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# Occurrence of Uvigerinids and Buliminids benthic foraminifera along the western continental margin, eastern Arabian Sea

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## ABSTRACT

Uvigerinids and Buliminids are always considered to be sensitive to Ocean bottom environment representing two important components of the benthic foraminiferal population. Members of these groups have been considered as indicator species of watermass characteristic also. In the present study, Uvigerinids represented by 11 species belonging to two genera and Buliminids represented by 8 species belonging to 2 genera were recorded. *Uvigerina peregrina* and *Uvigerina hollicki*, *Siphouvigerina porrecta* were found to dominate the sediments collected from different stations along the Western continental shelf of India. *Uvigerina peregrina* was found to constitute 28%, 20.87% and 15.11% in off Cape Comorin (202 m), Kochi (202m) and Mangalore (205m) stations. Presence suggests there is a rich supply of labile organic matter and a high concentration of bacteria in the sediments. Buliminids were found to have less abundance as compared to the Uvigerinids, *Bulimina marginata*, *B.mexicana* and *B.aculeata* were the species which dominated. *Bulimina marginata* was found to constitute 7.7%, 7%, 6.78%, 5.82% in off Kochi (360m), Bhatkal (31m), Kochi (890m) and Kozhikode (219m) respectively. These are opportunistic species that are able to respond to high food availability. In the present study the distribution of Uvigerinids and Buliminids in the study stations is being presented and their ecological role is discussed.

**Key words:** Ecological indicators, Infauna, Organic matter flux.

## INTRODUCTION

Foraminiferans are interesting organisms possessing calcareous, agglutinated and organic tests of varied structural patterns. These single celled organisms have a very high constructional strength of tests which they built with the help of their granuloreticulate pseudopodia. A total of 38,000 reported species both extant and extinct from rocks and sediments from the marine realms have been known to exist since Cambrian period. The number of planktic species is very few as compared to the benthic foraminifera. Buliminids and Uvigerinids are groups which have been characterized as important members of benthic foraminifera possessing small tests with elongate

spirals and columns of bubble like chambers with comma shaped or delicately siphonate apertures (Haynes, 1981).The external surface of their test is often ornamented with costae, nodes or spines which appear to afford a peculiar advantage in the fine sediments of the ocean floor. Calcareous wall with both hyaline oblique and hyaline radial structures, trochospiral to triserial, biserial and uniserial genera usually round to trigonal in cross section. These groups became abundant in upper cretaceous but have originated in middle Jurassic as there are only doubtful records of these in Triassic period. These are characteristic Cenozoic assemblages, especially in sediments representing outer shelf and slope depths. Benthic foraminifera in sediments on the Indian margin of the Arabian Sea, where the oxygen minimum zone (OMZ) impinges on the continental slope, are exposed to particularly severe levels of oxygen depletion. Food supply for the benthic community is high but delivered in distinct pulses during upwelling and water mixing events associated with summer and winter monsoon periods (Enge *et al.*,2014).The benthic environment of upper continental slope in Arabian Sea is typified by low dissolved oxygen concentration and high organic matter content (Calvert *et al*,1995). The distribution pattern of Uvigerinids and Buliminids in marine sediments is related with high organic matter flux and low oxygen concentration and could be used as excellent ecological indicators. (Phleger & Soutar, 1973; Koutsoukos *et al.*, 1990).

In 2009, S.R.Bharti and A.D Singh had explored the buliminid population from a core collected from Eastern Arabian Sea (off Goa) and highlighted the role of the group in reconstruction of paleooceanographic conditions.Prabha Kalia(1978) had described some Buliminid species from middle Eocene sediments of Rajasthan In the present study the occurrence of buliminids and uvigerinids have been explored from the surface sediments obtained from the western continental margin.

## STUDY AREA

Arabian sea is distinct semi enclosed basin as it is landlocked in north by Asian continental landmasses and lies at low latitude.Seasonal winds, thermohaline circulation and seasonal reversal of atmospheric forcing influences this ecosystem (Jayaraj et al,2008). Enormous amounts of freshwater is brought in by the flow of Indus river which brings copious amounts of terrigenous sediments during the south-west monsoon and major influx of dust plumes from the Arabian peninsula (Shinu, 2008). High biological productivity and subsequent decay of organic matter lead to extremely low oxygen concentration and related intense water column denitrification along the continental margin of the Arabian Sea (Naqvi,1987). Primary cause of carbon enrichment and the good preservation of organic matter has been thought as the preexisting deep water anoxia, high productivity and favourable sediment texture (Calvert *et al.*,1995, Rao & Verrayya,2000).The meiobenthos in the region is mainly recorded highest at the mouth of estuaries and in upwelling zones whose dominance is comparatively less than the macrobenthos in the shelf regions and increases with the depth. Benthic production directly is related to the primary production of the overlying water.

