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SOIL STRUCTURE IN CLAM BEDS OF MULKY ESTUARY, KARNATAKA

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ABSTRACT:

Sediment properties of Mulky estuary were studied. Various parameters like, Sediment Temperature, pH, Texture, Organic carbon, and interstitial salinity were observed. The data established that sediment characteristics vary throughout the study period in the estuary.

KEY WORDS: *Sediment characteristics, Texture, Organic carbon, pH, Temperature.*

I. INTRODUCTION

Estuaries are regions of fundamental importance with respect to chemical processes occurring on the global scale, for they represent major route whereby lithospheric material had transported to the oceanic mentary domain [1]. The studies of marine processes have paved the way for predicting the geochemical behaviour of each individual element.

For efficient management of estuaries, knowledge of sedimentation and textural variation is of vital importance. The sediment acts as the reservoir of nutrient replenishment of these nutrients in times of need and their consequent renewal greatly helps in the biological cycle of the system. Such an exchange of nutrients depends upon the characteristics of the sediment and hydrographic features of the estuary. The distribution and abundance of benthic organisms are primarily influenced by the sediment texture characteristics.

Estuary sediments are derived from the river watershed and the continental shelf in front of the estuary. Lesser sources are erosion within the estuary, biological activity and eolian transport. The distribution of sediment facies is controlled by interaction between the available sediments, bottom morphology and flow hydrodynamics. Both landward transport of sediments by tidal currents and river inflow supply sediment to an estuary. In river dominated estuaries, equilibrium has been achieved and variation in sediment volume fluctuates with the river flow [2]. Sedimentation in estuaries is within three distinguishable regimes estuarine fluvial, estuarine estuary, estuarine marine. These sequences interfinges with fluvial and marine sediments at the inner and outer limits of the estuary respectively [3].

II. MATERIALS AND METHODS

Study Area:

The confluence of the Mulki and Pavanje rivers with the Arabian Sea leads to the formation of Mulki estuary. The Mulki estuary (lat. 13° 4' N and long. 74° 17' E) is situated at about 45 km north of Mangalore. The estuary is connected to the sea throughout the year and is subjected to tidal influence to the tune of 1.86 m affecting the water to a length of 6.0 km in Mulki river. The bottom is generally sandy with muddy stretches in the deeper areas. In the present study, four stations have been selected in the predetermined clam beds as shown in Fig. 1.

Figure 1. Location of sampling stations in the Mulki Estuary.

Sediment temperature:
Immediately after collection of sediment samples, the temperature was recorded by precision grade thermometer.

Sediment pH
Sediment pH was estimated by using pH meter (Model WTW pH 320).

Sediment texture
Dried sediment samples were weighed accurately and transferred into a 250ml beaker. The samples were made salt free by washing in distilled water Approximately 50 ml of 10% sodium hexameta phosphate solution was added to the sediment and soaked overnight. Subsequently, the samples were wet sieved through a 62µm sieve. The sand fraction retained on the sieve was dried and weighed. The mud fraction was collected in a 1000 ml beaker and transformed to a 1000ml measuring glass cylinder and subjected to pipette analysis. [4]. Dried sand was stirred for sand fractions analysis.

Sediment organic carbon
The organic carbon content of the sediment was determined by the method given by [5]. The results were expressed in percentage of organic carbon in dry sediment.

Interstitial salinity
Interstitial salinity was estimated by following the methodology given by [6] and presented as mg Cl^- /100 gm soil.

III. RESULTS

Sediment temperature:
The monthly sediment temperature values varied between 29.67 to 29.98 ^{0}C. In general, sediment temperature followed the same trend of water temperature showing trimodal distribution with a primary peak during October, second peak during in the month of February and a third peak was

recorded in the month of May Low temperatures were recorded during monsoon period and varied from 27.0 to 28.9 ^{0}C. Temperature increased from the later part of August onwards to reach first peak (30.3^{0}C) in early October. Temperature of the sediments declined gradually from October and continued to reduce till December and remained till January. From January on wards sediment temperature reached second peak of 32.04^{0}C (S3, February) and reached third peak (33.2^{0}C) after reducing in the month of April. Seasonally, low to medium temperature values were recorded in monsoon months and high temperatures were recorded in premonsoon season in Mulki estuary.

