

Corroded Planktic Foraminifer (*Globorotalia menardii*) in the Southern Bay of Bengal Sediment Trap Sample of February 1992

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Abstract: Planktic foraminiferal studies from the southern Bay of Bengal (SBBT) indicate the presence of corroded specimens of *Globorotalia menardii* in the deep trap at a depth of 3011 m during February-March 1992. Strangely, all the other spinose and less resistant spinose foraminiferal species are found devoid of any signs of dissolution in association with the highly corroded specimens of *Gr.menardii*. In view of the above and also to the fact that this trap depth is well above the lysocline, it is postulated that these corroded specimens of *Gr.menardii* tests could have been supplied by lateral advection and mixed up with the settling particles at SBBT, thus this assemblage is a resultant of two different sources, during this particular period.

Keywords: Planktic foraminifera, Corrosion, Lateral advection, Sediment trap, Bay of Bengal.

INTRODUCTION

Time series sediment traps have been widely used to collect settling particles of both biogenic and lithogenic. Although, it is largely believed that these particles collected in sediment traps are true settling particles, one is frequently confronted with explaining the source of these particles. It is well established that generally the bulk of particles are sedimented into the sediment traps from the overlying water column. At times, however, the nature of particles suggests a source, which is not directly from the overlying water column. In such cases their origin either from bottom suspension or lateral derivation may be invoked. Examples of such alternate sources come from the Bay of Bengal, Guptha et al. (1997), Arabian Sea, Curry et al. (1992), Pacific Ocean, Honjo (1982). In this short note we demonstrate a similar problem encountered (source of *Globorotalia menardii* is in question) during the course of study of samples collected by bottom tethered time series sediment trap in which a significant portion of particles carried into the southern Bay of Bengal traps may be undoubtedly derived from sources distant from the trap location.

between the National Institute of Oceanography, India and the University of Hamburg, Germany, PARFLUX Mark V Time-Series Sediment Trap was deployed at Southern Bay of Bengal (SBBT). The trap was programmed to collect thirteen consecutive samples with 26 days duration from February - December 1992. At SBBT mooring location, two sediment traps, one each at 1518 m (shallow) and 3011 m (deep) depths were deployed. Following the standard procedures, the cups were poisoned with mercuric chloride before deployment to prevent the organic matter decomposition (Honjo, 1977; Honjo et al. 1982) and sealed. After recovery of the sediment traps, each trap sample was wet sieved through a 1 mm screen and the fraction <1 mm was later split into aliquots using a Precision Rotary Splitter. The aliquots thus obtained were further sieved into four size fraction <125µm, 125-250 µm, 250-500 µm and 500-1000 µm. The specimens of *Gr. menardii* were counted and computed for their relative abundance. In the present study, data from only deep trap is dealt with. Other results are discussed elsewhere (Rahul Mohan and Srinivasan, 2000).

MATERIAL AND METHODS

As part of continuous ongoing collaborative programme

RESULTS AND DISCUSSION

Investigation on planktic foraminiferal flux from

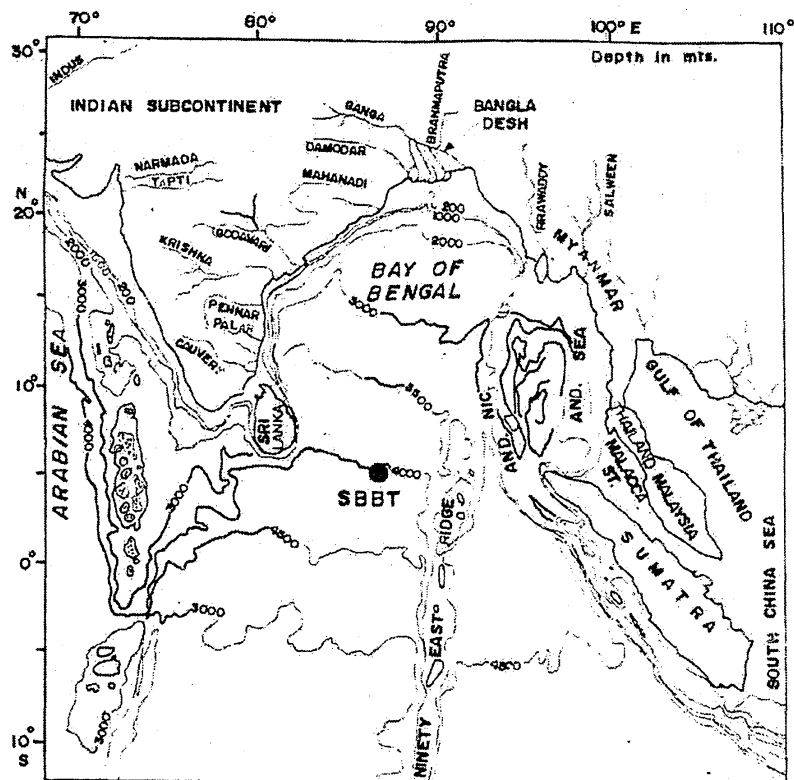


Fig.1. Location map of the Southern Bay of Bengal Trap (SBBT).

