International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Planktonic Foraminifera from the Offshore segment between Chennai and Cuddalore, Bay of Bengal, India

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Abstract: ***An attempt has been made to know the distribution of planktonic foraminifera in the continental shelf – slope region between Chennai and Cuddalore in the Bay of Bengal collected during a cruise. Fifteen species were identified from forty five grab samples. The total population is found to increase significantly from 30 m to the deeper region with maximum average of 41% observed in the samples from beyond 200 m of water depth. However, samples from less than 10 m witnessed only 1.4% of planktonic foraminifera. Results reveal that the spinose forms outnumbered the non – spinose forms making up 80 % of the total population.***

Keywords*:* Planktonic foraminifera, distribution, shelf – slope, Bay of Bengal

1. Introduction

Planktonic foraminifera are the single celled, free floating pelagic forms that live in the open sea usually in the upper 100- 150 m of the water column. They travel to greater distances being drifted by the currents and deposited in the bottom sediments. Their existences is known since the late Jurassic period and are believed to have evolved much rapidly after early Cenozoic period than the benthic forms rendering them as excellent biomarkers worldwide. They are extensively used in interpreting the past environment both regionally and globally as they are very sensitive to even slight changes in temperature, salinity, light, nutrient density and other like parameters. Their widespread distribution in the world oceans increases their utility in paleobiogeographic studies and in understanding the ocean circulation pattern. Recent years have witnessed their remarkable contribution in paleoclimatology and paleoceanographic research with the advent of the effective geochemical and isotope studies that can be carried out in their biogenic calcite shells [9]. Using Mg/ Ca ratio of their shells that mirrors the water temperature in which they grew is now a well-known proxy for reconstructing past oceanic temperature [1],[2],[7]. However, paired measurements of Mg/Ca and stable oxygen isotope ratios has solved issues related to temperature, salinity in paleoceanographic research [11]. Recent studies from the Bay of Bengal include reconstructing past SST and salinity [8], [13], radiocarbon dating of planktonic foraminifera [4] and distribution of planktons in the near shore and shelf - slope region of the northern Bay [6]. Thus to know the distribution pattern in present area under investigation is the main aim of this study.

2. Material and Methods

The study area is located in the south eastern coast of India in the Bay of Bengal bordering the offshore region from Mahabalipuram till Cuddalore. Surface sediment samples were collected on a Sagar Paschimi cruise, 05/2012 in May/June 2012 in the offshore region between Mahabalipuram and Cuddalore (Figure 1). Different depths ranging from ~ 10 m to ~ 300 m depth were sampled for sediments using van Veen grab sampler. However, sampling in few stations was difficult due to the rough bottom currents. About 50 gm of sediment from the grab samples were stained with Rose Bengal solution and left for two weeks in order to distinguish between the living and the dead foraminifera at the time of sampling (Walton, 1952). On reaching the laboratory, samples were washed in 63 and 125 µm ASTM sieves. The residue is dried and picked for approximately 300 numbers of foraminifera from each sample. The living forms were counted separately.

