

Topography & Sedimentary Characteristics of the Sandy Beach of Kavaratti (Lakshadweep)— A Premonsoonal Study

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During the southwest monsoon beach sediments on the western coast of Kavaratti are transported from the southern tip of the island to its northern tip. After the monsoon the littoral current reverses and the redistribution of the sediments takes place gradually. However it is observed that during the period of study complete recovery of the beach material is not taking place.

An ecological imbalance of the lagoon area along the Kavaratti Island was created due to the removal of coral rocks from the reef and lagoon bed for carving out a shipping channel inside the lagoon. This created a series of erosions of the beaches on the northern side. Since any amount of erosion would be detrimental to the atoll considering the size and location of the island in the open sea this study was taken up to assess the amount of erosion or accretion and the stability of the beaches.

Materials and Methods

Kavaratti is a flat sandy island with a 'storm beach', on its western side and sandy beach enclosed by a lagoon on the western side. The storm beach is covered with coral rock and boulders, whereas the sandy beach is of unconsolidated finely powdered coral, lesser amounts of shell fragments and coral pieces. The sandy beach is subjected to seasonal variations in its topography and physical characteristics.

Beach profile data and sediments along the beach were collected during Feb., April and June 1983. Ten stations were chosen for the study (Fig 1). Beach profiles were measured using a graduated pole and a measuring tape during the low tide of the day. In the present study 3 observations were made at an interval of 2 months, hence the data for beach profiles are given for Feb.-April and April-June. Sediment samples at 5 m intervals along each profile were collected from the upper 4 cm of the surface layer as outlined by Mason and Folk². Period and direction of the wave along with the breaker height were estimated visually during this period. Direction and speed of the littoral current was estimated by the fluorescent dye method. The width of the swash zone was also estimated.

The volume of material eroded or accreted for a meter length of the beach at each of the stations was computed using actual or arbitrarily defined basal and

near planes as described in Bird³. Sediment samples were subjected to grain size analyses using a set of sieves of aperture sizes — 2, — 1, — 0.25, 0.5, 1, 1.4, 2, 2.5, 3, 3.5 and 4 ϕ . The fractions of each sieve were weighed and the statistical parameters mean and skewness were computed from the cumulative frequency curve of each sample⁴.

Results

Beach profiles (Fig.2) show the topographical features and the erosional and accretional tendency of the beach during the study period. The beach slope

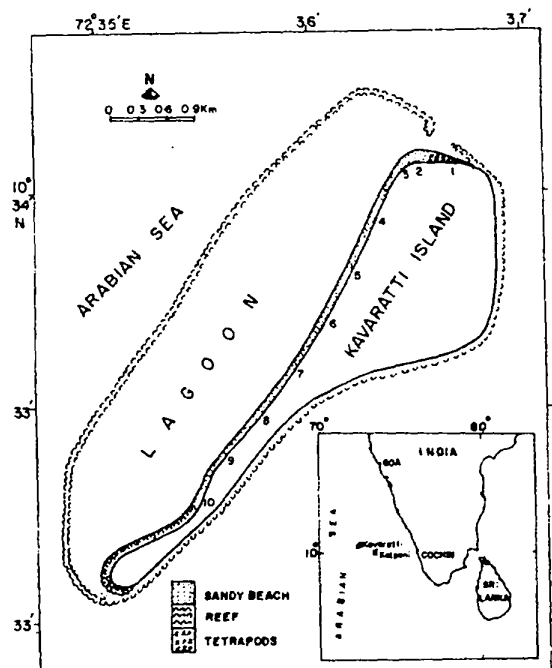


Fig. 1— Location of stations

eventhough it is uniform, shows a gradual increase in steepness towards sts 6 to 10. Generally the profiles do not show the presence of berm, except for a portion of the beach between sts 1 and 2. At st 1 a berm is formed along with the accretion during June. At the same time sts 9 and 10 exhibit step like formations due to erosion. Though there is accretion at sts 1-7 during Feb.-April the rate is considerably less except at st 1 ($5 \text{ m}^3 \text{ m}^{-1}$). During April-June there is a good amount of accretion at sts 1 to 4 (3 to $10.6 \text{ m}^3 \text{ m}^{-1}$) and erosion at other stations (-0.89 to $-2.04 \text{ m}^3 \text{ m}^{-1}$).

