

FORAMINIFERAL ABUNDANCE IN THE MODIFIED MARINE ENVIRONMENT OF COLA BAY REGION OF GOA

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ABSTRACT

In recent years, the most important problem that affects the modern foraminifera particularly their abundance, tolerance level, distribution and their adaptation from natural environment to a modified environment is caused by pollution. Calcareous perforate foraminifera are found to be very abundant over all other types in the living populations.

In the Cola bay region of Goa, where the marine environment is affected by the industrial effluents, the foraminiferal distribution shows that *Ammonia beccarii* and its variants, *Florilus scaphus*, *F. boueanum*, *Elphidium crispum* and *Pararotalia* sp. are very abundant; *Ammonia dentata*, *Cibicides pseudoungarjanus*, *Elphidium poyeatum*, *Calcarina calcar*, *Quinqueloculina seminulum* are common and *Brizalina striatula*, *Gavelinopsis complanata*, *Gyroidinoides* sp. are rare. Many of these species are related to high organic carbon content present in the sediment.

INTRODUCTION

In recent years, pollution of the marine environment has attracted the attention of the people all over the world in regions where there is a heavy concentration of industries, atomic power plants, fertiliser, pesticide factories and such other industries this problem has assumed serious proportions.

A preliminary investigation of the distribution and ecology of benthic foraminifer in Cola bay, Goa was undertaken recently, as part of a project by the National Institute of Oceanography to determine the cause-effect relationship of pollution in this affected area.

Forty bottom sediment samples from the bay and four beach samples were collected and analysed. Some of the aspects of the environmental variables are described here.

THE SETTING

The study area is a shallow protected small bay surrounded by high cliffs composed of laterite and thick vegetation. The bay is skirted with aprons of sand and clay with a patch of silty-clay on the distal side close to the open ocean, and it is gently sloping outward (Siddiquie *et al.*, 1975) (Fig 1). The affluent pipeline discharges its contents to the coastal waters at a point immediately adjacent to the low water

POLLUTION STUDIES

Z.A.C. SITE COLA BAY

GOA

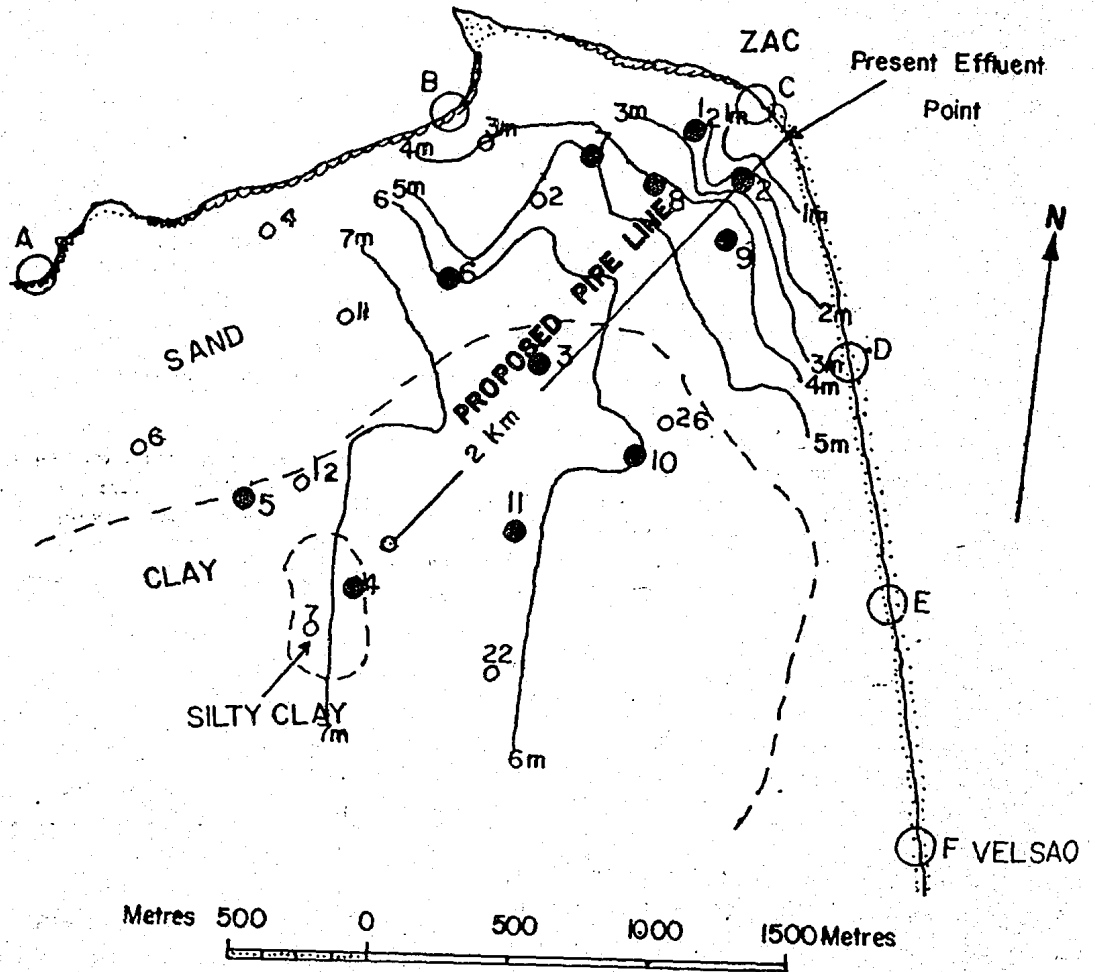
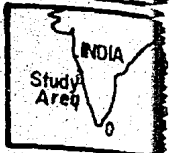


