

Benthic foraminifera and geochemical assessment of Puravadayinar and Vettar estuaries, Karaikal, south east coast of India—Implication for pollution monitoring studies

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ABSTRACT

A total of 24 surface sediment samples were collected from Puravadayinar and Vettar estuary. In the Puravadayinar estuary, 47 foraminifera and in Vettar estuary, 26 benthic foraminiferal species have been identified. The species, *Ammonia beccarii*, *A. tepida*, *A. dentata*, *Nonionoides elongatum*, *Elphidium advenum*, *E. discoidale*, *Cibicides simplex*, *Trochammina inflata*, and *Quinqueloculina seminulum* shows a prolific abundance in both region. Puravadayinar estuary records comparatively high value of organic matter in most of the stations. The contamination factor of the trace elements of sediment sample from the Puravadayinar estuary is $Co > Pb > Cu > Zn > Ni > Fe > Mn > Cr$ and in Vettar estuary $Co > Pb > Cu > Zn > Ni > Fe > Mn > Cr$. Factor analysis clearly reveals that fine particles and organic matter control the distribution metals in the sediments and organic matter act as a metal carrier in this region. These studies indicate geogenic origin of most of the elements. The impact of heavy metal pollution on benthic foraminifera was very less in the study area.

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1. Introduction

Microfossils are most common in marine environmental deposits, but also occur in brackish water, fresh water and terrestrial sedimentary deposits. Microfossils are ideally suited to environmental studies because their short generation times allow them to respond rapidly to environmental change. Foraminiferal studies have undergone a series of changes in the areas of sedimentation, biostratigraphy, and biochronology, palaeo-oceanography and planktonic evolution due to recent advance in technology, such as deep-sea coring, computers, and scanning electron microscopy. Benthic foraminifera are common in marine sediments; they are cosmopolitan, have a good fossil preservation and represent a useful tool for oceanographic and palaeoceanographic studies (Murgese and De Deckker, 2005) and their fossil remains can be used for palaeoecological reconstructions of former environments (Murray, 2001). For studies of marine biogeography and biodiversity, in small and large amounts of space and time, they are ideal

organisms (Buzasa et al., 2007). Several researches in foraminifera fossil, compared with the recent forms, leading to understanding the paleo-environmental conditions of the earth. The main objectives of the present study is to understand the ecology and distribution of benthic foraminifera, and to determine the environmental conditions of Puravadayinar and Vettar estuaries through sedimentological and geochemical studies of sediment samples.

2. Study area

The study area Puravadayinar is located in Karaikal districts of Pondicherry and Vettar estuaries is embedded in Nagapattinam districts of Tamil Nadu state (Fig. 1). Forming part of the fertile Cauvery delta, the region is completely covered by the distributaries of Cauvery. The Puravadayinar estuary is situated at the latitude between 10°50'30" and 10°51'0"N, longitude 79°50'30" and 79°51'30"E. The Vettar estuary is situated at the latitude between 10°49'30" and 10°50'0"N, longitude 79°50'0" and 79°51'0"E. The study area is covered completely by a thick mantle of alluvium of variable thickness. The region is flat, having a gentle slope towards the Bay of Bengal in the east. The geology of the study area is mainly comprised of quaternary sediments which increase towards the south of Coleroon River. These sediments