The pH followed the general trend with minor variations. The mean monthly pH values varied from 7.70 to 7.86. In general, high values were recorded during pre -and post monsoon periods. The peak was recorded (7.92, S3) during later part May. Lower values were recorded throughout the monsoon season. The pH showed an increasing trend throughout post and pre-monsoon seasons. Immediately after the commencement of monsoon the sediment pH values showed a declining trend and remained in the same trend throughout the monsoon season in Mulki estuary

Organic carbon:

The variations in the organic carbon content of sediments of selected stations during the period of investigation are given in. Organic carbon at different stations varied from 1.31 to 1.37% during the period of investigation. In general, the peaks of organic carbon values at different stations were observed during October, November and May (1.91, 1.89, 1.63) respectively.

Peak value at station S1 was observed in the month of October and at stations S2, S3, S4 in the months of November and October respectively. Lower values were recorded during the months of July, August and February. Station S1 recorded comparatively higher values in Mulki estuary.

Soil texture:

Percentages of different sediment fractions are presented in Figure 5 and Table 1. In general, the estuarine sediments under the present investigation contained mainly sand (80%) with low percentage of silt and clay constituting the of total components of the sediments.

Sand:

The minimum percentage of sand in the total sediment composition recorded at stations S1, S2, S3and S4 were 87.95%, 90.96%, 74.54% and 77.53% respectively. During the pre- and post monsoon seasons, the mean percentage sand was 89.57± 3.26.

Silt:

The silt content was the second highest after sand. The maximum silt content recorded was 6.72 % in the month of August at S3 station and the minimum was recorded in the month of August at station S4. In general, station S3 recorded higher values of silt with uniform percentage than the rest of the stations.

Clay:

Clay fractions of the sediment recorded in high percentages in station S4 during the sampling period and evenly distributed. Maximum clay content in the sediment was recorded in the month of September (20.99 %) and the minimum was recorded in the month of December (0.13%) with total mean of 6.45±3.04 %. In the rest of the stations fraction of clay was recorded in lower percentages.