Fig. 1.

Map showing sample locations, bathymetry and sediment distribution in Cola bay region of Goa.

mark (low-tide level). This creates an ecological shift in the normal marine environment.

The organic carbon content of the bottom sediments in the Cola bay varies widely and ranges from a low of 0.16 percent to a high of 6.18 percent, however, in the intertidal region the organic carbon content in the sediment ranges from 0.034 to 0.0322 per cent. The highest concentration is found in station No. 6. Some samples contain a high percentage of lignin, a constituent of terrestrial plants. The number of foraminifers in such samples is found to be considerably reduced.

DISCUSSION

The foraminifers are represented by a total of 66 species of benthonic and two planktonic types in the area. About 10 per cent of the total number of species are agglutinated and the rest are calcareous species. In the beach and very shallow nearshore environment, the region is dominated by calcareous-hyaline type populations largely represented by the *Ammonia-Florilus-Elphidium* suite. But *Ammonia beccarii* and its variants, *Florilus scaphus*, *F. boueanum*, *Elphidium crispum* and *Pararotalia* sp. are the dominant forms present in the sediment that is very close or adjacent to the region of affluent discharges and in the downslope channel. Hence, it is clear that these are the most tolerant as well as the most abundant species. Further, the specimens encountered are large in size, robust in appearance, and most of the ammonias are megalospheric. Ammonias may be considered as the most dominant above all other species present. *Ammonia beccarii* and some of its variants appear to reflect their ability to compete successfully and reproduce in the modified environment to an extent of complete exclusion of other species which may have an adverse impact on the environment. This species is also dominant in the deeper part of the channel where the effluents have a downslope transport into the open ocean. These calcareous species are also the dominant living forms in the region.

Further analyses of the samples showed that *A. tepida*, *A. parkinsoniana*, *Cibicides pseudo-unquarianus*, *Elphidium poeyanum*, *Calcarina calcar*, *Quinqueloculina seminulum* are commonly found on both sides of the channel through which the effluent discharge flows; however, *Florilus scaphus*, *F. boueanum*, and *Pararotalia* sp. are also found to be present and thus represent a low incidence. It is very interesting to note here that *Brizalina striatula*, *Gavelinopsis complanata* and *Gyroidinides* sp. are rare but they are characteristically absent in the channel area. This indicates that they are not tolerant to the modified environment caused by the effluent discharge in the region.

It is observed that agglutinated species like *Milliammina fusca*, *Textularia agglutinans*, *Trochammina* sp. are less tolerant to the effluents, hence they are neither found near the point of discharge, nor in the channel but are found quite far away where the effluents have a dispersion, dilution and movement, and thus the toxic effect has possibly become ineffective. This reflects the change in habitat conditions at these locations. But agglutinated species like *Eggerella advena* dominate the foraminiferal populations in such areas which are adjacent to the industrialised shores (Schaefer, *et al.*, 1975). However, Schaefer (1971) believed that the high variability of foraminiferal species and their abundance in nearshore environments is mainly due to turbulence and bottom current action. They may be partly true in the case of Cola bay area where the foraminiferal population in the beach environment shows a high variability. Bandy *et al.* (1964) have observed that foraminiferal abundance trends are normally parallel to shore-line but they become altered at the discharge or outfall areas; but the present authors have noticed in the study area that the alteration of foraminiferal trend is more radial. Benthonic foraminiferal suite of *Ammonia-Florilus-Elphidium* is many times abundant in the affected areas than in normal conditions of environment. Thus calcareous foraminifers are found to be very abundant over all other types in the living populations also. Some of the wlel

known pollution indicator species like *Buliminella elegantissima*, *Bulimina*, *Margarita denudata*, *Eggrella advena* and others are not present in the study area as the nature of the modified environment required for them is possibly caused by different type of pollutants.

Further studies on solution effects on relict and living populations, aberrant growths in the living populations, species diversity and relationships of species and species groups to ocean pollution and relationships of foraminifera with organic carbon in sediments are underway.

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