between standard deviation and meansize (0) of the sediments (Mckinney and Friedman, 1970) i.e. degree of sorting increases as the meansize of the sand increases (Ø) or finer the sand (mm) better the sorting (Inman, 1953). From this figure it is also clear that across the beach, the mean size (mm) values decrease from upper foreshore towards lower foreshore. This feature can also be seen clearly in Table-2 and also in Fig.-6 where the average of all thirteen months is considered.

DISCUSSION

From the literature available along the West Coast of India (Veerayya, 1972; Venkatesh and Michael, 1985 and Nayak, 1986) it is clear that within the beach mean grainsize of the sediments vary from very fine to coarse in a period of one calender year. During this one year period, generally, relatively coarse grained sediments, which are comparatively poorly sorted will be present during the monsoon season, associated with the erosional features of the beaches, due to high and steep waves of south west monsoon season (Veerayya, 1972).

The range of variability of grainsize parameters and morphology in the Killebag beach are considerably small in magnitude. The mean grainsize of the sediment samples in a period of one year, ranges between veryfine to fine sand class. However, the variation trend is similar to other beaches. The mean size of the sediments during fair weather season is comparatively finer than monsoon season (Fig.-5). It is clear from the bivariate plot of mean Vs standard deviation that the finer the sands, better the sorting. So it is clear that during monsoon season the sediments are relatively coarser and poorly sorted and associated with the erosional features of the beach.

The seasonal changes in textural characteristics of the sediments, along with the changes in morphology of the beach foreshore reflects the changes in oceanographic conditions as outlined by Trask (1956). Winds, waves and tides are the important factors for the movement of the material on the beach and the resultant form of the beach profile (King, 1972). Therefore, the forcing environmental process variables like winds, waves and tides are also considered as they are responsible for the beach morphological changes along this coast

(Nayak, 1986). Among these, the force of wind generated surface waves is the primary oceanographic factor for the changes in the beach morphology. The predominant waves from west and southwest (during SW monsoon season) are responsible for the severe erosion of the beaches along this coast during June to August (Nayak, 1986). During the other season the waves observed are comparatively low in their height and steepness and therefore helps for the deposition and development of the beach.

However, the waves received by Killebag beach are secondary in nature (observation) which are formed due to the refraction of primary waves at Binge point (Veerayya and Pankajakshun, 1987) also probably due to control of primary wave energy by Anjidiv Island. Therefore the changes observed in size characteristics as well as morphology are comparatively smaller in magnitude but the trend of variations in grainsize, standard deviation and morphology are similar to the general variation trend reported by Veerayya (1972) and Nayak (1986). The minor changes from the general variation trend like deposition during July can be explained by longshore current transport in pocket beaches and around head lands, recently carried out in this area by Veerayya and Pankajakshun (1987). From this study it is clear that in the sheltered beach like Killebag the pattern of variations of morphology and grainsize parameters are similar to the general trend but with a lesser magnitude. It is also clear from the present study that the Killebag beach is stable with net deposition of 0.75 m^3/m.

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Fig.1

Map of Karwar Coast showing Killebag Beach

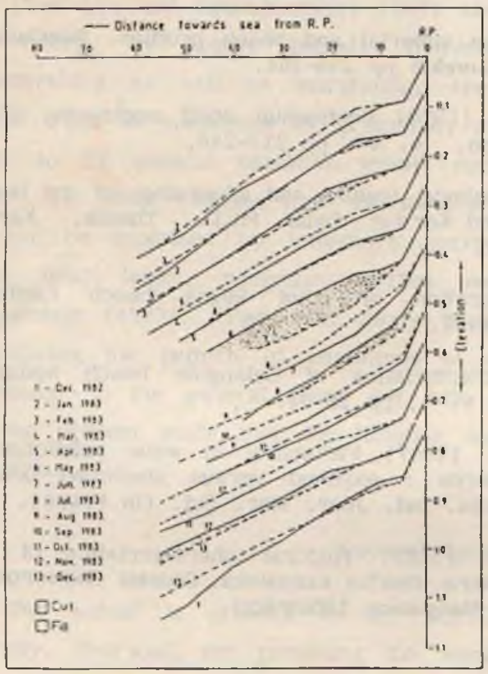


Fig.2

Monthly beach profiles with cut and fill at Killebag Beach.

