SEDIMENT TREND MATRIX ANALYSIS ALONG SHORE NORMAL TRANSECTS OFF SURATHKAL BEACH, KARNATAKA

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In order to study sediment travelling paths across shoreline in different seasons, sediment samples were collected normal to the shoreline along three profiles, separated by 220m from Surathkal beach near Karnataka Regional Engineering College (K.R.E.C.), Karnataka. The sediments were analysed for their grain size characteristics (statistical parameters) and sediment trend matrix was prepared. By using sediment trend matrix, sediment travelling paths were drawn. It has been found that during premonsoon, sediments were moving predominantly towards offshore region, resulting in erosion. Sediments were moving predominantly towards shore and build-up of beach takes place during the post monsoon season.

Introduction

Characterization of beach sand is useful in understanding the genesis of beach sediments and to identify sediment environment. Therefore study of sediments in beach has acquired great importance in recent years. Sediment movement and distribution along and towards the shore has an important bearing on the location and design of man made structures like breakwaters, jetties, specialized berths and navigational works such as dredging of channels etc.

The mean grain size, sorting, and skewness of a sedimentary deposit are dependent on the sediment grain size distribution of its source and the sedimentary properties of i) winnowing (erosion), ii) selective deposition of the grain size distribution in transport, and iii) total deposition of the sediment in transport. If a source sediment undergoes erosion and the resulting sediment in transport is deposited completely, the deposit must be finer(F), better sorted(B), and more negatively skewed(-) than the source (Case I). The lag remaining after erosion, must be coarser (C), better sorted (B) and more positively skewed (+) compared to the source (Case II). If the sediment in transport undergoes selective deposition then the resultant deposit can be either finer (F) (Case IIIA) or coarser (C) (Case IIIB) than the source, but the sorting will be better (B) and the skewness is more positive (+). In a system of related environments, these trends can be used to identify both the probable source and the probable deposit and hence the net sediment transport paths among sedimentary deposits (Patric McLaren, 1981). Such an analysis provides information on sedimentary processes and sediment transport-paths and identifies pattern of erosion and accretion.

Area of Study

Dakshina Kannada (D. K) coast, situated along the west coast of India lies between Talapadi (12° 45' 30" N, 74°52' E) in the south and Mulki (13°5' N, 74°47' 30" E) in the north covering a distance of about 40 km as shown in Fig.1. The rivers in the D.K. district originate in the western ghats, flow westward and take almost a right angle bend near the coast and then flow either northward or southward close to and parallel to the coast before joining the Arabian Sea. It is also seen that two or more rivers join together before they discharge into the Arabian Sea. The D.K. district receives an average annual rainfall of 3940 mm (K.R.E.C. Study Team, 1994).

The predominant wave direction in this area is west or northwest and occasionally southwest. Waves reaching upto 6.5 m in height have been recorded off this coast (Dattatri, 1973). Waves during non-monsoon months are generally less than one m in height. The area selected for the study is the beach adjacent to K.R.E.C., Surathkal and the observations were made at three different profiles, each separated by 220 m at (i) KREC Beach Road (KBR), (ii) Mukka Beach Road (MBR) and (iii) Mukka Beach (MB). The morphology of the study area along with locations of soundings and sampling for KBR is shown in Fig.2.

Methodology

Sediment samples were collected by hand grab method within a depth of 5 cm from the seabed (Krumbein and Pettijohn 1938) normal to the shoreline at 10 m to 30 m interval from shoreline to offshore bar with the help of local divers along three different profiles mentioned above during pre-monsoon and post-monsoon season during the years 1995 and 1996. About 30 samples were collected