sediment trap in the Southern Bay of Bengal (SBBT), [Latitude: $05^{\circ} 00.333' N$ and Longitude: $87^{\circ} 03.235' E$ (Fig. 1)], show in addition to the normal foraminiferal flux, corroded planktic foraminiferal tests (Plate 1). These corroded tests of planktic foraminifera are of *Globorotalia menardii*. Specimens of *Gr. menardii*, in the size range of 250-500 μm , constitute about 40% of the total *Gr. menardii* population. All these solution affected specimens were found only in the deep trap deployed at a depth of 3011 m during February 8 and March 5, 1992. This period also coincides with the increased total planktic foraminiferal flux in the deep trap at 3011 m by a factor of three ($1582 \text{ tests m}^2 \text{ day}^{-1}$), contrary to $509 \text{ tests m}^2 \text{ day}^{-1}$ observed in the shallow trap at a depth of 1058 m (Figs.2a and b).

The small size fraction (125-250 μm), is largely composed of spinose foraminiferal species (*Globigerinoides ruber*, *Globigerinoides sacculifer*, *Globigerinoides tenellus*, *Globigerinella aequilateralis*, *Globigerinella calida*, *Globigerina rubescens*, *Globigerina bulloides* etc).

These foraminifera less resistant to dissolution are found in significant proportion without any signs of corrosion (Plate 1). If we compare all the above spinose species to solution susceptibility ranking list of planktic foraminifera

from delicate to resistant, all of them are placed well above the *Gr. menardii* in their susceptibility to solution (Thunell and Honjo, 1981; Hemleben and Auras, 1984). Yet, *Gr. menardii* the more resistant tests only display signs of dissolution, which is quite intriguing. Generally, the dissolution of foraminifera is related to changes in the watermass of oceans. But, the pH (acidic/alkalinity) measured for supernatant waters in the collection cups of traps is well within the alkalinity limits and hence there is no scope for any kind of dissolution.

Therefore, it is believed that these specimens of *Gr. menardii* in association with the less resistant foraminiferal species which are devoid of any signs of dissolution may not be of *insitu* origin which may be substantiated by the following reasons:

Firstly, most of the spinose species of planktic foraminifera prone to dissolution are well preserved and occur in significant numbers at a depth of 3011 well above lysocline.

Secondly, the dissolution of foraminiferal shells by and large do not (or very little) take place during settling of foraminiferal tests (Berger and Piper, 1972; Adelseck and Berger, 1975 and Honjo, 1977).