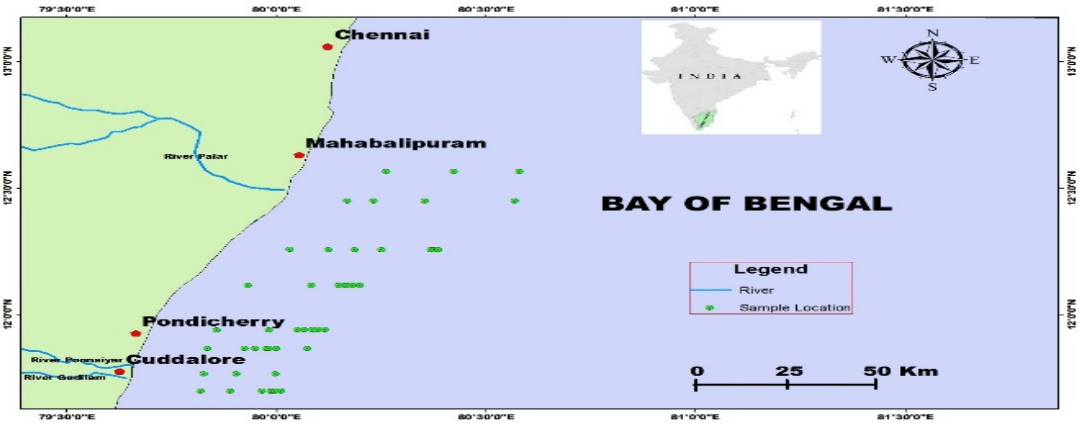

Figure 1: Map showing sample locations in the study area

3. Results and Discussion

The analysis of surface sediments confirmed the presence of 15 planktonic species belonging to 9 genera, 4 families, and 2 superfamilies in the order Globigerinida (Plate I).The relative abundance of planktons is considered for this study as their number increased from the shore to the offshore side [5]. The overall percentage of these forms as estimated from the surface sediments off Mahabalipuram- Cuddalore segment ranged from 0 to 69%. Sums of 2,924 individuals were picked from 45 surface sediments. The presence and absence of the identified species in the sample locations is given in Table 1. In all the samples collected below 40 m, the plankton population is only 3%. Their contribution is as low as 1.3% in the samples below 10 m, 1.5% in between 10 to 20 m and 5% in the samples obtained below 40 m depth. Yet a steady increase in the average planktonic percent is observed from 40 m to 300 m in the study area. Half of the counted tests is typified largely by *Globigerinoides sacculifer* and *Globigerina calida*. Associated species in the order of decreasing abundance include *Globigerinoides ruber*, *Neogloboquadrina dutertrei*, *Globigerina bulloides* and *Globigerina aequilateralis*. The individuals of *Orbulina universa*, *Globorotalia menardii*, *Globorotalia tumida*, *Globigerinoides conglobatus*, *Globorotalia inflata*, *Candeina nitida*, *Sphaeroidinella dehiscens*, *Pulleniatina obliquiloculata* and *Beella digitata* varied from 10 to 100 making up 11% of the total population of planktonic foraminifera.

The spinose forms are predominantly composed of shallow water dwelling, tropical species – *G.sacculifer* and *G.calida* followed by *G.ruber*, *G.bulloides*, *G.aequilateralis*. The non-spinose forms namely *C.nitida*, *P.obliquiloculata*, *N.dutertrei*, *G.menardii*, *G.tumida* and *G.inflata* found in the outer shelf and slope contribute only one- fourth of the total number of planktonic forms altogether. Living forms are rare and only few numbers were found in sample no.21, 25, 26, 27 and 42. Higher percent of juveniles along with few adults is witnessed in the middle shelf region whereas very low diversity and abundance is pronounced in the inner shelf. The presence of adults along with juvenile forms in the upper slope suggests low current activity [10]. Relict specimens of *G.sacculifer*, *G.ruber*, *G.inflata*, *G.calida* and *G.bulloides*, were also identified in the shallow region and below 100 m depth.

The abundance and distribution seems to have better correlation with depth, grain size and salinity than with other ecological parameters. Relative increase in species abundance from the shore is indicative of depth as a controlling factor for

Table 1: Table displaying the presence / absence of planktonic foraminifera as encountered in the study site

Sample ID	Depth (m)	*G.sacculifer*	*N.dutertrei*	*G.calida*	*G.bulloides*	*G.ruber*	*G.menardii*	*G.tumida*	*G.aequilateralis*	*G.conglobatus*	*O.universa*	*G.inflata*	*C.nitida*	*S.dehiscens*	*P.obliquiloculata*	*B.digitata*
1	20	X														
2	32	X	X	X	X	X			X							
3	63	X		X		X	X			X						
4	8															
5	21	X			X						X					
6	35	X	X		X											
7	63	X		X		X			X							
8	8	X		X					X			X				
9	28	X	X	X	X	X	X		X			X	X			
10	46	X	X		X	X			X							
11	71	X	X	X		X	X	X	X	X	X	X	X	X		
12	86	X		X		X		X		X				X		
13	156	X	X	X		X	X		X					X	X	
14	205	X	X	X		X	X	X	X	X				X		
15	6															
16	25			X												
17	53	X			X	X			X				X	X		
18	79	X	X	X	X	X	X	X	X	X		X			X	X
19	100	X	X	X	X	X	X	X	X	X		X			X	X
20	167	X	X	X	X	X	X	X	X	X	X	X			X	
21	176	X	X	X	X	X	X	X	X		X	X	X			X
22	9	X					X									
23	26	X		X		X							X			
24	51	X	X	X	X	X	X	X	X	X		X				
25	91	X	X	X	X	X	X	X	X	X		X	X		X	
26	138	X	X	X	X	X	X		X	X	X				X	
27	176	X	X	X	X	X	X	X	X			X			X	X
28	308	X	X	X	X	X	X	X	X			X				
29	8	X		X	X	X										
30	25															
31	45	X	X	X	X	X	X	X	X		X					
32	95	X	X	X	X	X	X	X	X							
33	130	X	X	X	X	X	X	X	X			X			X	
34	149	X	X	X	X	X	X	X	X			X				X
35	229	X	X	X	X	X	X		X			X				X
36	11	X														
37	32	X	X		X					X						
38	74	X	X		X	X	X	X				X		X		
39	9	X														
40	15	X		X					X							
41	26	X	X			X										
42	75	X	X			X	X		X							
43	119	X	X	X		X	X		X	X						
44	161	X	X	X		X	X	X	X	X				X		
45	282	X	X	X	X	X	X	X	X	X	X	X	X			X