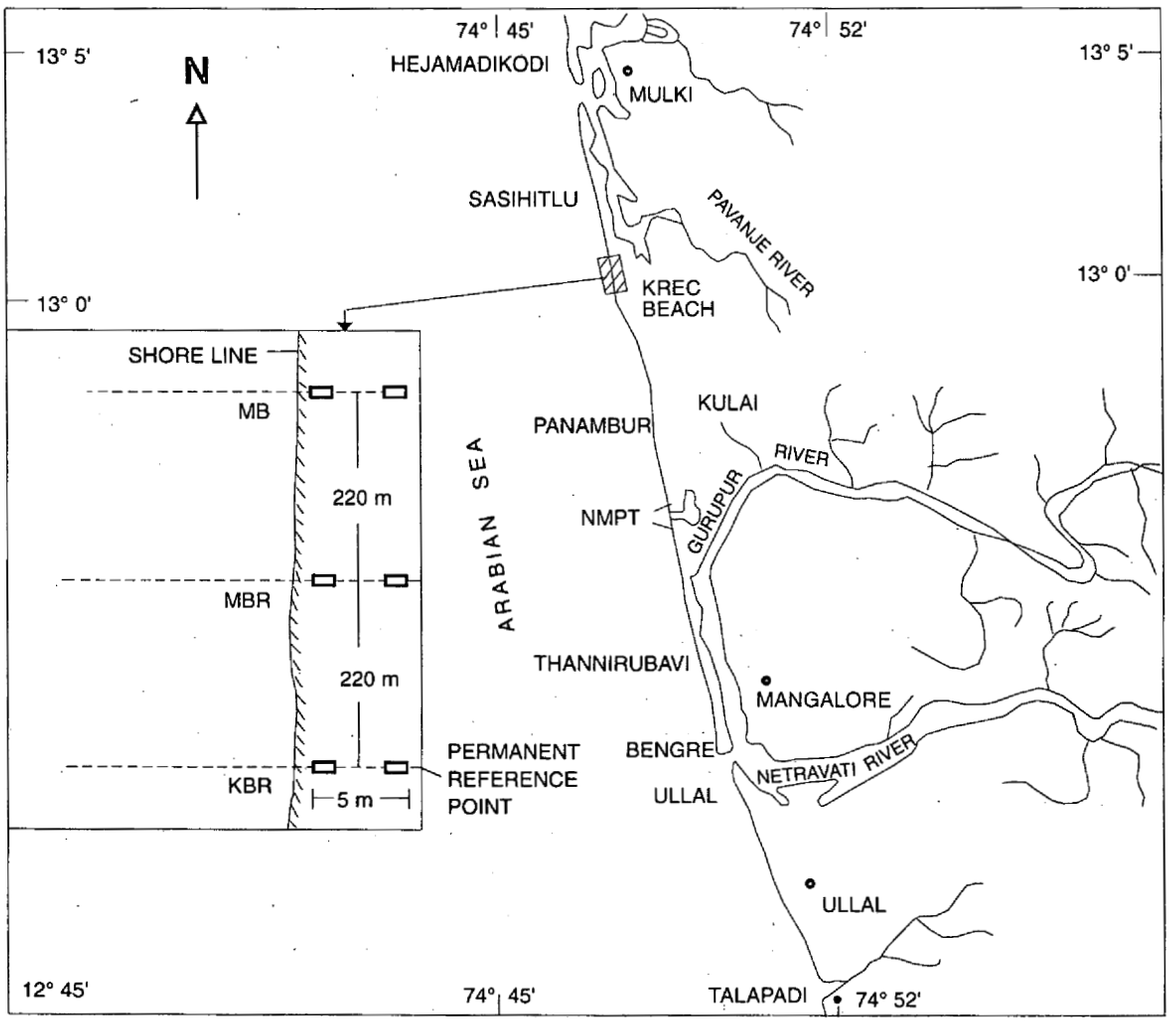

Fig.1. Location of the study area.