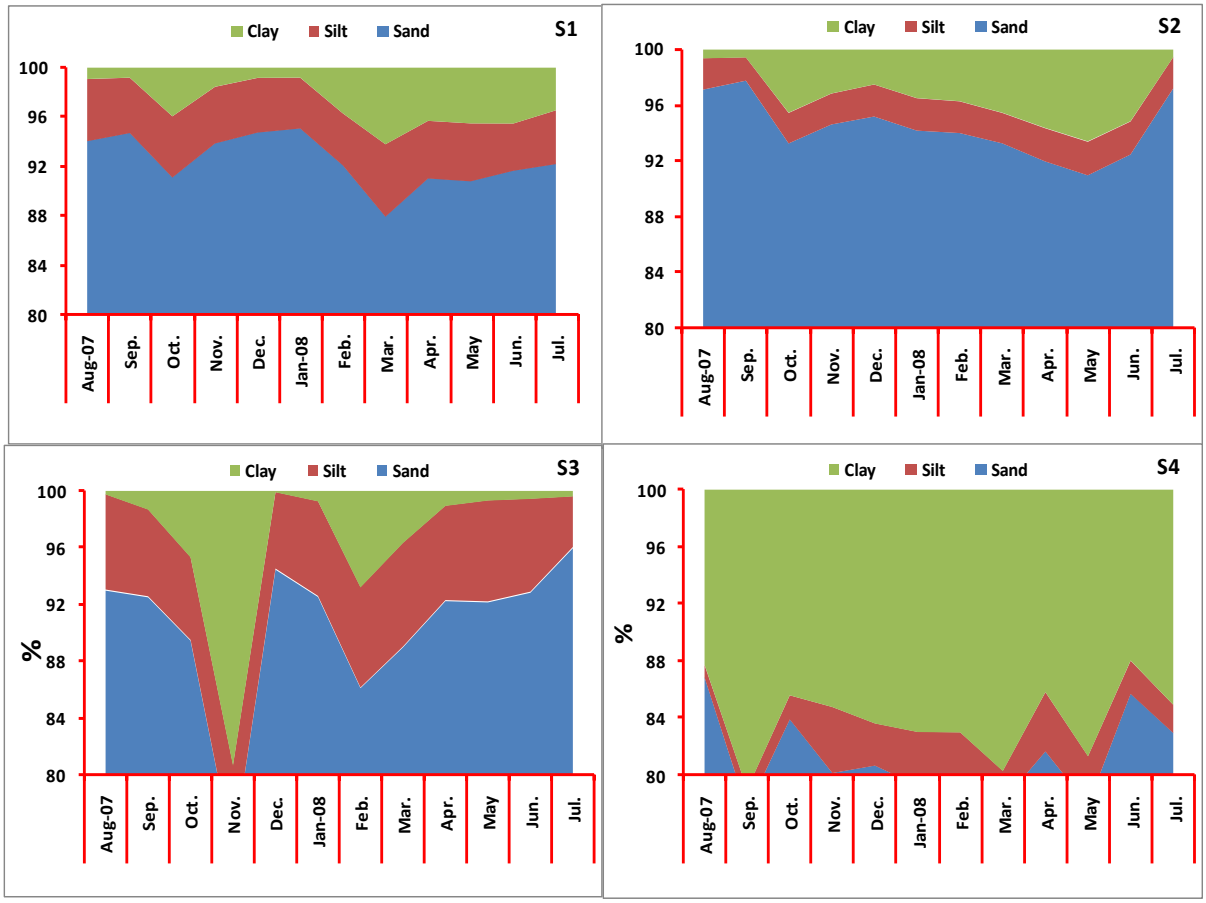

Fig.5. Percentage distribution of sand, silt and clay at different stations in the clambeds of Mulki estuary.

Table1: Sediment composition (%) at different stations in the clambeds of Mulki estuary.

Stations	Composition	Monsoon		Post monsoon				Pre monsoon				Monsoon		Mean	SDV
		Aug-07	Sep.	Oct.	Nov.	Dec.	Jan-08	Feb.	Mar.	Apr.	May	Jun.	Jul.		
S1	Sand	94.05	94.70	91.11	93.86	94.74	95.07	92.09	87.95	91.04	90.81	91.66	92.20	92.44	2.12
	Silt	5.02	4.47	4.94	4.57	4.41	4.10	4.21	5.86	4.65	4.68	3.82	4.34	4.59	0.52
	Clay	0.94	0.83	3.95	1.57	0.85	0.83	3.70	6.20	4.31	4.52	4.53	3.46	2.97	1.87
S2	Sand	97.11	97.75	93.25	94.61	95.18	94.17	93.99	93.25	91.96	90.96	92.45	97.20	94.32	2.16
	Silt	2.26	1.68	2.19	2.22	2.30	2.33	2.28	2.18	2.38	2.41	2.37	2.25	2.24	0.19
	Clay	0.63	0.57	4.57	3.18	2.52	3.51	3.73	4.57	5.66	6.64	5.18	0.55	3.44	2.05
S3	Sand	93.01	92.53	89.46	74.54	94.49	92.56	86.11	88.99	92.26	92.17	92.86	96.01	90.41	5.64
	Silt	6.72	6.13	5.84	6.13	5.39	6.68	7.09	7.32	6.66	7.12	6.56	3.58	6.27	1.02
	Clay	0.28	1.34	4.70	19.33	0.13	0.76	6.81	3.69	1.08	0.71	0.59	0.42	3.32	5.46
S4	Sand	86.84	77.53	83.89	80.13	80.65	79.24	78.81	78.13	81.64	77.88	85.69	82.94	81.11	3.12
	Silt	0.88	1.49	1.70	4.64	2.97	3.79	4.19	2.17	4.18	3.45	2.33	2.00	2.81	1.22
	Clay	12.28	20.99	14.41	15.23	16.38	16.98	17.01	19.71	14.19	18.68	11.98	15.07	16.07	2.78

Interstitial salinity

High interstitial salinity was recorded during the post monsoon and premonsoon season and low values in monsoon seasons. Two peaks at all the stations were observed during the post monsoon season (January) and pre monsoon season (May).

