TEXTURAL REFLECTIONS OF THE ISKAPALLI LAGOON, EAST COAST OF INDIA

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In order to understand the sediment dynamics of the Iskapalli lagoon, located in northern part of the Penner delta, east coast of India, grain size parameters were analyzed for 36 sediment samples from tidal channel, lower and upper lagoons. Sediment distribution pattern indicates that tidal channel is mostly occupied by sand, lower lagoon by mixed clayey sand and sandy mud and upper lagoon mostly by clayey sand.

Introduction

General morphology and evolution of the Iskapalli lagoon on the East Coast of India were studied by Seetharamaiah and Gandhi (2000). However, surface sediment distribution and its response processes were not established. This is attempted in the present study.

Methods of Study

Thirty six surface sediment samples were collected from the lagoon area (Fig.1a) using Peterson grab during a field survey carried out in March, 2000 in a mechanized country boat. These samples were first desalinized and dispersed with sodium hexametaphosphate. The dispersed wet samples were then air-dried, thoroughly mixed and utilized for textural analysis by standard procedures of sieving and pipetting (Carver, 1971). The grain size parameters *viz.* mean size, standard deviation, skewness and kurtosis were calculated using the procedure of Folk and Ward (1957). Sand, silt and clay proportions of each sample were also estimated.

Geomorphology of the Lagoon

The Iskapalli lagoon is located in the northern part of Penner delta and separated from the sea by a 4 km long prograded sand spit but is connected to it through a tidal inlet. A comparison of Survey of India toposheets (No. 66B/2) for the years 1917 and 1974 reveals growth of the spit and changes in the morphology of the lagoon. The length of the sand spit was about 2 km in 1917 (Fig.1b), but by 1974 (Fig.1c), the spit has grown 6 km long with two openings, one at the middle of the spit (southern mouth) and the other at the northern extremity of the lagoon. Subsequently, the spit length reduced from 6 km to 4 km and the northern mouth became inactive. However, at present, the southern mouth has shifted towards north and is active with to and fro tidal flow. The present spit with a total length of 4 km and a width of 120 to 180 m lies 1-2 m above the mean sea level. The tidal inlet north of the spit is 150 to 200 m in width and 1 to 2.5 m in water depth. Formation of sand dunes on the sand spit indicates stabilization.

For convenience, the lagoon is described as three entities, namely, tidal channel, lower lagoon and upper lagoon. The tidal channel is bound on one side by the prograded sand spit and on the other (western side) by the lagoonal island (Holocene sand ridges). The lower lagoon is wide with a maximum water depth of 3.5 m and is abounded by thick mangrove vegetation on western side and paleo sand ridges on southern margin. The Paideru river flows seasonally and joins the lower lagoon at the southern side. The upper lagoon having < 1m water depth lies between the lagoonal island, abundant with dense uniform mangrove vegetation of <2 m height on the east and salt pans of Iskapalli and Kurrupalem villages on the western side. Tidal water enters the upper lagoon only during high tides as this part is getting silted up slowly.

The lagoon is disturbed by human interference. The upper lagoon is separated into two segments by a road laid in 1996 to freely access the lagoonal island. Most of the mangrove vegetation around the lagoon has been removed and the land including the island has been sadly converted into aquafarms. Reduced tidal flow along with subdued fresh water input from local irrigation canals and ephemeral Paideru river result in higher concentration of shells in the lower and upper lagoons (Suryabhagavan, 2000). As this lagoon is one of the important remnants of transgression of the sea during the Holocene period with well recorded and preserved imprints of the sea level oscillations, there is an urgent need to protect the natural lagoon from human interference for short term gains.

Textural Characteristics

The sediments of tidal channel consists of 70-94% sand, 2-15% of silt and 1-5% of clay and the lower lagoon 60-90% sand, 5-20% silt and 5-20% clay. The upper lagoon sediments comprise 60-90% sand, 4-18% silt and 6-30%

