Distribution of Foraminifera in Kadalundi River Mouth Sediments, Kerala

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Abstract— The present study was focused to assess the sediment distribution and depositional history of the study area (Kadalundi river mouth, Kerala), also to find the microfaunal presence in the study area, through that to understand the depositional history of foraminifera in the marginal marine system. For this study one core and 10 surface samples were collected in the Kadalundi river mouth. The 70 cm core was spillited into two halves and lithologged. 27 subsamples weregenerated from the core at an interval of 2.5 cm. Sand-silt-clay ratios estimated. Concentration of $CaCO_3$ ranges from 0.2% to 1.9% in the core sample. Whereas in the surface sediments the range between 0.2% - 0.9%. Top 25 cm sediments of the core sample more and less calcium carbonate and forams. From 20.5-50 cm depth the fine sediments are favour to enrich the foraminiferal population. Bottom sediment is rich in sand also moderately rich in reworked adult foraminifera and juvenile forams. This reflects the energy was high enough to carry larger fragments into the study area. The imbalanced energy causes the juvenile foraminiera become extinct.

I. INTRODUCTION

A coastal lagoon is defined as a shallow stretch of seawater such as a sound, channel, bay, or saltwater lake near or communicating with the sea and partly or completely separated from it by a low, narrow elongate strip of land, such as a reef, barrier island, sandbank, or spit (Bates and Jackson, 1980). Micropaleontological and paleoceanographic studies on coastal eastern Arabian Sea sediments are still in infancy. Several investigations on the carbonate sediments of the western continental shelf of India have been made in the last few decades. But, previous studies were mainly focused to record distribution of recent foraminifera along the Indian west coast (Antony, 1968; Rao, 1974; Bhatia and Kumar, 1976; and Nigam and Khare, 1999).

Textural analysis is one of the most important basic parameter to determine the mechanism of transport and deposition of sediments; grain size statistical parameters such as mean and standard deviation replicate the energy condition of the depositional environment (R.L. Folk, M.C. Ward, 1957: G.M. Friedman, 1961: G. Kumar *et.al.*, 2010).

Estuarine foraminiferal investigations in the Indian estuaries have received meager attention. Initially taxonomic and ecological studies of foraminifera on beaches and estuaries of eastern coast of India have been carried out (S. N. Bhalla, 1968, 1970).

II. STUDY AREA

Kadalundi River (Kadalundipuzha) is one of the four most important rivers flowing through Malappuram district in the Indian state of Kerala. Kadalundi river that serves as a borderline between the Kozhikode and Malappuram districts is 130kms in length with a drainage area of 1,099 sq.kms.

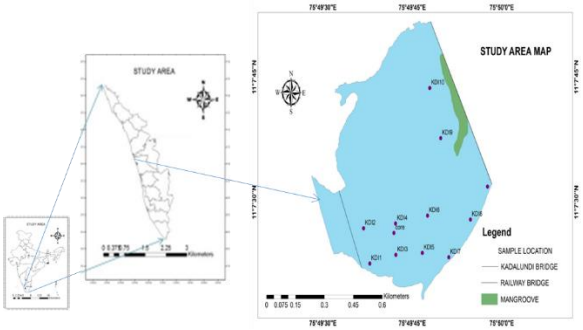


Figure 1. Study Area map

Sample details

Table.1. Latitude and Longitude of Surface Sample

SI.No	Sample No	Latitude	Longitude
1	KDIs-1	11°7 ’26.68”	75°49’37.85”

2	KDIs-2	11°7’26.9”	75°49’36.8”
3	KDIs-3	11°7’23.72”	75°49’42.22”
4	KDIs-4	11°7’27.47”	75°49’42.17”
5	KDIs-5	11°7’23.95”	75°49’46.66”
6	KDIs-6	11°7’28.4”	75°49’47.54”
7	KDIs-7	11°7’23.44”	75°49’51.11”
8	KDIs-8	11°7’27.94”	75°49’54.73
9	KDIs-9	11°7’37.68”	75°49’56.11”
10	KDIs-10	11°7’43.69”	75°49’59.75”

Table.2. Core Sample details

Sample No	Core Length	Water Depth	Latitude	Longitude
Core 1	70 cm	1 m	11°7’26.34”	75°49’41.89 ”

One core and ten surface samples were collected from different locations. Core sample was lithologged and subsampled. The core sample was subsampled into 27 subsamples at an intervel of 2.5 cm. The samples then processed for various sedimentological and micropaleontological analysis such as sand silt clay analysis, calcium carbonate analysis and foraminifera picking and identification studies. The procedure for sand silt clay ratio was carried out following the method described by Ingram (1970). The procedure for calcium carbonate analysis was carried out the following Rapid titration method described by Muller (1967).

