Foraminiferal Studies in the Beypore River Mouth Sediments

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Abstract-Foraminifers from beach and river mouth sediments, however, are equally important as they can be of immense utility while understanding the dynamics of wave action during tides, cyclonic storm surges, or rarely tsunamis. Beypore river mouth sediments has been investigated for recent benthic foraminifera. The present study aims to investigate sediment distribution in the Beypore river mouth and to find out the micro fauna present in the study area. With this it is planned to understand the relation between sediment nature and micro fauna. The surface and subsurface samples were collected from the Beypore estuary and from Chaliyam river. One core and thirteen surface samples were collected from different locations. Core sample was lithologged and subsampled. Terrigenous materials in core sediments are varying from 75-95 % and composed of quartz grains. The total biogenic content varies from 5-25 %. The biogenic matter consists of shell fragments, juvenile gastropods, foraminifera and others. Accordingly, 8 species / genera are reported and majority of them illustrated. No planktonic foraminifera recorded in this area. Most of the foraminiferal tests are found to be juvenile form. Few are fresh form and many are reworked forms. This kind of population indicates the foraminiferal test growth is controlled by high energy system, that to brought reworked tests into this study area.

Keywords: Beypore river mouth, Foraminifera, Reworked forms

INTRODUCTION

A sedimentary environment is an area of the Earth's surface where sediment is deposited. It can be distinguished from other areas on the basis of its physical, chemical, and biological characteristics. Marginal marine setting lies in between the continental and the marine depositional realms. It is a narrow zone dominated by river, wave, and tidal processes. Salinities may range in different parts of the system from fresh through brackish to supersaline water, depending upon river discharge and climatic conditions.

Foraminifera are micro-unicellular organisms. They are almost marina living organisms though a few live in brackish and even in fresh water. These organisms build a shell and for paleontologists, the characteristics of the shell are the primary feature which can be used to distinguish one species from one another and hence, to use these distinction to form interpretation of time or environment.

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; Seibold, 1972; Setty, 1973, 1974; Rao, 1974; Bhatia and Kumar, 1976; Nigam and Sarupriya, 1981; Setty and Nigam, 1982; Nigam, 1986, 1987; Nigam and Rao, 1987; Naidu, 1990; Nigam and Henriques, 1992; Nigam and Sarkar, 1993 and Nigam and Khare, 1999). A few papers have been published on the late Quaternary biological and lithological response to climatic fluctuations and sea level changes in northern and central part of the western continental shelf (Nair, 1974; Nair and Hashmi, 1980; Nigam, 1986, 1988, 1989; Nigam and Nair, 1989; Nigam and Khare, 1992a,b and Rao *et al*., 1987). No serious attempt was made to study foraminiferal assemblages from subsurface sediments of the shelf of Kerala and their response to the late Quaternary oceanographic changes occurred along the cost.

The widely utilized classification proposed by Loeblich and Tappan (1987) has been followed in the present study. The identification of the species recorded in this study is based on comparison with the Catalogue of Foraminifera by Ellis and Messina (1940 onwards), innumerable publications.

The Chaliyar is one of the major rivers of the West Coast of India and joins the Arabian sea at Beypore near Calicut. At its Iower reaches it is known as the Beypore river forming the Beypore backwater before if joins the sea. The Beypore estuary enters the sea in a south-westerly direction.