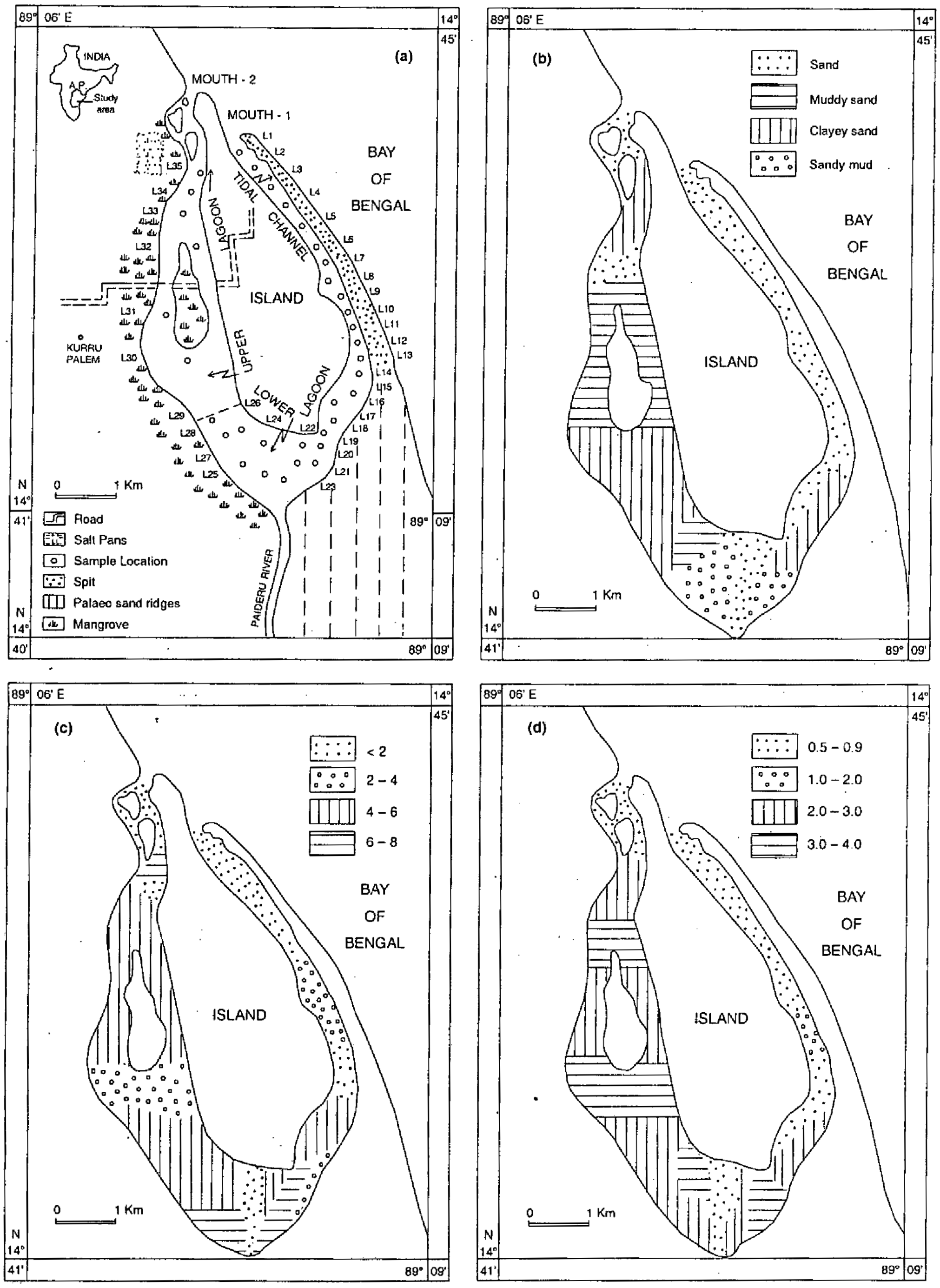

Fig.1. (a) Sample locations. (b) morphology of the lagoon in 1917. (c) morphology of the lagoon in 1974 and (d) textural distribution pattern.

clay. A high sand content is observed at the channel of the lagoon, whereas, in relatively deeper areas, a high content of silt with clay is observed. The sediment texture (Fig.1b) reveals that the tidal channel is occupied by sand, the lower lagoon by clayey sand and sandy mud and the upper lagoon mostly by clayey sand. Though the lower lagoon is deeper, sand also occurs in it, as the Paideru river draining from paleo sand ridge areas and joining the southern margin contributes much of the sand. Sand occurrence at the northern mouth and clayey sands adjacent to it indicate that tidal inflow into the lagoon takes place only during highest high tides.