Sand Silt Clay Analysis (Core Sample)

Table 3. Sand-Silt-Clay Analysis values (core sample)

DEPTH (cm)	SAND %	SILT %	CLAY %	SEDIMENT NATURE
2.5	85.2	4.8	10	Sand
5	78.2	11.8	10	Silty sand
7.5	82.8	7.2	10	Sand
10	85.8	4.2	10	Sand
12.5	84.2	5.8	10	Sand
15	61.4	18.6	20	Sand-silt-clay
17.5	76.4	3.6	20	Clayey sand
20	83.6	6.4	10	Sand
22.5	73.8	16.2	10	Silty sand
25	47.8	32.2	20	Sand-silt-clay
28	79.6	10.4	10	Silty sand
30.5	53.6	26.4	20	Sand-silt-clay
33	57	33	10	Sandy silt
35.5	67.6	22.4	10	Silty sand
38	21.6	58.4	20	Sand-silt-clay
40.5	44.2	45.8	10	Sandy silt
44	13.4	36.6	50	Silty clay
46.5	81.4	8.6	10	Sand
49	63.4	16.6	20	Sand-silt-clay
51.5	72.4	7.6	20	Clayey sand
53	62.8	17.2	20	Sand-silt-clay
55	54.4	15.6	30	Sand-silt-clay
58	64.4	25.6	10	Silty sand
61.5	54.6	15.4	30	Sand-silt-clay
63	66	24	10	Silty sand
65.5	87.2	2.8	10	Sand
69	87.6	2.4	10	Sand

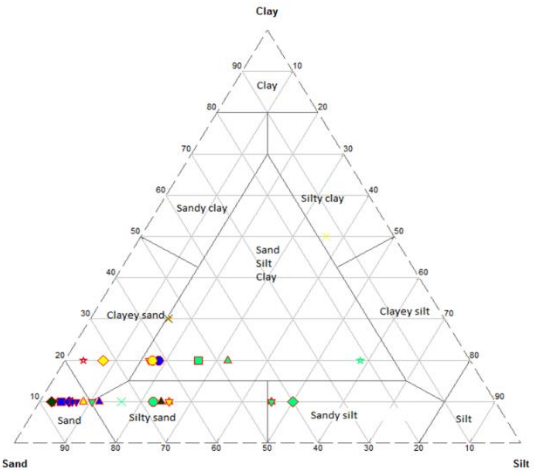


Figure .2 Triplot showing sand-silt-clay analysis for core sample

Sand-silt-clay analysis in core sample shows that the upper part of the core is dominated by sand and the concentration of silt and clay is less. The maximum amount of sand is seen at depth of 2.5, 7.5, 10, 12.5 and 20 centimeters. The nature of sediment is sandy.

In the middle part the mud is dominated than sand % and mud shows its maximum at a depth of 25, 30.5, 38, 40.5, and 44 centimeters. The sediment nature in the central part is sandy silt. The bottom again shows the dominance of sand and the sediment nature is silty sand and sand. The points in the plot also concentrated in the sand portion and some are fall under silty sand and clayey sand.

Sand Silt Clay Ratio (Surface Sample)

Table .4. Sand-Silt-Clay Analysis values (surface samples)

SAMPLE NO	SAND %	SILT %	CLAY %	SEDIMENT NATURE
KDIs-1	88	2	10	Sand
KDIs-2	67.2	12.8	20	Clayey sand
KDIs-3	78	2	20	Clayey sand
KDIs-4	83.6	6.4	10	Sand
KDIs-5	68	2	30	Clayey sand
KDIs-6	79.8	0.2	20	Clayey sand
KDIs-7	77	3	20	Clayey sand
KDIs-8	86	4	10	Sand
KDIs-9	98.8	1.2	0	Sand
KDIs-10	79	1	20	Clayey sand

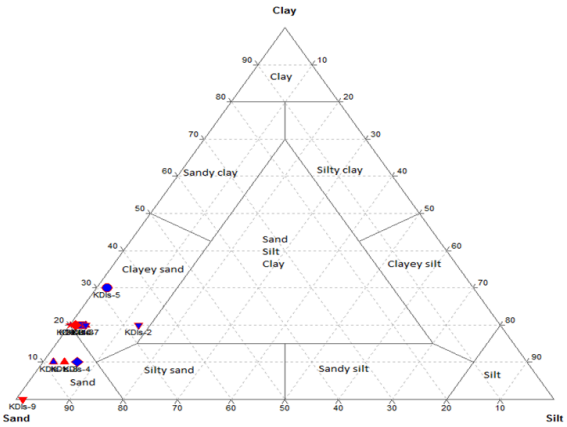


Figure 3.Triplot showing sand-silt-clay (surface samples)

