

depletion was noticed (in May 1972). However, with reference to the light depths the distribution pattern showed a slight increase in 10% light depth.

Discussing the seasonal variation of dissolved oxygen in surface waters over the shelf, Sharma¹² pointed out that there is no seasonal fluctuation, although lower concentrations are found during January. The concentration of oxygen decreased with increase in depth. As the region of sampling is only 20 m, a wider variation may not be expected. April, June and August had waters with low oxygen content at 1% light depth. Jayaraman *et al.*¹ failed to find any distinct vertical gradient in the dissolved oxygen values from 0 to 50 m during the summer months in waters off Cochin. Ramamirtham and Jayaraman⁴ found concentrations higher than 5 ml/litre for surface waters and very low values below 10 m depth. However, Anand *et al.*¹³ did not find such steep fall in dissolved oxygen.

It is not possible to give the causative factors for the observed variations in the nutrient concentrations of waters off Cochin. Among the 4 factors studied, reactive nitrite gave minimum values. An inverse relationship between reactive nitrite and nitrate was noticed at certain instances. Monsoon and post-monsoon months showed high reactive silicate (Table 1). This may be an indication of the effect brought about by the monsoon runoff.

The author expresses his sincere gratitude to Dr S. Z. Qasim, Director, NIO, for his guidance and helpful suggestions during the course of the work. The present work was carried out during the tenure of a Senior Fellowship offered by the ICAR, New Delhi.

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Shelf Edge Regime & Foraminifera Off Pondicherry, Bay of Bengal*

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Received 10 August 1978

Occurrence of *Globorotalia menardii neoflexuosa*, *Globoquadrina conglomerata* and *Neogloboquadrina pachyderma dextralis typica* in the sediments is significant, as these are also reported from the Arabian Sea earlier, and further as they are reported to be 'extinct' in the present day Atlantic. Similarly, the presence of *Rotalia nicobarensis* and *Triloculina tricarinata* is significant as they are known to occur since the Miocene time. Relative abundance of such robust forms as *Amphistegina*, *Borellis*, *Operculina*, *Operculinoides*, the Peneroplidae, and the Miliolidae may be due, in part, to their survival over long periods of time and also to their continued existence even today. Some species have a wider range of distribution extending from shallower to upper bathyal zones. The faunal elements suggest an Indo-Pacific and East African relationship.

SETTY and Rajamanickam¹ described the heavy mineral suite present in the shelf-slope region between Pondicherry and Madras (12°: 13°05'N and 80°: 80°36'E). Their study indicated (1) fluctuation of the sea level during the Pleistocene time; (2) possible existence of a relict structure; (3) overlap of an augite rich zone over an augite poor zone; and (4) quiet water, and comparatively low energy environment. The samples used in the present study were collected (June 1964) during the 15th cruise of *INS Kistna* as part of the IIOE, Indian Programme. This paper deals with, mainly the foraminiferal faunal assemblage of the augite-rich shelf-slope regime at station Nos 354 and 378 (Table 1).

The inter-relationship of the grain size and mineral constituents of the sediment and the faunal assemblage has revealed that the substrate and the environmental conditions are suitable and conducive for a rich faunal assemblage. It is observed that the planktonic and benthonic populations are well-balanced and highly diversified.

Surface and bottom temperatures are nearly the same at both the stations (Table 1). Salinity however, remains almost constant. Dissolved oxygen content shows a definite negative gradient with depth from the surface at st. 378. It appears that all the 3 parameters are optimum within the latitudinal range here.

Planktonic (19) and benthonic (75) foraminifera encountered at these 2 stations is given in Table 2.

Planktonic species are more common on the outer-shelf and in the upper bathyal zones, whereas the benthonics are abundantly distributed on the substrate of the shelf and decrease gently towards the shelf edge. Abundant, common, and rare among

*Paper read at Seminar on Coastal Sedimentaries south of lat. 18°N, Madras, March 1976.

SHORT COMMUNICATIONS

TABLE 1 — TEMPERATURE, SALINITY AND DISSOLVED OXYGEN DATA RECORDED AT THE TIME OF COLLECTION

	Station numbers	
	354	378
Location		
Latitude (N)	12°00'	12°36.5'
Longitude (E)	80°06'	80°40'
Depth (m)	99	201
Temperature (°C):		
S	29.60	29.28
B	22.71	22.78 at 169 m depth
Salinity (‰):		
S	33.92	33.61
B	34.68	34.75
Dissolved oxygen (ml):		
S	—	5.07
B	—	1.27

S = surface; B = bottom.

the planktonics are given in Table 2. *Spheroidinella dehisens* has been reported for the first time from this region. *Neogloboquadrina pachyderma dextralis typica* Setty n. subsp. has been earlier reported in the Arabian Sea^{2,3} and in Bay of Bengal⁴ as *Globigerina pachyderma*. Majority of the species are warm water fauna.