Isolines of mean grain size and skewness of sediments at each station is shown in Figs 3-5. The finer sediments ($> 2 \phi$, Figs 3B, 4B, and 5B) are present in the backshore regions above the high water mark (HWM) throughout the study period. The coarser sediments ($< 2 \phi$) are generally seen below the HWM. However in Feb. a tongue of coarser sediments ($< 2 \phi$) extends into the backshore between sts 4 and 6 and between sts 8 and 10. The tongue of coarser material between sts 4 and 6 disappears by April and the area is filled with finer materials.

The finest materials of size $> 2.4 \phi$ are seen just above the HWM (Fig.4B). By June the gradient of the sediment size becomes minimum and the spread of the finest sediments over the entire area of the beach is complete.

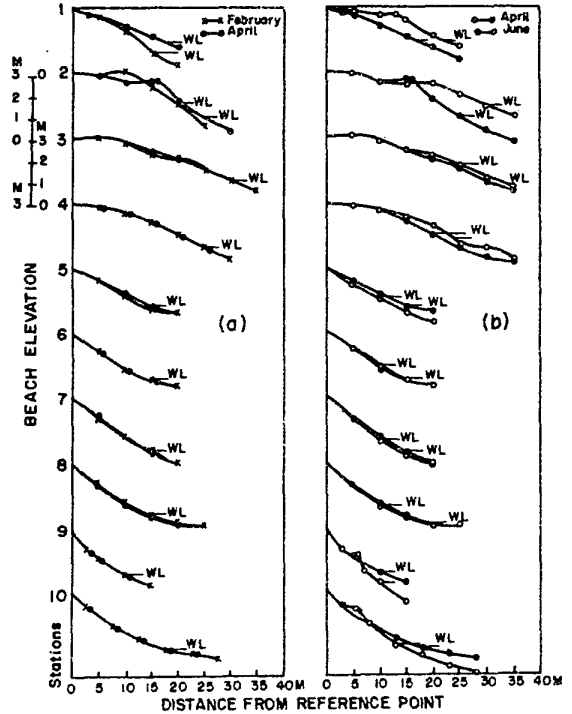
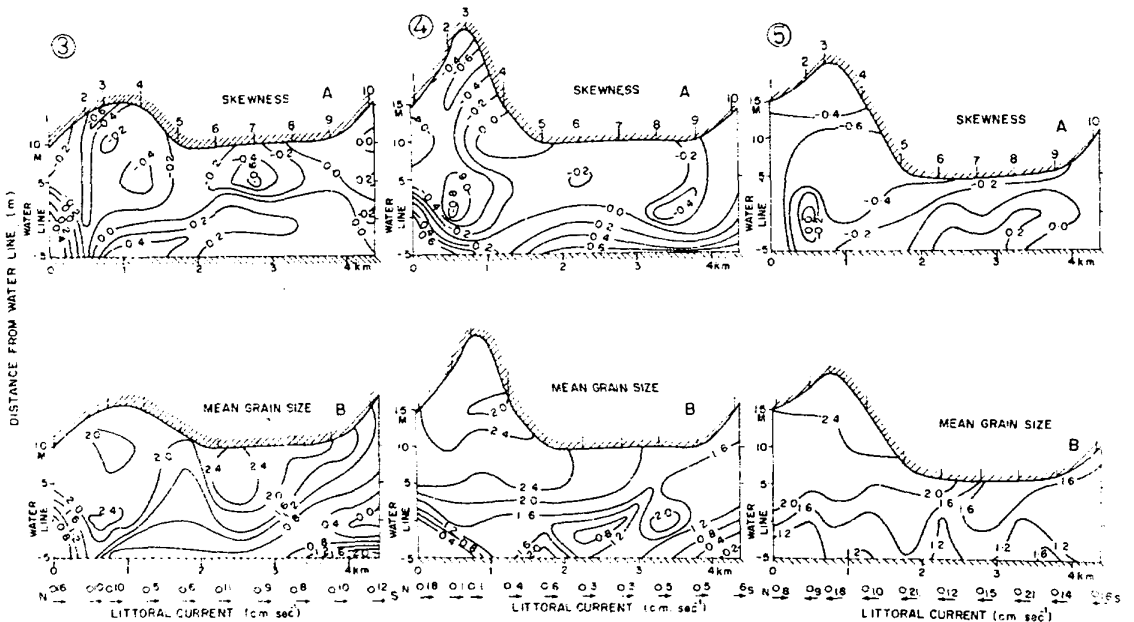