Thirdly, assuming the sinking velocities of *Gr. menardii*

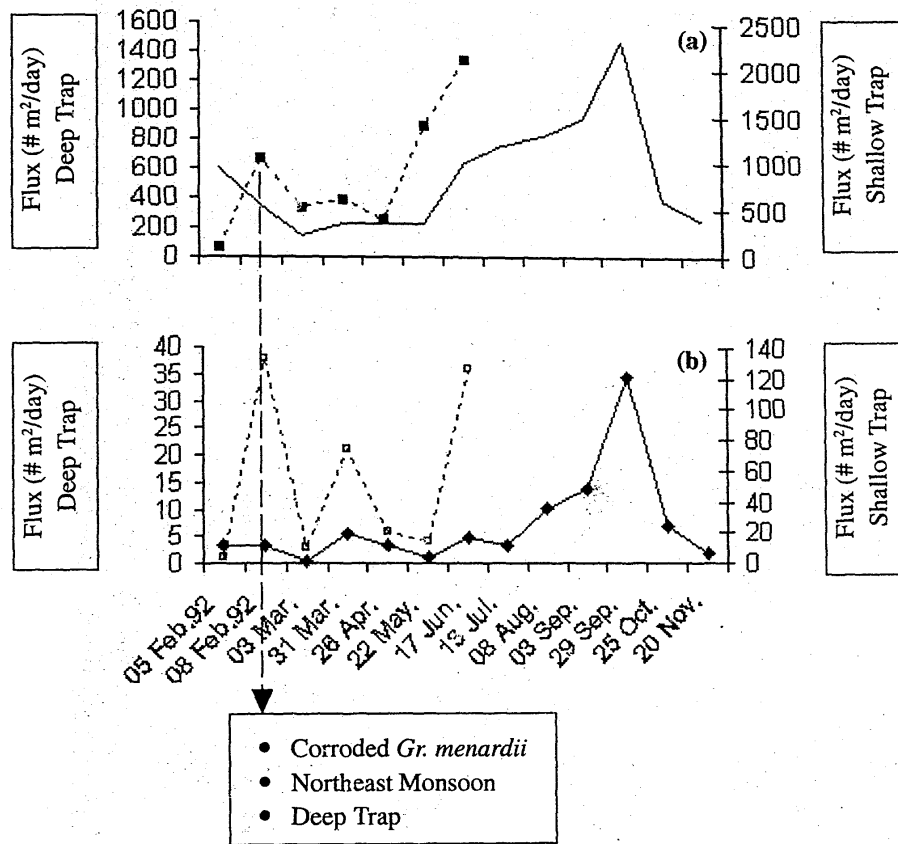


Fig.2. (a) Time series data of Total planktic foraminiferal flux [Y1 axis Deep trap/ Left axis; Y2 axis Shallow trap/Right axis] for the period Feb.05, 1992 to Nov.20, 1992. (b) Time series data of *Globorotalia menardii* flux [Y1 Deep trap/ Left axis; Y2 axis Shallow trap /Right axis] for the period Feb.05, 1992 to Nov.20, 1992. (Note only 07 samples collected by the deep sediment trap). The Dotted Line indicates Deep trap;.Solid Line indicates Shallow trap.

tests in plankton (Takahashi and Be, 1984), which is in the order of 1104 m/day, the residence time of these specimens in the water column before reaching the deep trap at a depth of 3011 m may be about three days and the residence time is too short to undergo dissolution, if any.

Fourthly, the occurrence of increased flux from shallow to deep trap is attributed to lateral advection in the southern Bay of Bengal (Ramaswamy and Parthiban, 1992), and finally, as the calcium carbonate compensation depth lies at about 4500-4700 m depth in the low latitudes of India (Kolla et al. 1976), where the bottom trap is deployed above the calcium carbonate compensation depth (Belyaeva, 1963), it is imperative to infer that these specimens of *Gr. menardii* have undergone corrosion elsewhere before they could be trapped in the deep trap.

von der Borch et al. (1974) reported the occurrence of strongly corroded keeled tests of *Globorotalia* on the seafloor from the DSDP Site 218, Leg 22, in the vicinity of SBBT mooring location. Furthermore, they also mentioned

that some of the more delicate foraminiferal tests were well preserved, and hence concluded that the occurrence of corroded tests of *Globorotalia* may be due to mixing/redeposition. However, the possibility of a role played by re-suspension of sediment at SBBT site may be ruled out as the depth between the deep trap and the seafloor is > 700 m.

The sediment trap location in the Bay of Bengal is about 500 km away from the eastern continental margin of India, which otherwise would have been one of the main sources of supply of material. Based on the study of a few deep sea cores from the southern tip of the Indian Peninsula in the Indian Ocean, contrary to Belyaeva (1963), Oba (1969) reported that all the cores from a depth range of 2523 m to 4863 m display some degree of dissolution evidenced by fragmented broken tests of *Gr. menardii*. Although, Oba (1969) did not explain reasons for dissolution at shallow depths, Steens et al. (1992) reported the fragmentation in foraminiferal shells in western Arabian Sea and attributed to variation in intensity and vertical distribution of the