the horizontal distribution. The increase in the size of planktons is correlated with finer sediments. Well-preserved, bigger sized adults (>90%) were observed in the stations with muddy substrate while medium- small sized forms prevailed in sandy sediments. *G.ruber* (white)

occurring in higher proportion in stations exhibiting salinity >36 - 42 psu suggests that salinity has more influence than temperature [3]. *G.sacculifer* is found in large numbers between 50 and 100 m where the optimum temperature is 28° [15]. The significant rise in the abundance especially in the upper slope suggests the higher availability of organic carbon.

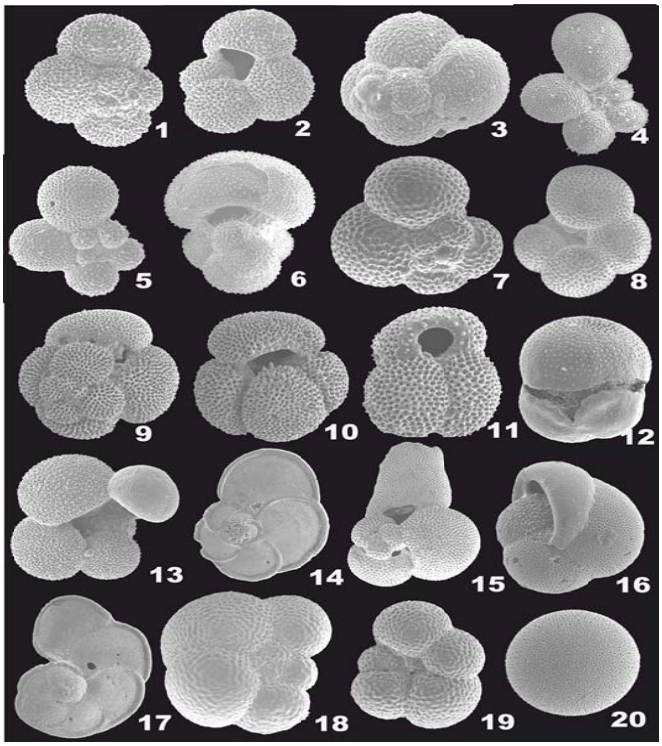

Plate I: 1) *Globigerina bulloides*, dorsal view X250 2) *G.bulloides*, ventral view X270 3) *Candeina nitida*, dorsal view X420 4) *Beella digitata*, dorsal view X160 5) *Globigerina aequilateralis*, dorsal view X230 6) *G. aequilateralis*, apertural view X130 7) *Globigerina calida*, dorsal view X300 8) *G. calida*, ventral view X250 9) *Globigerinoides conglobatus*, dorsal view X120 10) *G. conglobatus*, apertural view X130 11) *Globigerinoides ruber*, ventral view X250 12) *Sphaeroidinella dehiscens* , ventral view X120 13) *Globorotalia inflata*, ventral view X190 14) *Globorotalia menardii*, dorsal view X120 15) *Globigerinoides sacculifer*, dorsal view X95 16) *Pulleniatina obliquiloculata*, ventral view X210 17) *Globorotalia tumida*, dorsal view X60 18) *Neogloboquadrina dutertrei*, dorsal view X230 19) *N. dutertrei*, ventral view X210 20) *Orbulina universa* X130

4. Conclusions

Altogether 15 planktonic foraminifera is reported from the substrate sediments of the offshore region between Mahabalipuram and Cuddalore. Depth, salinity, grain size and temperature are the factors influencing their distribution. The study area exhibits an assemblage of tropical to subtropical dwelling species dominated by *G.sacculifer* and *G.calida*.

5. Acknowledgements

We are deeply grateful for UGC scholarship and Ministry of Earth Sciences funding through NIOT, Chennai for sample collection. Also we acknowledge, CIF, Pondicherry University for helping us avail the SEM facility.

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