Intestinal salinity values were was low during monsoon months and ranged between 8.02 to 348.33 mg Cl^-/100gms of soil. In the post monsoon season , the values ranged from 164.12 to 690.87 mg Cl^-/100gms of soil and in premonsoon season the values fluctuated between 491.73 (February at S1) and 774.76 (S4 in May). The interstitial salinity values were 774.76 at S4 in the month of June and a low of 98.02 mg Cl^-/100gms of soil in the month of August at station S2. In general, station S1 recorded higher values of interstitial salinity as compared to other stations. The average values ranged from 430.37 ±268.13 to 365.53 ± 267.97 mg Cl^-/100gms of soil in Mulki estuary

Discussion

During the study period the sediment temperature fluctuated between 27.05 ^{0}C and 32.40 ^{0}C. The minimum temperature of sediment was found to be slightly lower than that of the surface water. While, maximum temperature of sediment was found to be almost similar to that of the maximum temperature of surface waters. [7, 8, 9, 10] observed a slight increase in sediment temperature in the estuaries of Dakshina Kannada. Similar results were recorded by [11, 12, 13] in Mulki estuary. The seasonal distribution of sediment temperature revealed a gradual decrease in the values during southwest monsoon season. During pre monsoon period the sediment exhibited two peaks, while in pre monsoon, it exhibited an increasing trend with a peak in May. Thus it was clear that the sediment temperature in the Mulki - Pavanje estuary exhibited by and large a trimodal distribution. [14, 15] have recorded unimodal seasonal oscillation of sediment temperature in Nethravati-Gurupur estuary.

The pH is the only parameter which not only changes the chemical property of the interstitial habitat but also influences the benthic community structure. The variations in pH of the sediments also generally followed the changes observed in the overlying water. During the present study maximum pH was recorded in the month of May while uniform pH values were recorded in almost all the months during the study period. The difference between the stations was not marked. [16, 12] while working on the benthos in the coastal waters of Dakshina Kannada have documented slightly higher values of pH which fluctuated from 7.60 to 8.00, whereas [8] observed pH ranged between 6.05 and 8.45. [15] recorded the sediment pH which ranged from 6.80 to 8.00 in Nethravati-Gurupur estuary. [17] documented gradual increase of sediment pH from inshore to offshore regions in the coastal waters of Versova, Bombay.

The organic carbon represents the availability of organic matter in the sediments and this has significant role in aquatic productivity by providing various essential chemical compounds. The bottom sediment into which the dead organic matters get deposited undergoes chemical and bacterial decomposition and thereby releases the nutrients. Organic matter in sediments is derived from primary production within aquatic ecosystem (autochthonous sources) and also from terrestrial biota (allochthonous sources) by transport of leached and eroded materials [18]. In the present study organic carbon in the sediment varied from 0.55 to 1.91 %. [11] documented organic carbon in Mulki estuary, which varied from 0.01 to 1.65 %. Similar range of organic carbon was recorded by [14, 19, 15] in Nethravati - Gurupur estuary,

The nature of soil or sediment governs the type of fauna and density which can exist at a given place and time. It is known that the meiobenthos and macrobenthos in the aquatic environment will be influenced by the texture of the sediment in which they establish themselves and live [20]. Sediments of Mulki estuary revealed a clear cut dominance of sand over silt and clay. The percentage contribution of silt and clay fractions did not exceed 25 % in the sediment. The colour of the sediment varied from brown to black. Working on the clam bed ecology in Goan estuary, [21] found the sediment to be predominantly the sandy throughout the post -and pre monsoon season. [22] While studying the sediment characteristics of Cochin estuary stated that sediment texture in the estuary was influenced by the monsoon and mixing process in the environment. [23] Although observed dominance of sand in the sediment during monsoon and post-monsoon season they have documented higher percentage of silt and clay at some stations during monsoon and post-monsoon season in Mandovi estuary.

Interstitial salinity closely followed the conditions of the waters in the near bottom. Thus, the values were lower in the months of June and September. At all stations the salinity showed a gradual

increase and it continued to reach peak in the month of May. [24] Observed lowered interstitial salinity beneath overlying sea water even at high tide in Kames Bay, Millport. [25] Measured the interstitial salinity in the sediments in Pocasset river, Massachusets and found in spite of wide fluctuations in the near bottom water salinity, however sediment salinity remained in stable conditions. [26] Noted that the fluctuations of the salinity of the flowing waters tend to influence the interstitial salinity of sandy sediments to a greater extent than that greater quantum of muddy fractions.

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