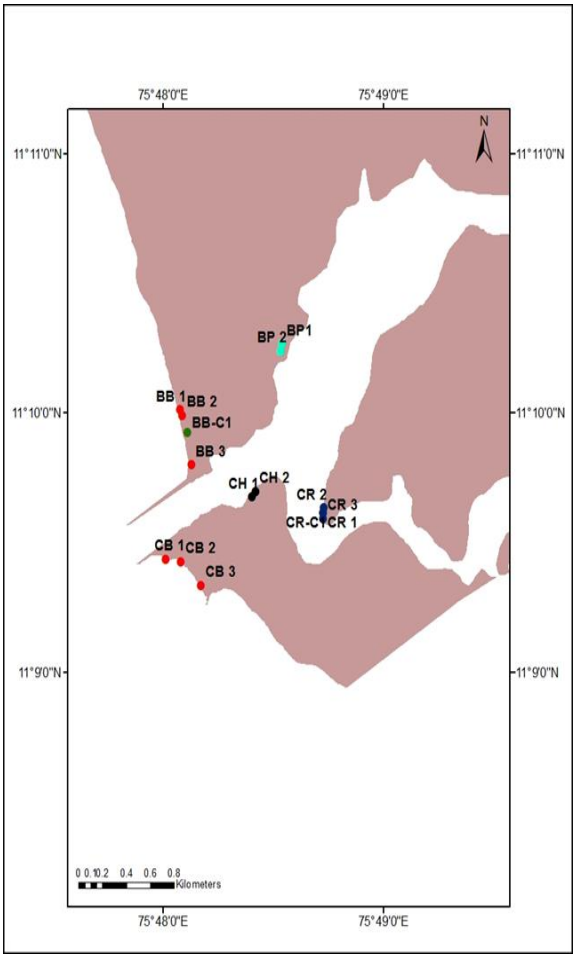


Fig.1. Study area with sample locations

MATERIALS AND METHODS

The surface and subsurface samples were collected from the Beypore estuary and from Chaliyam river. One core and thirteen surface samples were collected from different locations. Core sample was lithologged and subsampled. The core sample was subsampled into 17 subsamples at an intervel of 4-5 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.

Tab.1. Sampling details

Environment	Surface sediments	Core sample
Beach	6 Surface sediments BS1, BS 2, BS3, CS1, CS2 and CS3	BB-C1 Core length-81cm
River mouth	CH1, CH2	CH-C1 Core length-76cm
River	BP1, BP2, CR1, CR2 and CR3	----

The sand, silt and clay in the sediments were analyzed by the wet sieving method in accordance with the procedure adopted by the Krumbein and Pettijhon (1938).

Micropaleontological studies carried out to identify foraminifera in the sediment samples which are divided into each 2.5 cm are taken. With the samples a solution of 3 parts of water and one part of hydrogen peroxide was added. This was kept for 6-8 hrs for disintegration of the clay or removal of the clay from the shell. After 6-8 hrs the samples were washed using 230 ASTM mesh to separate the clay particles from the samples. This was then dried in the oven at below 50^{o}c and dried samples were taken for the micropaleontological studies under stereo binocular microscope.

RESULTS AND DISCUSSION

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 5, 19, 27.5, 36 and 46 centimeters. The nature of sediment is sandy with very little or no clay, mud shows its maximum at a depth of 10.5, 40, 55, 65 and 76 centimeters. The bottom core sediments are sand with little mud. This shows that the sand is dominating in this area.

Table.2. Sand-Silt-Clay Analysis values for core sample

Sample Name	Depth (Cm)	Sand %	Silt %	Clay %
CR-C1/1	0	97.2	2.8	0
CR-C1/3	10.5	86.6	13.4	0
CR-C1/5	19	91.6	8.4	0
CR-C1/7	27.5	90	9.6	0.4
CR-C1/9	36	92.2	7.4	0.4
CR-C1/11	46	90.6	9.4	0
CR-C1/13	55	86	14	0
CR-C1/15	65	88.6	11	0.4
CR-C1/17	76	82.6	17.4	0

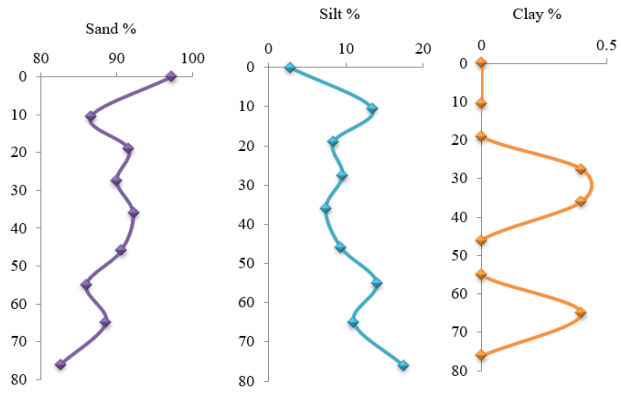


Fig. 2. Down-core variation of sand, silt and clay in river core sample

In surface sediments, samples are sand dominated with very low mud content. The mud content is higher in the western and southern part of the study area