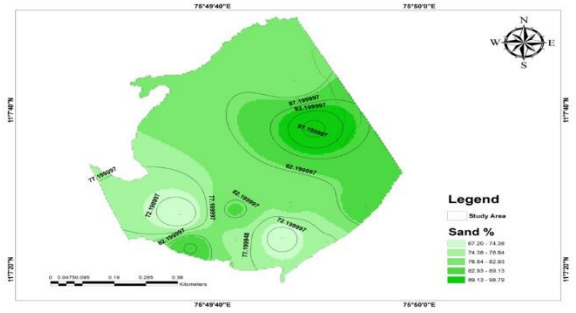


Figure 4**.** Surfer diagram showing distribution of sand in the study area

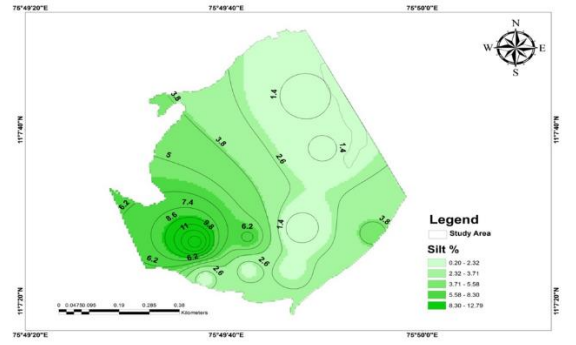


Figure 5. Surfer diagram showing distribution of silt in the study area

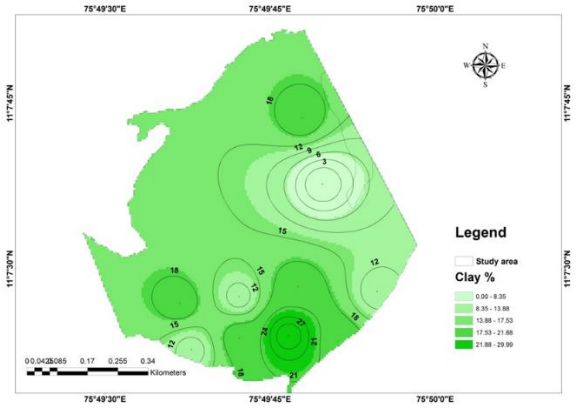


Figure 6. Surfer diagram showing distribution of clay in the study area

In surface sediments, sand shows maximum in the eastern part of the study area and moderate concentration in the south western part. Whereas sand is minimum in the south east and western part of the study area. Silt concentration shows maximum in the western part and minimum in the north and eastern part o the study area. Clay size sediments are predominant at the southern part of the study area.

Surface Sample

Table 5. CaCO3 Values (surface sample)

SAMPLE NO	$CaCO_3$ %
KDI 1	0.3
KDI 2	0.7
KDI 3	0.3
KDI 4	0.5
KDI 5	0.3
KDI 6	0.3
KDI 7	0.4
KDI 8	0.5
KDI 9	0.2
KDI 10	0.9

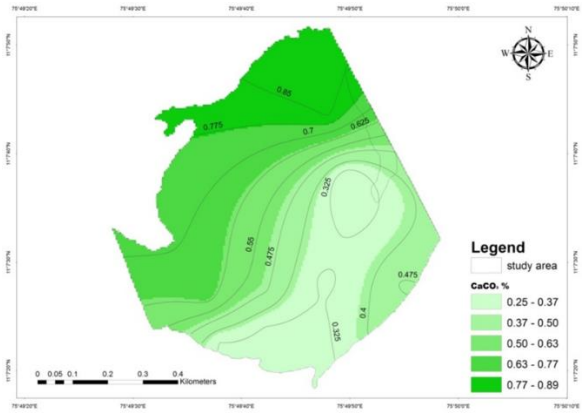


Figure 7. Surfer diagram showing CaCO3 distribution in the surface sediments

Calcium carbonate show maximum when sand is less and calcium carbonate is less where sand is maximum. Calcium carbonate is maximum at sample location 10 and minimum at sample location 9. This shows that the calcium carbonate is mainly from the shells of organisms. In general, $CaCO_3$ distribution in the study area is maximum in the northern and north western side and minimum in the south and southeastern side. Supply of CaCO3 may due to the dissolution of carbonate shell materials.