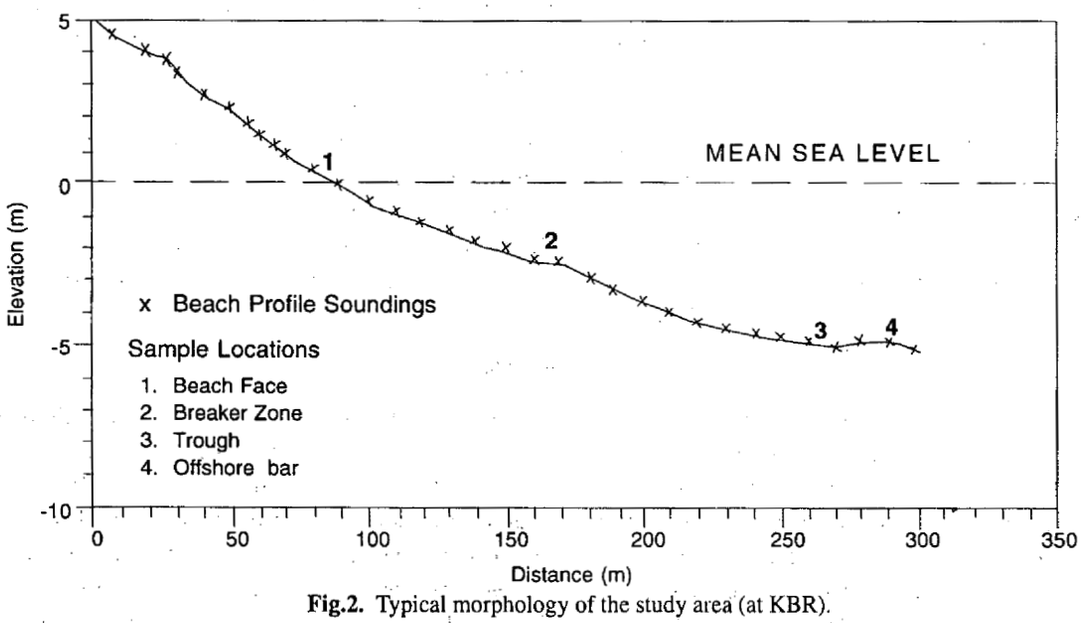

Fig.2. Typical morphology of the study area (at KBR).

along each profile. However, after analysing the sea bed profiles at the above locations during pre- and post-monsoon seasons, only four representative samples from the typical sub-environments like, beach face, breaker zone, trough and offshore bar were selected for drawing sediment trend matrix and the sediment travelling paths. The samples collected were washed and dried and sieved on a Ro-top machine using I.S. sieves spaced at half phi interval. Log probability plots were prepared with grain size (phi) on x-axis and the cumulative percentage coarser on y-axis. Statistical parameters like mean, standard deviation and skewness for the samples were computed using the formula given by Folk and Ward (1957). Due to lack of space, only the values corresponding to samples collected at KBR during pre-monsoon and post-monsoon of year 1996 are given in Table 1.

From the grain size statistics the sediment trend matrix, as suggested by Patric Mc Laren (1981) was prepared for each profile. The sediment trend matrix has been used to obtain the sediment travelling paths.

Results and Discussion

Table 2 and Table 3 show sediment trend matrices for the profile KBR during pre- monsoon and post-monsoon seasons of 1996, which is also the relative grain size statistics. Sediment trend matrix for the remaining profiles during pre- and post- monsoons were also prepared and the sediment travelling paths for all the three profiles were drawn and are as shown in Fig. 3 and Fig. 4. The sediment trend matrix (Table 2) and the sediment travelling paths for the profile at KBR (Fig. 3) during pre-monsoon season suggest that :

i) Beach face could be a sediment source for the breaker zone and offshore bar,
ii) Breaker zone could be a sediment source for the offshore bar, iii) Trough could be a sediment source for breaker zone and offshore bar. It indicates that during pre-monsoon period, the predominant sediment movement direction is from beach face towards the offshore. This kind of movement occurs when the waves are approaching with their crest parallel to the coast. This movement results in the temporary erosion of coast during pre-monsoon season. The sediment from the beach face is removed and is deposited in the breaker zone and offshore bar area. Similarly, sediment travelling paths can be identified for the profiles at MBR and MB from Fig. 3.

From the sediment trend matrix (Table 3) and the sediment travelling paths (Fig. 4) during post-monsoon period, the following sediment exchanges can be inferred for the profile at KBR : i) Beach face could be a sediment source for the breaker zone, ii) Trough could be a sediment source for the beach face, breaker zone and offshore bar, iii) Offshore bar could be a sediment source for the beach face and breaker zone. Similarly, sediment travelling paths can be identified for the profiles at MBR and MB as shown in Fig.4.

During post-monsoon season, the predominant direction of sediment movement is from offshore towards beach face which results in beach build up. Hence there is temporary accretion of beach during post-monsoon season. The sediments from the trough and offshore bar area are brought to beach face by the waves during this period. Thus from the study of sediment movement paths and field observations (K.R.E.C. Study Team, 1994) one can conclude that, at the beaches in these locations, the sediment which is removed from the beach face during pre-monsoon period, will be brought back by the waves during the post-monsoon season. This erosion - accretion processes is only temporary or seasonal and it can be said that the beaches of the study area are in the state of dynamic equilibrium.

