

## FORAMINIFERA OF COASTAL AND OCEANIC WATERS OFF NORTH-EASTERN BRAZIL

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### RESUMO

A composição de espécies e a distribuição de Foraminifera costeiro e oceânico foi estudado no nordeste do Brasil, entre 2° a 9° S e 34° a 38° W. Coletou-se amostras com rede bongo (120 µm de abertura de malha) em 70 estações ao longo de 14 perfis perpendiculares à costa, em fevereiro-março/1995. Foram identificados 11 espécies. A baixa densidade (média total de 26 ind.m<sup>-3</sup>) correspondeu geralmente às massas de água oligotróficas, e diferenças na abundância foram afetadas localmente pela influência dos manguezais na áreas costeiras e pelas ressurgências topográficas nas áreas oceânicas. Foi indentificado um grupo de espécies indicadoras de massas d'água tropicais, de plataforma e da corrente do Brasil.

### ABSTRACT

The species composition and distribution of coastal and oceanic Foraminifera was studied off Northeast Brazil between 2° to 9° S and 34° to 38° W. Samples were collected with a bongo net (120 µm mesh size) at 70 stations along 14 transects perpendicular to the coastline from February to March 1995. A total of 11 species were identified. The low abundances (total average 26 ind.m<sup>-3</sup>) of Foraminifera generally corresponded to oligotrophic water masses and differences in abundance were locally affected by mangroves nearshore and by topographic upwelling offshore. The main group of species originated from a mixture of tropical, coastal and Brazil Current water masses.

Palavras-Chave: foraminífera, plâncton, atlântico sul

### 1. INTRODUCTION

The distribution pattern of living Foraminifera is determined chiefly by the climatic belts and their current systems. Thus, one can recognize antartic, subantartic, transitional, subtropical, and tropical assemblages (Bé & Tolderlund, 1971; Hemleben *et al.*, 1989).

The shelf and open ocean off Northeast Brazil is largely affected by two water masses, the Tropical (TW) and South Atlantic Central Waters (SACW) (Stramma *et al.*, 1990). A pycnocline with a stable thermocline, located between the depths of 100 and 300 m, prevents mixing between the Tropical surface and the deeper, nutrient rich SACW waters (Macedo *et al.*, 1996; Medeiros *et al.*, 1999). The inner-shelf waters are dominated by the oligotrophic Brazil Current (BC) and the low productivity is only enhanced by sporadic local upwelling events either at the shelf edge or at seamounts and island. The impact of several medium sized rivers upon the coast has yet to be established, but seems to be restricted to a narrow coastal band.

The planktonic Foraminifera exerts an important role in the marine environment, as they are used to trace present day ocean surface currents and their hydrographic properties (Boltovskoy, 1962, 1970; Kemle-von Mücke & Hemleben, 1999). However, little is known of the quantitative composition and distribution of Foraminifera off north-eastern Brazil. Previous investigations were restricted mainly to Boltovskoy (1981; 1999), although information for the Northeast of Brazil is fragmentary.

The survey formed part of the Brazilian-German JOPS II (Joint Oceanographic Projects) oceanographic expedition on board of the german RV Victor Hensen in Brazilian waters (Ekau and Knoppers, 1996) and this research was carried out in order to known the species composition and the distributional patterns of planktonic Foraminifera off Northeast Brazil.

### 2. MATERIALS AND METHODS

A Bongo net (mesh size 120 micrometers and mouth diameter of 30cm) was hauled obliquely at a speed of 2 to 2.5 knots from a depth between 14m in nearshore and 150m in offshore waters. A flowmeter (Hydrobios, Kiel) was fitted onto the opening of the net. Samples were preserved in a 4% buffered formalin/seawater solution. Foraminifera species were identified (Boltovskoy, 1981, 1999 manuals used among others) and taxon abundance per cubic meter was determined from a 1 ml subsample, taken with a Stempel-pipette of the entire sample (250 ml). Triplicate subsamples were counted.

### 3. RESULTS AND DISCUSSION

A total of 11 species were identified (Table I), of which 4 occurred in more than 50% of the samples, while 5 were found in less than 10% of the samples. The relative importance of different species varied among stations, although the most abundant species in decreasing order of numerical abundance were: *Globigerinoides ruber*, *Globigerinoides sacculifer* and *Globorotalia menardii*.