- Down core correlation

From this the sand and CaCO3 is showing negative correlation, i.e., as sand percentage increases the percentage of CaCO3 is decreasing and vise versa.

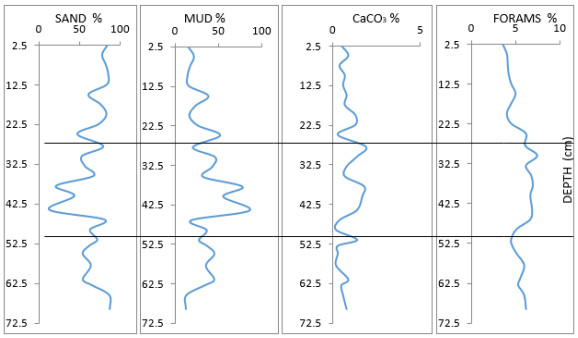


Figure 8.Graph showing down core correlation

In case of mud and $CaCO_3$, they are showing positive correlation, as the percentage of $CaCO_3$ increases the percentage of mud increasing. Also same in case of forams, it is negatively correlated with sand percentage and positively correlated to the mud and $CaCO_3$ percentage. From this we can understand that the $CaCO_3$ mainly from shells of organisms.

Top 25 cm sediments of the core sample more and less calcium carbonate and forams. From 20.5-50 cm depth the fine sediments are favour to enrich the foraminiferal population. This causes the CaCO3 enrichment in the middle of the core sediment. Bottom sediment is rich in sand also moderately rich in reworked adult foraminifera and juvenile forams. This reflects the energy was high enough to carry larger fragments into the study area. The imbalanced energy causes the juvenile foraminiera become extinct.

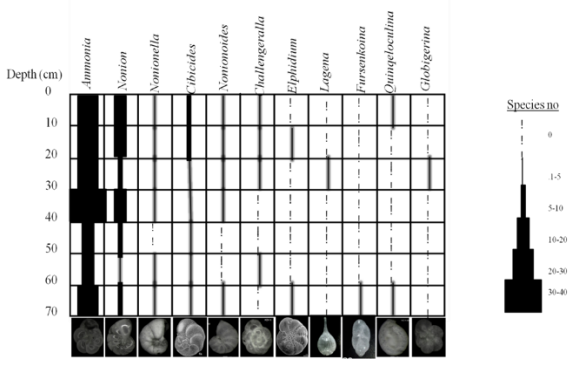


Figure 9.Down core distribution of foraminiferal in generic level

In down core variation, *Ammonia* shows its abundance from top to bottom and its maximum is at the centre. Minimum is at 40-60 cm depth. *Nonion* is present from top to bottom of the core, shows maximum at the top and centre, shows minimum at a depth of 50 cm.

Nonionella shows its presence from top to bottom and at a depth of 40- 50 cm it is absent. *Cibicides* is maximum at top and uniform after 20 cm till the bottom. *Nonionoides* are minimum in 40-60 cm and shows its presence through out the core. *Challengeralla* is minimum at middle and bottom and shows the presence in the top core sediments. *Elphidium* is dominant only at 10cm and bottom of the core. *Lagena* is present only at a depth of 20 cm. *Fursenkoina* is dominant only at the bottom of the core and *Quinqeloculina* is present at top and bottom of the core. *Globigerina* is present only at a depth of 20 cm.

- Distribution of Foraminifera in surface samples

In surface sample both benthic and planktonic foraminifera are seen. Most of them are juvenile and reworked forms which indicate the environment is not favourable for the growth of foraminifera due to the imbalance in energy.

Table 6. Foraminifera distribution in surface sample

	Ammonia	*Nonion*	*Nonionella*	*Cibicides*	*Nonionoides*	*Globigerina*
KDIS 1	13	10	2	0	0	0
KDIS 2	27	17	4	0	0	0
KDIS 3	8	0	0	3	0	0
KDIS 4	27	12	0	4	0	2
KDIS 5	15	4	0	2	0	0
KDIS 6	22	12	2	4	2	0
KDIS 7	15	4	0	5	0	0
KDIS 8	12	6	0	8	2	0
KDIS 9	3	0	0	0	0	0