Fig. 2— Beach profiles of (a) Feb. and April (b) April and June 1983



Figs 3-5-- Spatial distribution of graphic skewness(A), mean grain size(B) and littoral current in (3) Feb.(4) April and (5) June 1983

In Feb. normal to positively skewed sediments (Fig.3A) are found in the foreshore, while backshore sediments are positively skewed. By April the skewness value (Fig.4A) decreases considerably between the LWM and 5 m mark above at sts 1-3, while there is a general increase in the skewness value from backshore to foreshore between sts 4 and 8. By June, widely placed contours show a more uniform distribution of skewness (Fig.5A) in the region.

Discussion

In Kavaratti atoll, the coral reef formation and the lagoon between the island and the coral reef act as a barrier for wave action on the western side of the island, as a result of which a sandy beach has formed on this side. During SW monsoon (June-Sept.) a certain fraction of high waves cross over the reef and their energy is dissipated on the shores of the island. The direction of approach of these waves (period 8 to 9 sec) in the lagoon varies from SW to W. The visually observed breaker height of 60 cm at sts 1,2 and 9,10 gradually decreases towards the other stations. In the premonsoon period (Feb.-May) the waves pass through the entrance channel (Fig.1) approaching from N and NE directions with a maximum breaker height of 50 cm at sts 1 and 2. The littoral current in the lagoon is the product of the above mentioned wave climate and is directed from S to N during June (Fig.5B).

The continued presence of northerly directed littoral currents during the monsoon causes a general transport of sediments from the southern tip of the island to its northern tip on the western side of the island. The distribution of sediment pattern observed during Feb. is the result of the monsoon distribution. It is quite evident from Fig.5B that the finer fractions have been carried out from sts 8-10 and deposited between sts 2 and 3. Also there is a general transport of sediments from st 1 to the region between sts 2 and 3. The beach profile data also show that there are wider

beaches between sts 2 and 3, being regions of deposition. The positive skewness of the foreshore region during Feb. also confirms that the area is a region of deposition.

However after the monsoon the littoral current reverses its direction and is from N to S during Feb. and April (Fig.3B and 4B). The distribution of sediment pattern observed during June, before the intensive impact of the monsoon is the postmonsoonal effect of the littoral current. There is a redistribution of sediments from N to S and finer sediments occur uniformly all along the beach from sts 1 to 10. There is thus a cyclic movement of the sediments from N to S and again from S to N. However, it is observed that complete recovery does not seem to take place at the southern end stations.

Duane⁵ has shown that skewness is environmentally sensitive and negative skewness is characteristic of coastal environment that is undergoing erosion and non-deposition. In the present case negative skewness is found in the backshore regions and positive skewness in the foreshore regions indicating erosion in the beach in the past and accretion presently, which further shows that the beach has become somewhat stable to the wave regime of this region. Hence any disturbance in the sediment budget of this region is bound to affect the present stability of the beaches.

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