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

Sample Name	Sand %	Silt %	Clay %
CH 1	98.4	1.6	0
CH 2	99.6	0.2	0.2
BS 1	96.4	3.6	0
BS2	98.2	1.6	0.2
BS3	98.4	1.4	0.2
CS1	98.2	2.4	0.6
CS2	97	2.2	0
CS3	97	1	0
BP1	97.8	1.2	0.4
BP2	99	2.2	0.8
CR1	98.6	1.4	0
CR2	97	3	0
CR3	96.2	3.8	0

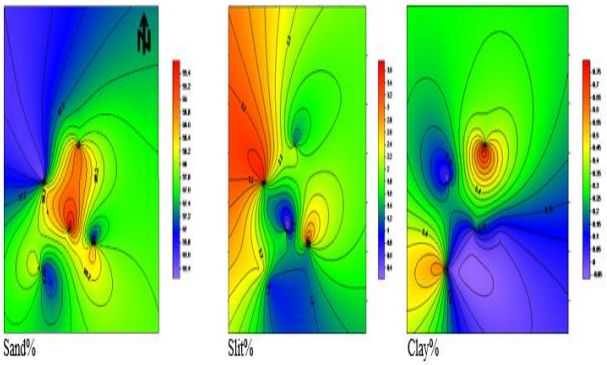


Fig. 3.Surfacial distribution of sand, silt and clay in the study area

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

Table.4.Sand, Mud, $CaCO_3$ and Foraminifera (%) in surface samples

Sample Name	Sand %	Mud %	$CaCO_3$ %	Foraminifera %
CH 1	98.4	1.6	1.8	0
CH 2	99.6	0.4	1.3	0
BS 1	96.4	3.6	1.8	0.68
BS2	98.2	1.8	1.5	0
BS3	98.4	1.6	1.6	6.47
CS1	98.2	1.8	2	3.636
CS2	97	3	2	0
CS3	97	3	1.5	0
BP1	97.8	2.2	1.8	0
BP2	99	1	1.4	0
CR1	98.6	1.4	0.3	0
CR2	97	3	0.4	0
CR3	96.2	3.8	0.3	0

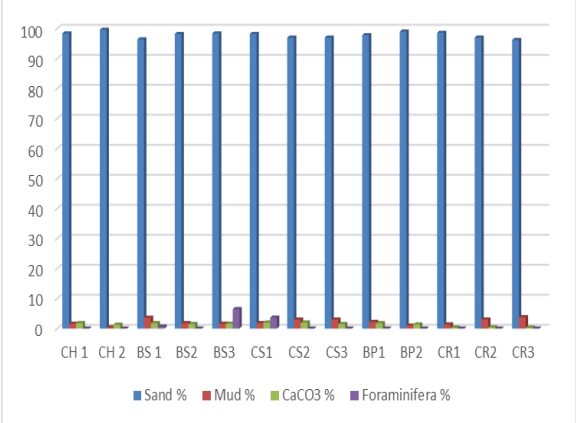


Fig. 4. Sand, Mud, $CaCO_3$ and Foraminifera (%) in surface samples

Down core relationship for sand and $CaCO_3$ showing negative correlation, i.e, as sand percentage increases the percentage of $CaCO_3$ is decreasing and vice versa. 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 $CaCO_3$, it is negatively correlated with sand

percentage and positively correlated to the mud and $CaCO_3$ percentage. It is a clear indication that the $CaCO_3$ mainly from shells of organisms.