## MATERIALS ND METHODS

A total of 69 surface sediment samples were analysed for the occurrence of the buliminids and uvigerinids in the present study.The diversity of the buliminids and uvigerinids have been explored. The collected samples were processed using the Conventional micropaleontological technique. About 5 gm of sediment sample was soaked in 30% Hydrogen peroxide solution for twelve hours and boiled for 2-3minutes. After cooling , the material was wet seived over 63 µm and 100 µm screens. The residue was dried and is kept in plastic tubes for microfaunal analysis. The dried samples (> 125 µm) were split into subsamples using a micro ottosplitter to get representative sample. One gram dry sediment was analysed under binocular stereozoom microscopes (WILD MZ12.5) and MZ8 microfaunal assemblage slides were prepared

For identification of the foraminifera upto the species level, taxonomic keys of Loeblich and Tappan (1988),R.W Jones (1994), Sen Gupta (1999) and all the available literature were used. The identification was confirmed using the scanning electron micrographs (Fig.2) of the important species.

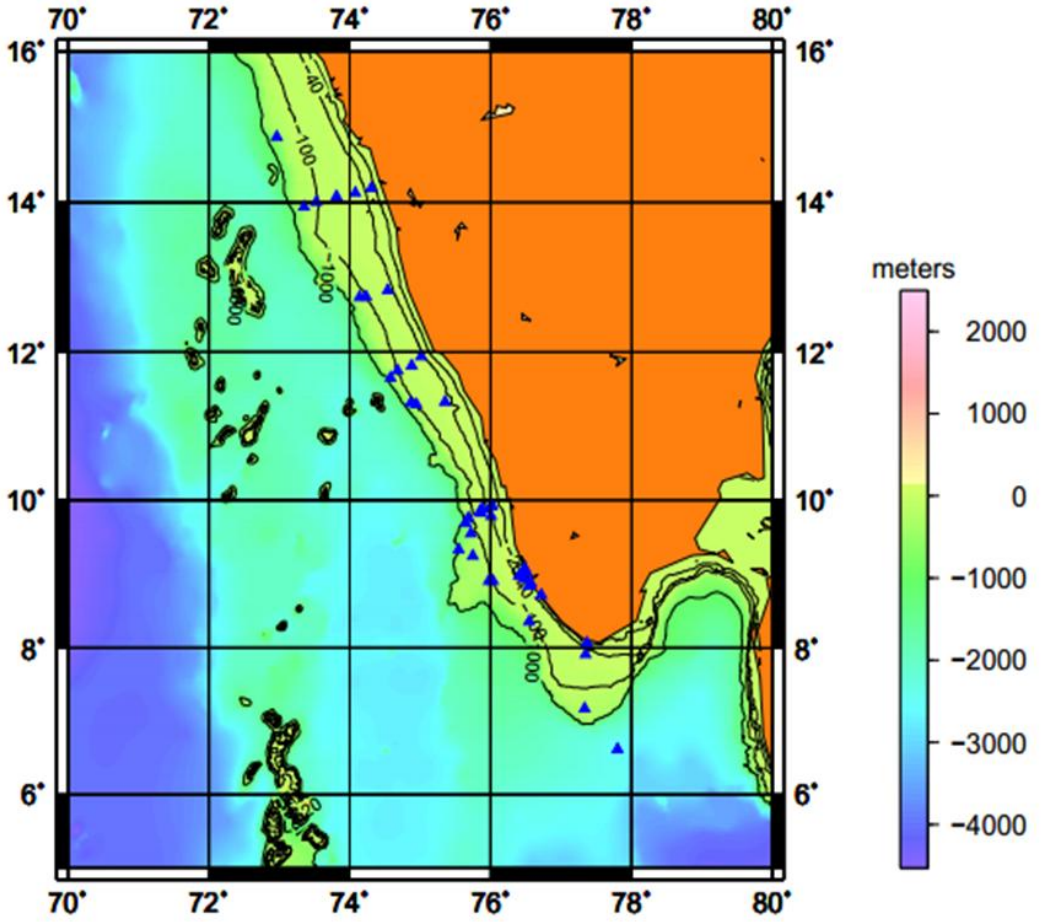


**Fig. 1.** Study area with sampling stations

## RESULTS AND DISCUSSION

Uvigerinids represented by 11 species belonging to two genera and Buliminids represented by 8 species belonging to 2 genera were recorded in the present study from different stations along the south west continental shelf(Fig.1). The Uvigerinids were identified mainly based on the test, chamber shape, pore pattern, shape and density of costae, presence and frequency of pustules between costae, coiling mode, apertural features, ornamentation and wall texture. Buliminids were identified with the nature of costae, nodes or spines on their tests.