Fig.3

Monthly variation in Graphic Mean and Inclusive Graphic Standard Deviation from December, 1982 to December, 1983 at high, mid and low tide levels.

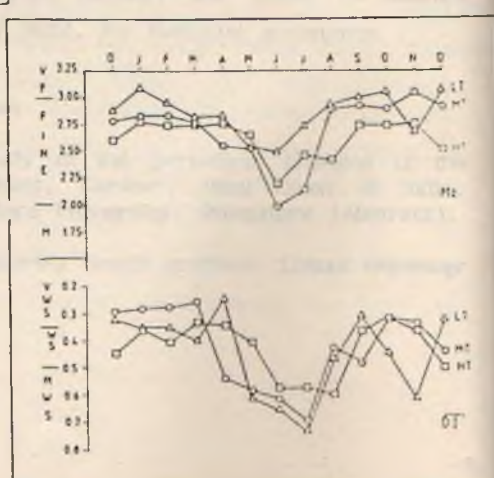
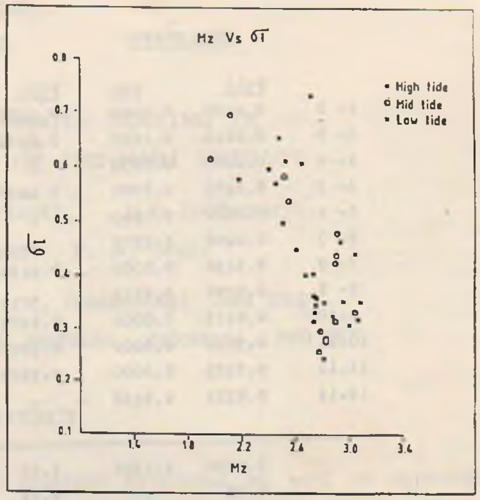


Fig.4

Bivariate plot of Mean Size (Ø) Vs Inclusive Graphic Standard Deviation.



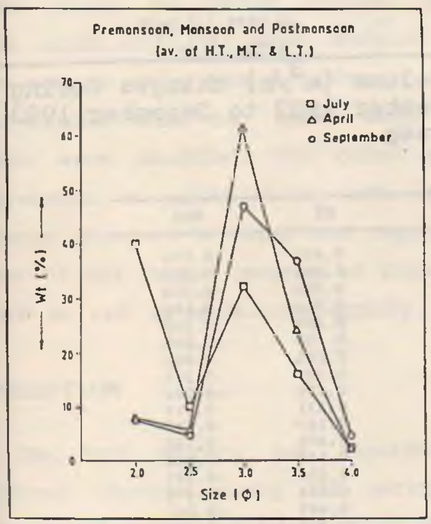
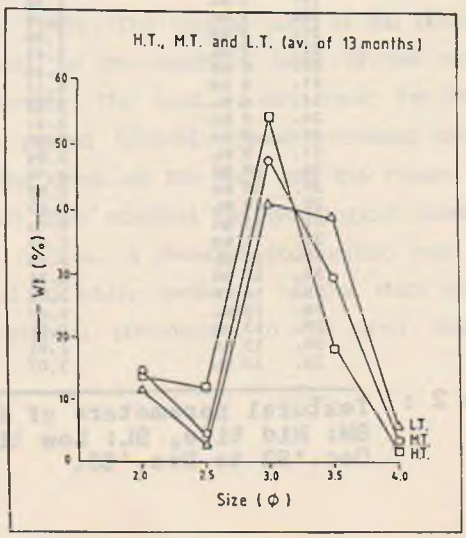


Fig.5

Seasonal frequency distribution curves of average foreshore sediments for different size grades.