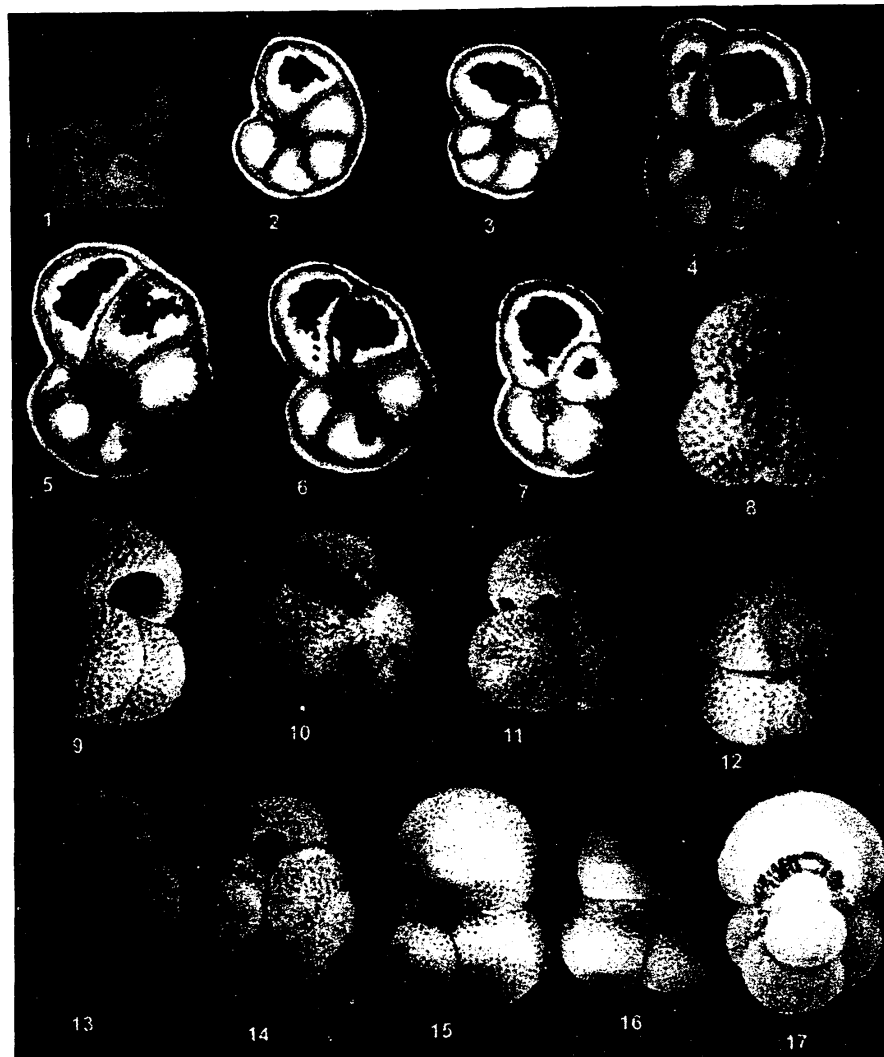


Plate 1.1. Enlarged view of dissolved shell wall of *Globorotalia menardii*, 1000 X. 2. *Globorotalia menardii*, 100 X, dissolution effect. 3. *Globorotalia menardii*, 100 X, dissolution effect. 4. *Globorotalia menardii*, 70 X, dissolution effect. 5. *Globorotalia menardii*, 70 X, dissolution effect. 6. *Globorotalia menardii*, 70 X, dissolution effect. 7. *Globorotalia menardii*, 100 X, dissolution effect. 8. *Globigerinoides ruber*, 200 X, note spines, apertural view. 9. *Globigerinoides ruber*, 200 X, side view. 10. *Globigerinoides ruber*, 150 X, trochospiral view. 11. *Globigerinoides ruber*, 150 X, trochospiral view. 12. *Globigerinoides quadrilobatus*, 150 X. 13. *Globigerinoides ruber*, 150 X, twinned rubber. 14. *Globigerinoides ruber*, 150 X, twinned rubber. 15. *Globigerinoides sacculifer*, 100 X, side view. 16. *Globigerinoides sacculifer*, 100 X, phenotype. 17. *Globigerinella aequilaterails*, 100 X, note intact spines.

Oxygen Minimum Zone (OMZ). This OMZ effects the dissolution of foraminiferal tests due to under saturation of calcium content. Furthermore, they attributed dissolution to the enhanced organic production in response to intense SW monsoon. Berger (1972) opines that the shallowing of the foraminiferal lysocline close to continents may be another causative factor responsible for carbonate dissolution during the interglacial period which is not applicable in the present case.

Apparently, as an alternative, these corroded tests must have been transported by under water currents (Antarctic

Deep Bottom Water?) flowing from south to north beyond the equatorial Indian Ocean region. Kolla et al. (1976) also suspected the bottom water current transport of sediment in the western Bay of Bengal. But as an alternative cause, deep sea abyssal storms is not plausible to invoke mixing/resuspension as for example Benthic Layer Experiments (HEBBLE) site on the Novo Scotian Continental Rise. Because, the distance between the sediment trap and the seafloor is >700 m, which is too high to influence re-suspension. It is further envisaged that, in addition to the tests of *Globorotalia*, significant quantity of clay may also

get transported and redeposited. Similarly, during the course of our investigation on coccolithophores along the equator (83° E and 93° E), we have come across an admixture of intact and corroded cells of coccolithophores suggesting that there is a possible lateral advection of particles taking place in this part of the Indian Ocean.

Acknowledgement: The authors are indebted to the Centre Director, National Centre for Antarctic & Ocean Research,

Department of Ocean Development, Headland Sada, Goa, and the Director, National Institute of Oceanography, Dona Paula, Goa for their constant help and encouragement. Thanks are also due to the Captain and crew of *ORV Sagar Kanya* and the Department of Ocean Development (DOD), New Delhi. One of the authors (RM) is grateful to DST for granting Fast Track Young Scientist Scheme in September 2002 at Department of Geology, Banaras Hindu University, Varanasi. Further, the authors would also like to thank two anonymous reviewers for constructive comments.

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(Received: 26 April 2004; Revised form accepted: 21 September 2005)