Table. 5. Down core correlation of sediment nature and biogenic materials

Sample Name	Depth (cm)	Sand %	Mud %	$CaCO_3$ %	Clastic materials %	Biogenic materials %
CR-C1/1	0	97.2	2.8	0.2	95.23	4.76
CR-C1/3	10.5	86.6	13.4	0.4	92.307	7.692
CR-C1/5	19	91.6	8.4	0.6	93.75	6.25
CR-C1/7	27.5	90	10	0.2	93.16	6.83
CR-C1/9	36	92.2	7.8	0.2	88.65	11.34
CR-C1/11	46	90.6	9.4	0.3	94.01	5.91
CR-C1/13	55	86	14	0.2	88.235	11.76
CR-C1/15	65	88.6	11.4	0.2	91.38	8.616
CR-C1/17	76	82.6	17.4	0.1	90.25	9.578

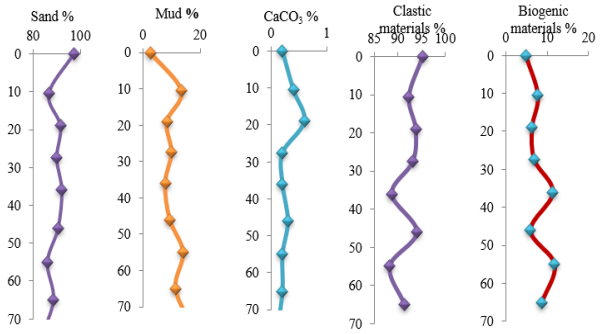


Fig.5. Down core correlation of sediment nature and biogenic materials

In surface sample both benthic and planktonic foraminifera are present. Most of the foraminifera are juvenile and reworked forms which indicate the environment is not favorable for the test growth of foraminifera due to the imbalance in energy. There are 8 species of foraminifera falling in 5 genera and 2 sub orders found in this area. The foraminifera are found in two sample stations named BS 3 and CS 1 of which 8 species are identified from the total of 34 foraminifera. In which 22 are fresh tests and 12 are reworked/deformed. Most of the foraminiferal tests are found to be juvenile form. Few are fresh form and many are reworked form. This kind of population indicates the foraminiferal test growth is controlled by high energy system, that to brought reworked tests to this study area.

In core sediments, benthic foraminifera are the dominant microfauna. About 8 genera / species of benthonic forams were identified in the top core sample. The dominated forms are *Ammonia beccarii* (12-27.6%) and *Ammonia dentata* (10-23%). *Rosalina globularis* (0-18.5%),*Spiroloculina depressa* and *Spiroloculina henbesti. Pararotalia nipponiaca and challengeralla sp*, are the rare species found in the study are. No planktonic foraminifera recorded in this area.