Conclusions

The methodology of sediment trend matrix can be successfully applied to identify the sediment movement paths. In the study area during pre-monsoon, sediments were moving predominantly towards the offshore. During post-monsoon, sediments were predominantly moving towards the beach face. The stretch of beach considered for the

Table 1. Grain size statistics for the samples from different sub-environments collected at KBR during pre-monsoon(PR-M, 25.5.1996) and post-monsoon (PS-M, 02.11.96)

Sub environment	Mean (phi)		SD (phi)		Sk (phi)	
	PR -M	PS -M	PR M	PS -M	PR -M	PS-
Beach face	1.123	2.393	0.583	0.570	-0.591	-0.078
Breaker zone	1.300	2.440	0.530	0.512	-0.127	-0.238
Trough	1.170	1.903	0.680	0.691	-0.343	-0.045
Offshore bar	1.323	2 .060	0.491	0.637	-0.197	-0.116

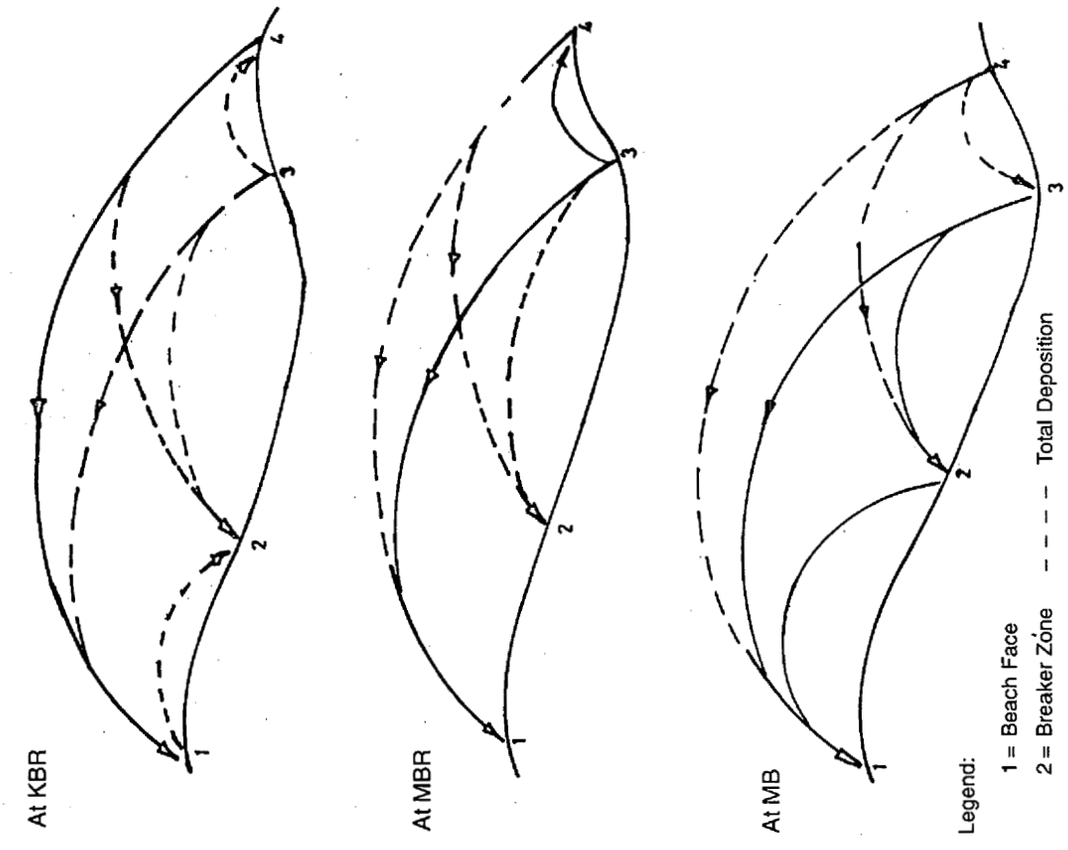

Fig.3. Sediment travelling along three profiles at KREC Beach Road (KBR), Mukka Beach Road (MBR) and Mukka Beach (MB) during pre-monsoon (25.05.1996)