The distribution pattern of phi mean size of the lagoon sediments is shown in Fig.2a. The tidal channel is composed

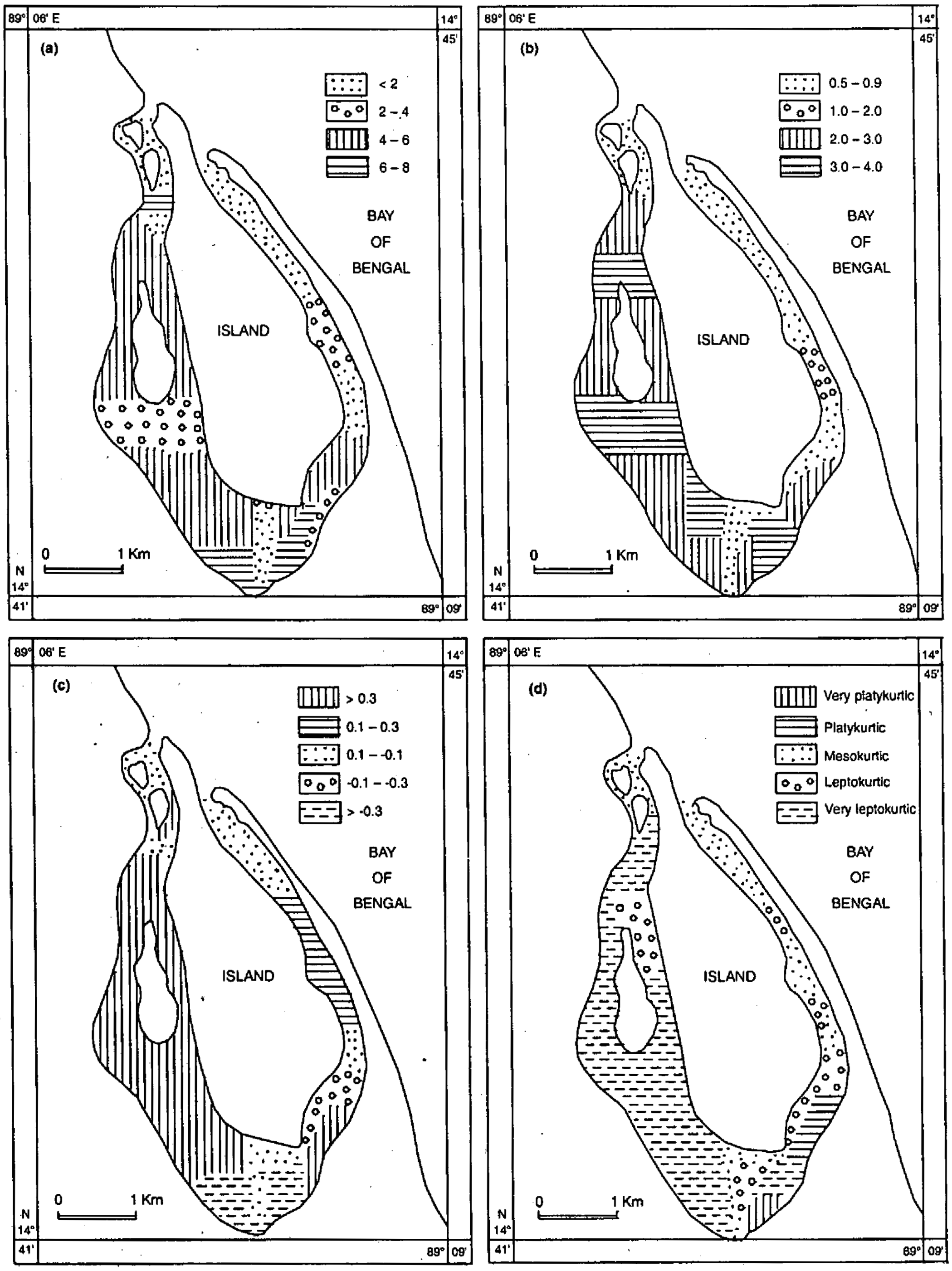

Fig.2. Distribution pattern of **(a)** phi mean size **(b)** standard deviation **(c)** skewness and **(d)** kurtosis of the Iskapalli lagoon sediments.