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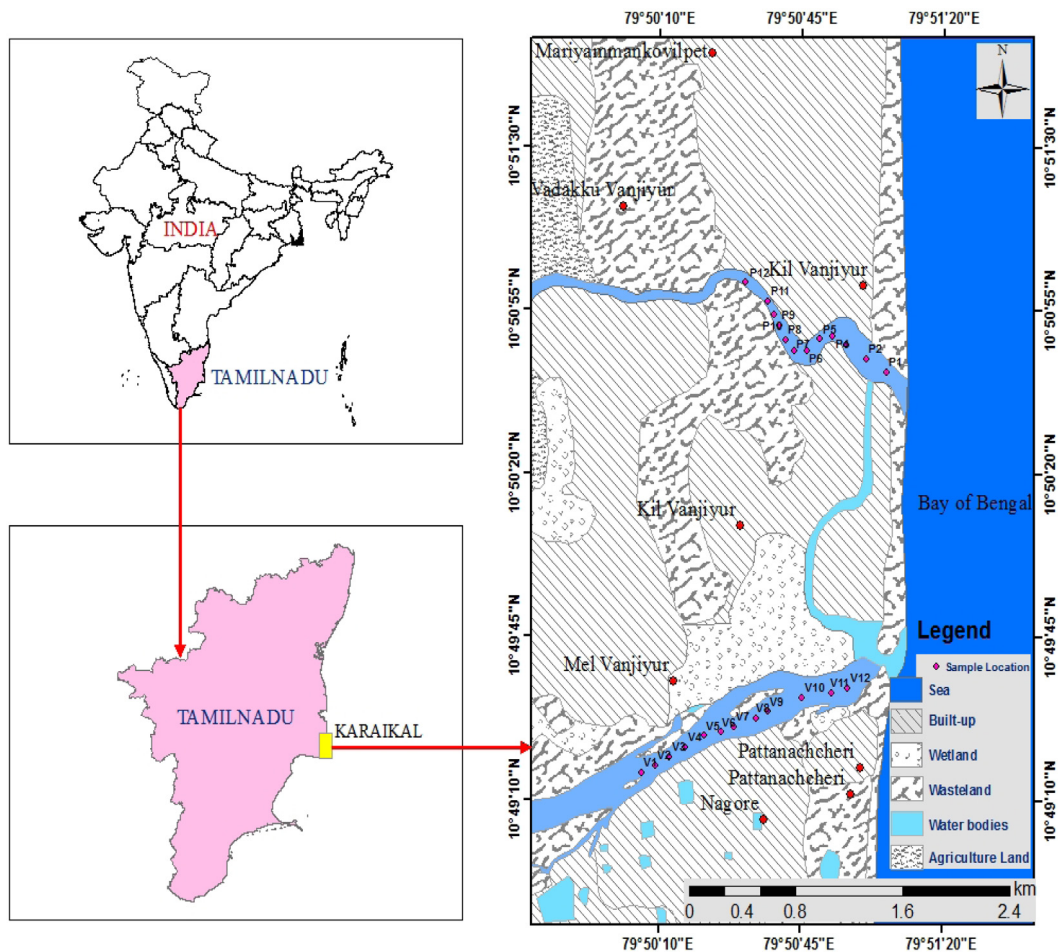


Fig. 1. Study area map showing sample location.

have been delineated as alluvium plain deposits of the Cauvery River and its distributaries as narrow fluvial-marine deltaic plain deposits and marine coastal plain deposits. The fluvial deposits comprise flood plain, flood basin, point bar, channel bar and Palaeo-channel with admixtures of sand, silt and clay. The deltaic plain includes Palaeo-tidal flat with clay and sand, sand ridges or gray brown sand.

3. Methodology

As a prelude to sample collection a base map was prepared using Survey of India topo sheets (1:50,000). All the prominent and permanent objects, rivers, tanks, roads and places were marked in the base map. In order to study the various aspects of recent benthic foraminifera, a field work has been carried out along the Puravadaianar and Vettar estuary. A total of twelve surface sediment samples were collected from each estuaries of Karaikal region (Totally 24 samples i.e., Puravadaianar and Vettar estuary) during the month of September 2014. pH were determined onboard immediately after collection using calibrated thermometer with a resolution of 0.1 and Elico portable water quality analyzer, respectively.

The sediment samples were wet-sieved through ASTM 230 mesh (opening = $63 \mu\text{m}$) and kept immersed in a solution of rose Bengal for at least 6 h (Walton, 1952). After coning and quartering the samples, 25 g of each oven-dried sediment sample was divided into four fractions using a convenient set of sieves: ASTM nos. 30, 60, and 120. The relatively coarser fractions (+30 and +60) were subjected to manual separation of foraminiferal tests using

a 0.00 Windsor sable-haired brush (brush with soft bristles), while the comparatively finer fractions (+120 and -120) were slowly sprinkled over carbon tetra chloride in a beaker. Foraminiferal tests that floated in the CCl_4 solution were separated by filtering the solution; the sunken fraction was cross-checked for any tests that might have escaped floatation. Foraminiferal tests separated by hand-picking and specimens were mounted over a thin layer of tragacanth gum on 24- or 48-chambered micropaleontological slides, according to their family, genus and species, wherever possible. The systematic study of foraminifera has been carried out, following the classification proposed by Loeblich and Tappan (1988). Sand-silt-clay ratio estimation was carried out using the procedure of Krumbein and Pettijohn (1938). Organic matter was determined by titration method of Jackson (1958). Estimation of CaCO_3 was made by adopting the procedure proposed by Piper (1947) for the digestion the geochemical analytical procedure suggested by Shapiro and Brannock (1956).

4. Results and discussion

In the **Puravadaianar estuary**, 47 foraminifera (45 benthic and 2 planktonic) species and varieties belongs to 27 genera, 19 families, 13 superfamilies' and 5 suborders of order Foraminiferidea has been identified (Table 1). Among these 4 are arenaceous, agglutinated taxa (suborder TEXTULARIINA), 1 is calcareous hyaline form (LAGENINA), 14 are calcareous, imperforate, porcelaneous forms (suborder MILIOLINA), and 27 are calcareous, perforate species (2 are planktonic forms) of the (suborder ROTALIINA). In the **Vettar estuary**, 26 benthic foraminiferal species and varieties belonging

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