The Checklist of the species recorded is given below:

**Systematics**

**Phylum :** Protozoa
**Class:** Sarcodina
**Order:** Foraminiferida
**Suborder:**Rotaliina Delage
**Family:**Buliminidae
**Genus:** *Bulimina*
***Bulimina marginata* d'Orbigny, 1826**
***Bulimina gibba* Fornasini, 1902**
***Bulimina mexicana* Cushman, 1922**
***Bulimina inflata* Seguenza,1862**
***Bulimina rostrata* Brady,1884**
***Bulimina acculeata* d'Orbigny, 1826**
***Bulimina nojimaensis* Asano,1950**
***Genus:*** *Globobulimina*
***Globobulimina pacifica* Cushman,1927**

***Family:*** **Uvigerininae**
***Genus*****:***Uvigerina*
***Uvigerina peregrina*** **Cushman,1923**
***Uvigerina hollicki*** **Thalmann,1950**
***Uvigerina costata*** **Bieda, 1936 †**
***Uvigerina bradyana*** **Fornasini,1900**
***Uvigerina mediterranea*** **Hofker,1932**
***Uvigerina auberiana*** **d'Orbigny, 1839**
***Uvigerina schwageri*** **Brady, 1884**
***Uvigerina canariensis*** **d'Orbigny, 1839**
***Genus*****:** *Siphouvigerina*
***Siphouvigerina ampullacea*** **(Brady, 1884)**
***Siphouvigerina interrupta*** **(Brady, 1879)**
***Siphouvigerina porrecta*** **(Brady, 1879)**

The most dominant species of uvigerinids along the entire south west coast were *Uvigerina peregrina, Uvigerina hollicki, Siphouvigerina porrecta* .*Uvigerinids* were found to have maximum occurrence at off Cape comorin(208m) , wherein *Uvigerina peregrina* and *Uvigerina hollicki* dominated.

*Uvigerina peregrina* was found to constitute 28%, 20.87% and 15.11% in off Cape Comorin (202 m), Cochin (202m) and Mangalore (205 m) of the relative abundance respectively. This specie is a shallow infaunal member which is found to be most abundant where there is a rich supply of labile organic matter and a high concentration of bacteria (Altenbach & Sarnthein,1989; Altenbach *et al.*,1999; Fontanier *et al.*,2002).It prefers a depth range from 0-3354 metres and is eurythermal (tolerates a temperature range from 0.48°C to 29.19°C).It is one of the most important species of benthic foraminifera for biostratigraphy and paleoenvironmental investigations of continental margin sediments from bathyal water depths. Although its depth varies from region to region, it shows a remarkable consistency with the water depth from any area( Miller and Lohmann, 1982).Its presence confirms the high level of organic matter in these stations from where they recorded a maximum abundance. In the present study it generally seen to be abundant in deeper waters than in shallower depths. The success of the Uvigerinids at great depths is related to their ability to tolerate low oxygen levels. However, Rathburn and Corliss (1994) had shown that 'low oxygen taxa', such as *Bulimina, Globobulimina, Uvigerina* ,were found to be rare at a number of sites in Sulu Sea, where the bottom water oxygen concentration was 1.76 ml/l or less. They had pointed out that dominance of these taxa is typical of environments with high organic flux, rather than of environments with low oxygen concentrations. It is very difficult to distinguish their separate influence on species composition. But infaunal species have been used as an indicator species for the depth of zero oxygen sediment layer.