Fig.6

Frequency distribution curves of average sediment samples in different size grades for different levels.



	FROM GRAPH		TOTAL		APRIL	= 0
	Fill	Cut	Fill	Cut	D_1	-0.8675
1- 2	0.6600	0.0000	0.6600	-	J	-0.2075
2- 3	0.1925	0.1250	0.0675	-	F	-0.1400
3- 4	0.0275	0.3750	-	0.3475	M	-0.4875
4- 5	0.4875	0.0000	0.4875	-	A	±0.0000
5- 6	0.0200	0.0900	-	0.0700	M	-0.0700
6- 7	0.0000	1.6575	-	1.6575	J	-1.7275
7- 8	0.5150	0.0000	0.5150	-	J	-1.2125
8- 9	0.0700	0.3925	-	0.3225	A	-1.5350
9-10	0.9475	0.0000	0.9475	-	S	-0.5875
10-11	0.2050	0.0000	0.2050	-	O	-0.3825
11-12	0.7575	0.0000	0.7575	-	N	+0.3750
12-13	0.0225	0.5150	-	0.4925	D_2	-0.1175
	3.9050	3.1550	3.64	2.89	Net change	
	0.75	-	0.75	-	D_2-D_1	
1-13	0.8625	0.1125	0.75	-	-0.1175 + 0.8675	
					0.75	

Table 1 : Monthly beach volume (m^3/m) changes during the period from December 1982 to December 1983 at the Killebag Beach.

S.No.	SAMPLE No.	M_z	σI	SKI
1.	1 BH	2.61	0.450	-0.174
2.	1 BM	2.79	0.294	0.356
3.	1 BL	2.88	0.326	0.028
4.	2 BH	2.77	0.358	0.186
5.	2 BM	2.83	0.282	0.550
6.	2 BL	3.09	0.350	-0.065
7.	3 BH	2.74	0.405	0.068
8.	3 BM	2.83	0.279	0.516
9.	3 BL	2.96	0.352	-0.056
10.	4 BH	2.75	0.331	0.177
11.	4 BM	2.78	0.257	0.573
12.	4 BL	2.82	0.400	0.168
13.	5 BH	2.76	0.344	0.188
14.	5 BM	2.56	0.538	-0.231
15.	5 BL	2.81	0.246	0.478
16.	6 BH	2.68	0.403	-0.061
17.	6 BM	2.53	0.585	-0.255
18.	6 BL	2.54	0.613	-0.297
19.	7 BH	2.19	0.577	-0.174
20.	7 BM	1.98	0.616	0.175
21.	7 BL	2.49	0.655	-0.281
22.	8 BH	2.46	0.571	-0.289
23.	8 BM	2.13	0.696	0.246
24.	8 BL	2.73	0.733	-0.226
25.	9 BH	2.41	0.598	-0.269
26.	9 BM	2.90	0.425	-0.231
27.	9 BL	2.94	0.465	-0.343
28.	10 BH	2.74	0.362	-0.012
29.	10 BM	2.92	0.481	-0.269
30.	10 BL	3.00	0.308	-0.051
31.	11 BH	2.74	0.314	0.177
32.	11 BM	2.90	0.314	0.009
33.	11 BL	3.05	0.443	-0.224
34.	12 BH	2.76	0.361	0.045
35.	12 BM	3.05	0.331	-0.115
36.	12 BL	2.67	0.608	-0.321
37.	13 BH	2.51	0.500	-0.286
38.	13 BM	2.91	0.440	-0.319
39.	13 BL	3.07	0.318	-0.069

Table 2 : Textural parameters of Killebag Beach. (BH: High tide BM: Mid tide, BL: Low tide, 1 to 13 : Months from Dec.'82 to Dec.'83.