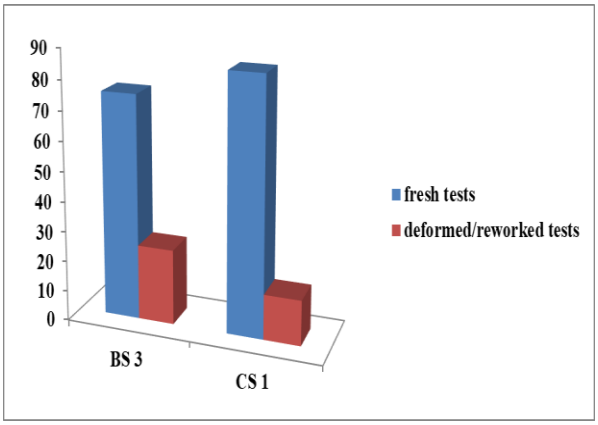
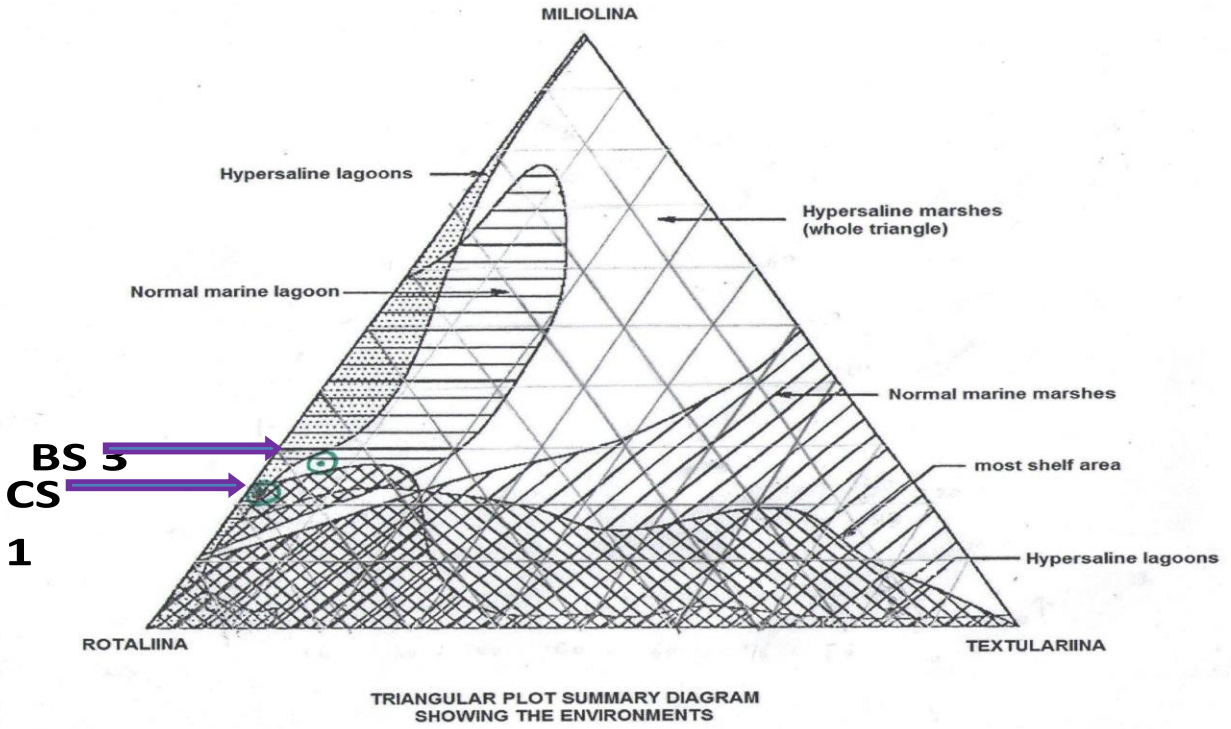


Fig.6. Bar diagram indicates the species diversity in surface samples

The depositional environment of the foraminifera was identified on basis of plotting suborder abundance of foraminifera in a trilinear plot. They are mainly occurs in the boundary of Hypersaline lagoon and Normal marine lagoon.



TRIANGULAR PLOT SUMMARY DIAGRAM
SHOWING THE ENVIRONMENTS

CONCLUSION

Based on the results obtained, in the studied area, terrigenous content in sub-surface sediments are varying from 75-95 % and mainly composed of quartz grains. Total biogenic content varies from 5-25 % and consists of shell fragments, juvenile gastropods, foraminifera and others. Benthic foraminifera are the dominant microfauna. The dominated species are *Ammonia beccarii* (12-27.6%) and *Ammonia dentata* (10-23%). *Rosalina globularis* (0-18.5%), *Spiroloculina depressa* and *Spiroloculina henbesti. Pararotalia nipponiaca and challengeralla sp*, were reported as rare species. *Ammonia beccarii* is a cosmopolitan species which is tolerant to extreme ranges of salinity. No planktonic foraminifera recorded in this area. Most of the foraminiferal tests are found to be juvenile form. Few are fresh form and many are reworked tests are more in population than fresh forms. This kind of population indicates the foraminiferal test growth is controlled by high energy system, that to brought reworked tests to this study area. The depositional environment of the foraminifera is falling in the boundary between hypersaline lagoon and normal marine lagoon.

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