*Bulimina marginata*, *Bulimina mexicana* and *Bulimina aculeata.* dominated the Buliminid populations .Buliminids were found to have maximum occurrence in off Kochi (890m). *Bulimina marginata* was the most dominant specie which was found to constitute 7.7%, 7%, 6.78%, 5.82% in off Kochi (360 m), Bhatkal (31 m), Kochi (890 m) and Kozhikode(219 m) respectively out of the whole foraminiferal population from these stations. This specie shows a positive correlation with the total organic content and is an opportunistic species able to respond to high food availability (Jorissen *et al.,* 1992).*Bulimina marginata* is a deep infauna found in anoxic sediments and surface sediments. This particular species colonises macrofaunal burrows to feed on the bacteria in the borrow walls (Fontanier *et al.,* 2002).Although other buliminids were found in the sediments of Western continental margin, they had rare occurrence as compared to the dominant species. The presence of certain species in deeper waters indicates that these are typical species that could find and utilize packaged detritus such as faecal pellets, and Buliminid species have specially adapted to expoit organic detritus.

Another interesting property noticed was the ornamentation on the buliminid tests which were found to be more prominent in species from deeper waters sediments .Among species of genera Bulimina and Uvigerina small, less ornamented types occur in the continental shelves and there is a progressive increase and differentiation of surface sculpture with increasing depth of water. Pores were more common in shelf species and spines were prominent in the tests of species from deeper waters. This was in accordance with the finding of earlier works by Smith (1963), Lutze(1964).In their works they have noted the presence of larger bathyal species which had longer spines ,increase in overall length and strength of costae.

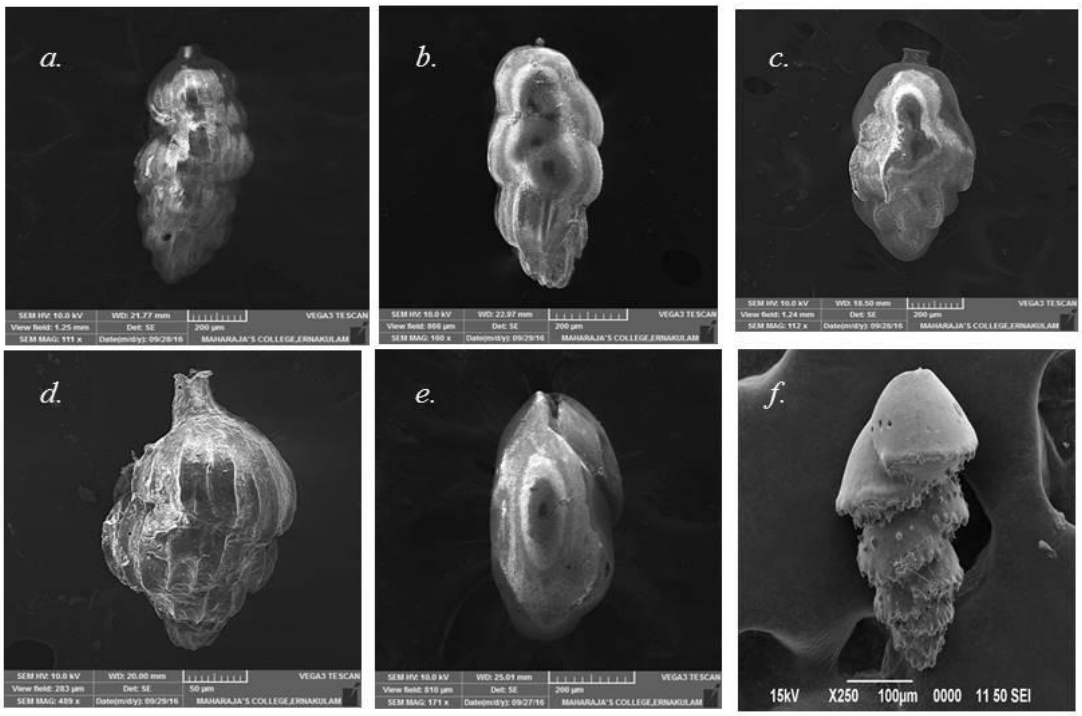


Figure 2: Uvigerinids and Buliminids from surface sediments
*a. Uvigerina peregrina b. Uvigerina hollicki c. Uvigerina schwageri*
*d. Uvigerina costata e. Globobulimina pacifica f. Bulimina marginata*

## CONCLUSIONS

Uvigerinids were found to be more dominant than buliminids along the surficial sediments. There was a marked difference in the diversity of uvigerinids along with the depth as more number of species were seen from the deeper waters. The uvigerinids tend to have less spines and more striations with increasing depth, the deeper the sediment depth the more abundant the species. Presence of these groups along the western continental margin clearly indicates that the continental region of Eastern Arabian Sea is productive and rich inorganic matter content. These groups which thrive in low oxygen conditions were found along the shelf which also highlights the low oxygen conditions in the region.

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