Srinivasan *et al.*⁵ consider that *G. menardii neoflexuosa* first appeared in the interglacial episode V of the Pleistocene, though it became extinct in the Atlantic nearly 80000 yr ago it is found to be still living in the northern Indian ocean (also Setty⁶). Similarly, *Globoquadrina conglomerata*, which is reported to be 'extinct' in the present Atlantic since nearly one million years is found to be living in the Arabian Sea⁷ today.

The benthic faunal population found in this regime is rich, varied, diversified and also well-preserved. Most of them are cosmopolitan. The relative abundance of such robust forms as *Amphistegina*, *Borelis*, *Operculina*, *Operculinoides*, the Peneroplidae and Miliolidae may be due, in part, to their survival over long periods of time and also to their continued existence today. *Ammonia beccarii*, and *Buliminella elegantissima* which have a range up to 100 m are found at st. 354. Similarly, *Amphistegina* sp. *Bolivina fragilis*, *B. lanceolata*, *Nonionella atlantica*, *Eponides repandus*, *Quinqueloculina lamarkiana*, *Epistomina elegans*, *Cancris sagra*, and *Textularia canderiana*, are present in st. 354 which have a greater range (from 250-500-1000 m). Thus, some of these species are found to be present at st. 378 also. However, *Bolivina spissa*, *B. pacifica*, *Bulivinella folia* and *Buliminella exiles*, appear here for the first time. *Quinqueloculina lamarkiana*, though restricted up to 200 m depth range, it is like *Ammonia beccarii* and variants, an open ocean, lagoonal and also marsh form. *Pseudoeponides umbonatus* which has a range up to 3000 m, but

TABLE 2 — PLANKTONIC AND BENTHONIC FORAMINIFERA AT DIFFERENT STATIONS

Depth (99 and 201 m)	Stations	
	354	378
PLANKTONIC FORAMINIFERA		
<i>Globigerina bulloidesa</i>	×	×
<i>G. calidab</i>	×	×
<i>G. falconensisb</i>		×
<i>G. rubescense</i>		×
<i>Globigerinoides conglobatus</i>	×	×
<i>G. rubera</i>		×
<i>G. succulifera</i>	×	×
<i>Globigerinella aequilateralisb</i>		×
<i>G. siphoniferab</i>	×	×
<i>Globoquadrina conglomeratab</i>		×
<i>G. dulertreia</i>	×	×
<i>G. hexagonac</i>		×
<i>Globorotalia menardii b</i>	×	
<i>G. menardii neoflexuosab</i>	×	
<i>G. tumidab</i>	×	
<i>Neogloboquadrina pachyderma dextralis typica</i>		×
<i>Orbulina universaa</i>		×
<i>Pulleniatina obliqueloculatab</i>	×	×
<i>Spheroidinella dehisense</i>	×	×
BENTHONIC FORAMINIFERA		
<i>Ammodiscus</i> sp.c	×	×
<i>Ammonia beccarii</i>	×	
<i>Ammomassilina</i> sp.b	×	×
<i>Amphistegina lessonib</i>	×	×
<i>Amphisorus hemprichiic</i>	×	×
<i>Asterigerina indistinctac</i>	×	×
<i>Bathysiphon</i> sp.c	×	×
<i>Bolivina advenac</i>		×
<i>B. fragilisb</i>	×	
<i>B. lanceolatac</i>	×	
<i>B. minimac</i>	×	
<i>B. cf. B. minutissimab</i>	×	×
<i>B. pacificac</i>		×
<i>B. robustab</i>	×	
<i>B. spissac</i>		×
<i>Bulivinella foliac</i>		×
<i>Bolivinoides</i> sp.c		×
<i>Borelis</i> sp.b	×	
<i>Buliminella elegantissimac</i>	×	
<i>B. exilisc</i>		×
<i>Cancris auriculusc</i>	×	
<i>C. sagra b</i>	×	×
<i>Cassidulina lomitaensisc</i>		×
<i>Cibicides convexaa</i>	×	×
<i>C. lobatulusc</i>		×
<i>C. vortexc</i>	×	×
<i>Cibicidina basilobac</i>		
<i>Cornuspira involvensc</i>	×	
<i>Cushmanella browniib</i>	×	×
<i>Dentalina communisb</i>	×	
<i>Dyocibicides biserialisc</i>	×	
<i>Elphidium fax barbarenseb</i>	×	
<i>Eponides</i> sp.c	×	
<i>E. frigidesc</i>		×
<i>E. repandusb</i>	×	×
<i>E. tenerac</i>		×
<i>Epistomina elegansb</i>	×	
<i>Fissurina</i> sp.b		×
<i>Guttulina pulchellac</i>		×
<i>Gyroidina acutac</i>	×	
<i>Hanzawaia nipponicab</i>	×	
<i>Lagena</i> sp.c	×	
<i>Lenticulina midwayensisc</i>	×	
<i>Loxostomum okinawensisc</i>		×
<i>Nodosaria affinisb</i>	×	×
<i>Nonionella atlanticaa</i>		×
<i>Nonionella labradoricac</i>		×