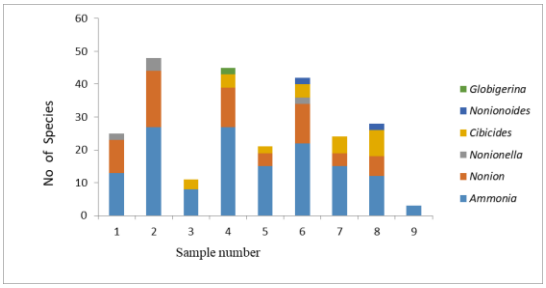
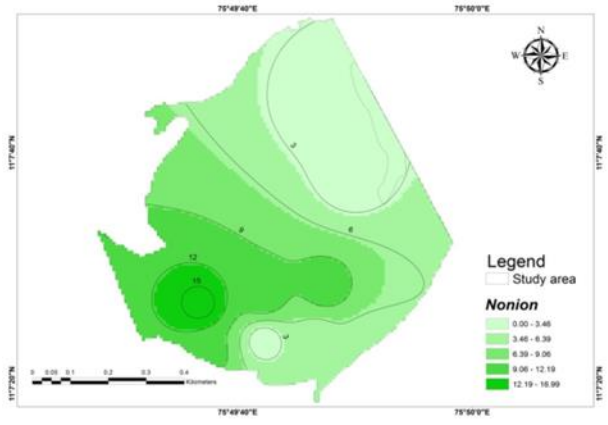
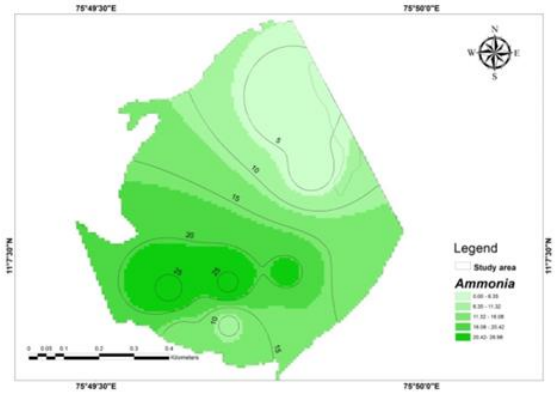


Figure 10.Bar diagram showing generic level distribution in surface sediments



A



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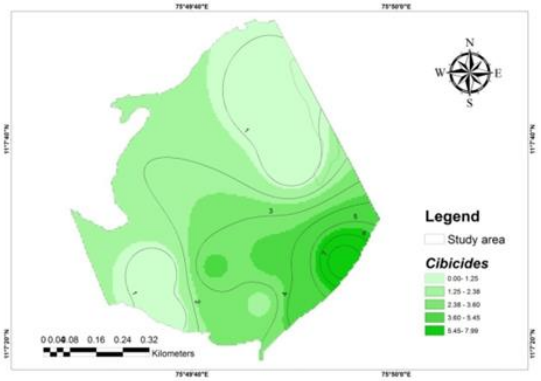

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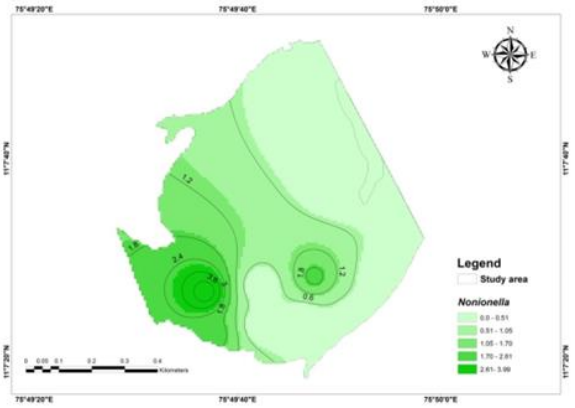

D

Fig.11. Surface distribution of A. *Nonion,* B. *Ammonia,* C. *Cibicides,* D. *Nonionella*

Nonion and *Ammonia* species are predominantly present in the western part of the study area and both the species are scanty in the northern sector. South east sector of the study area enriched with *Cibicides* species. *Nonionella* present in the South western part of the study area.

III. CONCLUSION

In surface sediments, sand shows maximum in the eastern part of the study area and moderate concentration in the south western part. Silt concentration shows maximum in the western part and minimum in the north and eastern part o the study area. Clay size sediments are predominant at the southern part of the study area.Common forams in core sample are *Ammonia, Nonion, Cibicides* and *Nonionella* and in surface samples, *Ammonia, Nonion* and *Cibicides*. Rarer forams in core sample are *Lagena, Fursenkoina and Elpidium*. Juvenile and reworked benthic and planktonic foraminifera are seen in the core sample. In surface sample both benthic and planktonic foraminifera were found. Most of them are juvenile and reworked forms which indicate the environment was not favour to the growth of foraminifera due to the imbalance in energy.

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