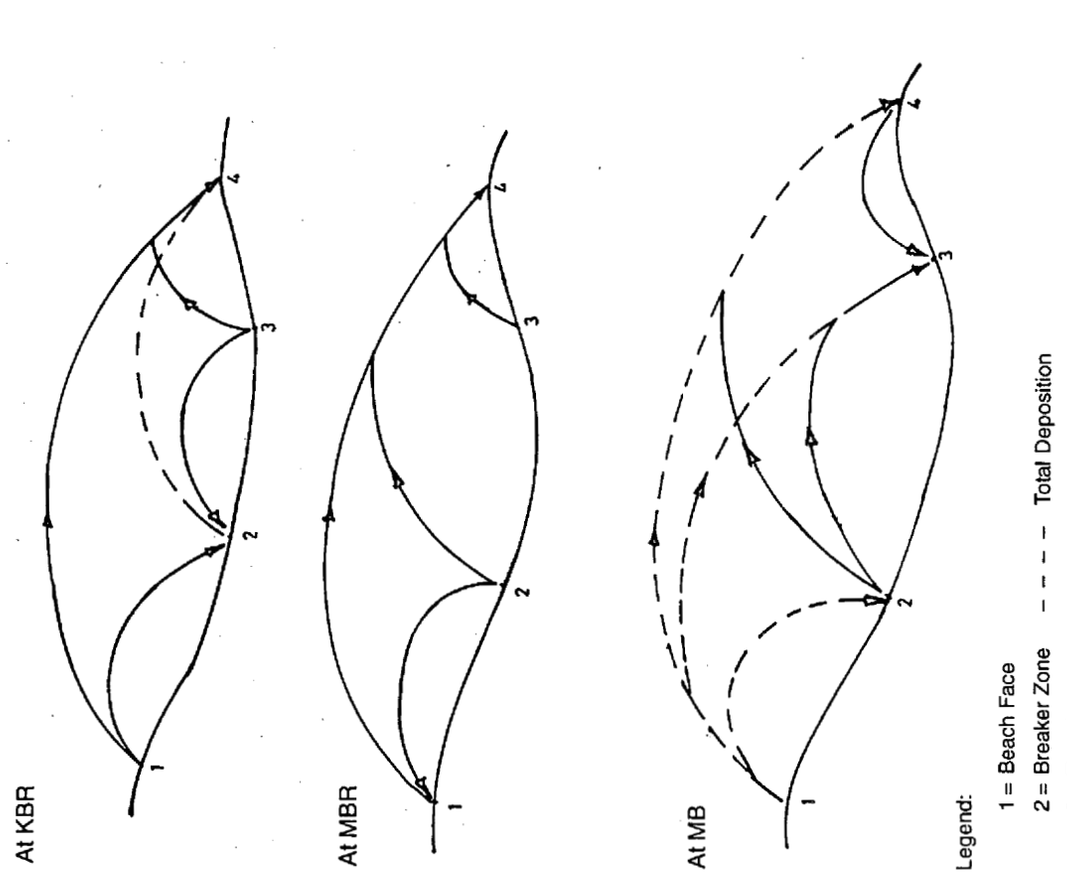

Fig.4. Sediment travelling along three profiles at KREC Beach Road (KBR), Mukka Beach Road (MBR) and Mukka Beach (MB) during post-monsoon (02.11.1996)

Table 2. Sediment trend matrix at KBR during pre-monsoon (25-5-1996)

	Sediment Source				
Sediment Deposit	Sub environment	Beach face	Breaker zone	Trough	Offshore bar	Grain size characteristics
	Beach face		C P -	C B -	C P -	Mean (phi) SD (phi) Sk (phi)
	Breaker zone	F B +		F B +	C P +	Mean (phi) Sd (phi) Sk (phi)
	Trough	C P +	C P -		C P -	Mean (phi) (Sd (phi) Sk (phi)
	Offshore bar	F B +	F B -	F B +		Mean (phi) SD (phi) Sk (phi)

P – poorly sorted

Table 3. Sediment trend matrix at KBR during post-monsoon (02-11-1996)

	Sediment Source				
Sediment Deposit	Sub environment	Beach face	Breaker zone	Trough	Offshore bar	Grain size characteristics
	Beach face		C P +	F B -	F B +	Mean (phi) SD (phi) Sk (phi)
	Breaker zone	F B -		F B -	F B -	Mean (phi) Sd (phi) Sk (phi)
	Trough	C P +	C P +		C P +	Mean (phi) (Sd (phi) Sk (phi)
	Offshore bar	C P -	C P +	F B -		Mean (phi) SD (phi) Sk (phi)

study is in dynamic equilibrium as the sediment which is removed from the beach face during pre-monsoon, will be brought back by the waves in the post-monsoon months. This erosion - deposition processes is only seasonal.

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