of fine to medium sand with phi mean size varying from 1.35 to 3.29. The lower lagoon is composed of mixed sediments from sand to sandy mud (2.11 to 7.69 ϕ) and the upper lagoon from sand to clayey sand (1.92 to 6.10 ϕ). A gradual increase of fine mode from tidal channel to upper lagoon can be noticed. In the tidal inlet channel, tidal and wave generated currents create churning action on the bottom which ultimately results in the removal of fines from the area and their subsequent deposition in calm areas, i.e., lower and upper lagoons. The sediments are well sorted in the tidal channel with standard deviation values ranging from 0.67 to 0.91 (barring that of two samples), whereas poorly sorted in lower and upper lagoons with standard deviation values ranging from 2.97 to 3.78 (Fig.2b). The energy

Table 1. Textural characteristics of the Iskapalli lagoon sediments

Sam. No	Phi mean size	Standard Deviation	Skewness	Kurtosis	Texture
L1	1.35	0.67	0.02	1.08	Sand
L2	1.47	0.76	-0.01	1.01	Sand
L3	1.84	0.82	0.08	0.96	Sand
L4	1.35	0.74	-0.05	0.95	Sand
L5	1.97	0.66	0.04	0.99	Sand
L6	1.75	0.71	-0.09	0.86	Sand
L7	3.29	0.62	-0.29	1.34	Silty sand
L8	2.56	1.21	0.19	0.98	Sand
L9	2.12	1.23	0.28	1.04	Sand
L10	2.22	1.16	0.29	1.01	Sand
L11	2.12	1.06	0.25	1.02	Sand
L12	1.81	0.91	0.19	1.17	Sand
L13	1.72	0.77	-0.04	0.98	Sand
L14	1.59	0.80	0.04	1.03	Sand
L15	2.15	0.87	-0.06	1.25	Sand
L16	1.54	0.67	-0.15	1.2	Sand
L17	5.61	2.97	0.41	0.88	Clayey sand
L18	2.11	2.91	0.53	2.54	Clayey sand
L19	3.47	3.52	0.63	2.4	Clayey sand
L20	7.69	2.56	-0.42	0.69	Sandy mud
L21	7.20	0.79	-0.10	0.99	Sandy mud
L22	2.20	0.79	-0.10	0.99	Sand
L23	1.86	0.91	-0.12	0.77	Sand
L24	2.42	3.10	0.50	2.42	Muddy sand
L25	7.90	2.46	-0.46	0.89	Sandy mud
L26	2.42	2.65	0.45	2.39	Clayey sand
L27	5.96	2.12	0.41	0.88	Clayey sand
L28	5.74	2.96	0.67	2.47	Clayey sand
L29	5.63	2.00	0.42	2.18	Clayey sand
L30	5.78	2.12	0.44	2.02	Clayey sand
L31	3.20	3.03	0.55	2.64	Muddy sand
L32	5.69	2.97	0.30	1.55	Sand
L33	1.92	2.61	0.06	3.46	Clayey sand
L34	4.96	1.74	0.55	0.92	Clayey sand
L35	6.10	3.78	0.65	3.36	Clayey sand
L36	1.45	0.79	0.04	1.05	Sand

generated from the tidal currents flowing into the lagoon through the tidal inlet gradually decreases towards the lower and upper lagoons resulting in poor sorting. Because of mixing of coarser sediments brought by Paideru river and the fine sediments by the tidal currents, the lower lagoon sediments show very poor sorting.

In the tidal channel of the lagoon, the sediments are symmetrical to positively skewed in contrast to negatively skewed sediments in the lower lagoon, while the upper lagoon again exhibits very positively skewed sediments (Fig.2c). The predominance of fine sand mode coupled with a lesser amount of silt and clay mode seems to result in the very positive skewness of the sediments of the tidal channel. Friedman (1967) and Cronan (1972) noted that polymodel sediments can show variable skewness values depending on the specific proportion of component populations. Thus, the varying skewness values in different segments of the lagoon may be due to the mixing of different proportions of silt and clay mode with sand mode. The kurtosis values reflect the fluctuations in the flow characteristics of the depositing medium. It is evident from Fig.2d that a majority of the tidal channel sediments of the lagoon are essentially mesokurtic, whereas most of the lower and upper lagoon samples are very leptokurtic.

Conclusions

The sediments of the tidal channel, lower and upper lagoons are distinct in textural characteristics. Due to the closure of the tidal inlet in the north coupled with bifurcation of the upper lagoon into two segments by a road laid to freely access the lagoonal island, the upper lagoon is likely to get silted up in near future. Therefore, there is an urgent need to protect the natural lagoon from human interference for short-term gains.

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