Continued

TABLE 2 — PLANKTONIC AND BENTHONIC FORAMINIFERA AT DIFFERENT STATIONS — contd

Depth (99 and 201 m)	Stations	
	354	378
BENTHONIC FORAMINIFERA		
<i>Operculina complanata</i> ^b	x	x
<i>Operculinoides</i> sp. ^b	x	
<i>Patellina inconspicua</i> ^c		x
<i>Peneroplis pertusus</i> ^c	x	
<i>Planorbulinella larvata</i> ^c	x	x
<i>Planulina ornata</i> ^c		
<i>Poreponides cribroropandus</i> ^c	x	x
<i>Pseudoponides umbonatus</i> ^c		x
<i>Pseudononion japonicum</i> ^b	x	x
<i>Pyrgo sarsii</i> ^c		x
<i>Quinqueloculina agglutinans</i> ^a	x	
<i>Q. lamarckiana</i> ^a	x	
<i>Q. tropicalis</i> ^b	x	
<i>Rectocibicides</i> sp. ^c	x	x
<i>Rotalia nicobarensis</i> ^b	x	x
<i>Ruessela spinulosus</i> ^c		x
<i>Spiroloculina antillarum</i> ^a	x	
<i>S. communis</i> ^a	x	
<i>Spirosigmoilina tenuis</i> ^c		x
<i>Sigmoilina celata</i> ^c	x	
<i>Textularia aurab</i> ^b	x	
<i>T. candeiana</i> ^c	x	
<i>T. secasensis</i> ^a	x	x
<i>Trifarina bradyi</i> ^b	x	x
<i>Triloculina tricarinata</i> ^a	x	x
<i>Trimosina millettii</i> ^c		x
<i>Uvigerina senticosus</i> ^c		x
<i>Valvulineria glabra</i> ^c		x

(a) Abundant; (b) common; (c) rare.

prolific in growth at 1000-2000 m range, is also present as rare, in st. 378.

Textularia secasensis is found in depth of >60 m, hence abundant in both regions. *Eponides tenera* and *Pseudoponides umbonatus* are typical deep water forms, but found, as rare, at st. 378. These species are common in the outer slopes of Bikini and other atolls in the Pacific⁸. *Cibicides lobatulus* found here is also found in the outer shelf region of Andros island of Bahama Bank⁸. *Dyocibicides biserialis* found to be abundant in 50-62 m depth, occurs at the shell (st. 354) at 99 m depth also.

Comparison of the benthonic species of this region with that of Visakhapatnam¹⁰ shows that several species are common to both. Bhalla¹¹ reports the occurrence of *Spiroloculina antillarum*, *S. communis*, and *Triloculina tricarinata* from the beach sands of Visakhapatnam also.

Spiroloculina antillarum and *Q. tropicalis* are not found in the west coast sediments. But species like *Textularia secasensis*; *Triloculina tricarinata*, *Dentalina communis*, *Bolivina robusta*, *Cancris sagra*, *Cornuspira involvens*, *Elphidium fax barbarensis*, *Spiroloculina communis*, *Poreponides cribroropandus*, and *Pseudoponides umbonatus* are common to both the areas¹². Such a comparison has shown that the east coast shelf fauna though similar in some respects, is somewhat different from that of the

west coast shelf fauna of India in the presence and absence of a few species¹².

Many of the species recorded here are reported from the Neogene and Holocene deposits of south and central Pacific⁸. Thus the assemblage shows an Indo-Pacific affinity. Similarly, *Rotalia nicobarensis* and *Triloculina tricarinata* are significant as they are known to occur since the Miocene time. These species are common in the present study area and the East African coast foraminiferal assemblages. Earlier, Bhalla¹³ while studying the foraminifera of the beach environment of Visakhapatnam and Madras observed that the elements of Indo-Pacific and East African assemblages exist in this region. Therefore, it may be stated that the foraminiferal assemblage of this regime includes both the Indo-Pacific and East African constituents.

The author is thankful to Dr S. Z. Qasim, Director, for permission and encouragement.

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Coincident Occurrence of *Sagitta enflata* (Chaetognatha) & *Cypridina dentata* (Crustacea: Ostracoda: Cypridinidae) Off Maharashtra Coast

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Received 22 March 1978; revised received 3 June 1978

Coexistence of unusual congregations of the chaetognath *S. enflata* and the ostracod *C. dentata* was observed in the zooplankton off the Maharashtra coast between 17°20' to 19°14'N and 72°21' to 72°56'E during the 12th cruise of *RV Gaveshani* in the west coast of India. They contributed 54 to 80% of the total biomass. Oceanic associations of plankton species usually exhibited high diversity and the coincident occurrence of 2 swarms of the distinct species was rare. Such dense concentrations of a few species may be considered as population explosions resulting in a situation referable to a 'monotone' plankton.