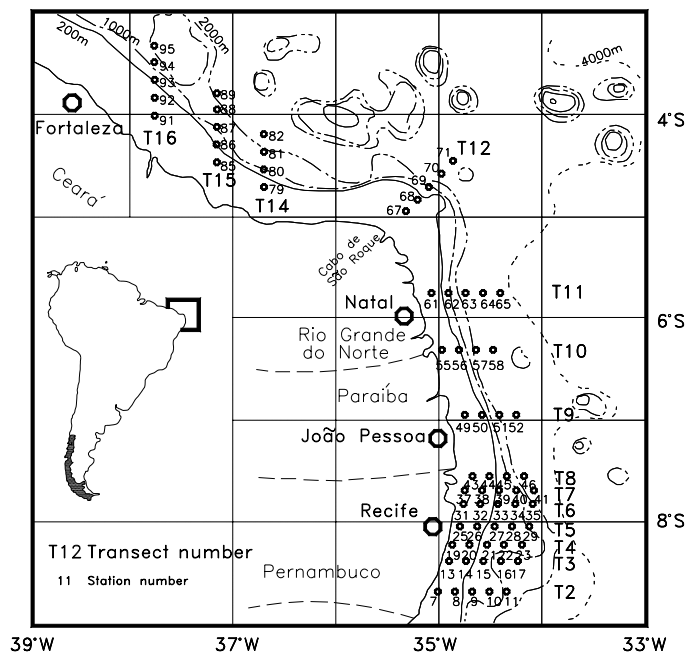


Figure 1 – Investigation area and plankton stations during leg 5 of the JOPS-II cruise.

Table I – List of Foraminifera species off north-eastern Brazil, February/March 1995.

| Species  |
|--|
| <i>Candeina nitida</i> d'Orbigny, 1839                           |
| <i>Globigerinella calida</i> (Parker, 1962)                      |
| <i>Globigerinoides ruber</i> f. <i>alba</i> (d'Orbigny, 1839)    |
| <i>Globigerinoides ruber</i> f. <i>Rosacea</i> (d'Orbigny, 1839) |
| <i>Globigerinoides sacculifer</i> (Brady, 1877)                  |
| <i>Globigerinoides trilobus</i> (Reuss, 1850)                    |
| <i>Globorotalia menardi</i> (Jones & Brady, 1865)                |
| <i>Hastigerina pelagica</i> (d'Orbigny, 1839)                    |
| <i>Orbulina universa</i> d'Orbigny, 1839                         |
| <i>Tretomphalus bulloides</i> d'Orbigny, 1826                    |
| <i>Turborotalita quinqueloba</i> (Natland, 1938)                 |

*Globigerinoides ruber* pink form may be considered a summer species, whereas *Globigerinoides ruber* white form occurs year-round and dominates during the austral winter. Its widespread distribution in the underlying sediment suggests that the planktonic pattern is a result of reproductive habits (Kemle-von Mücke & Hemleben, 1999). *Globigerinoides sacculifer* maximum abundance at the equator corresponds roughly with the oxygen rich SACW and the less saline surface water coming from the coast of Equatorial West Africa (Levitus & Boyer, 1994). This suggests that *G. sacculifer* is an indicator of oxygen-rich, low-salinity waters, yet in other regions, like the Caribbean, *G. sacculifer* prefers higher salinities, whereas *G. ruber* occur in low-salinity water masses. These contrasting observations suggest that, within certain limits, salinity seems to play a minor role (Kemle-von Mücke & Hemleben, 1999). On the other hand, food availability may explain these contrasting distributional patterns, as was observed by field and laboratory

experiments (Kemle-von Mücke, 1994), that indicate that *G. sacculifer* occupies more oligotrophic water masses and feeds mostly on copepods, whereas *G. ruber* prefers eutrophic environments. This pattern was observed in the present study, when *G. ruber* dominated in coastal eutrophic areas from Pernambuco and Paraíba State, while *G. sacculifer* dominated the oligotrophic coastal and oceanic areas of Rio Grande do Norte and Ceará States.

In general, in the transects off Rio Grande do Norte and Ceará States, oceanic species dominated at all stations, and this pattern could be attributed to the lack of freshwater runoff from the continent due to the dry climate and geomorphology of the area. Mabesoone and Coutinho (1970) mention that the constant Northeast tradewinds and the dry climate in the coastal area of these States permit the formation of extensive beaches and dunes, that are in constant movement due to vegetation absence; these dunes block the free flow of rivers to the sea and behind them a sequence of freshwater lakes are formed. The changes observed in these coastal areas seem to be principally driven by seasonal blooms of *Tetromphalus bulloides*, a benthonic species with a reproductive phase in the plankton. This species was also very common in most coastal samples.

*Globorotalia menardi* is a rather common member of the fauna in tropical ocean and indicates affinities with Equatorial Undercurrent, which flows along the equator at 50-100m (Bé, 1977; Kemle-von Mücke & Hemleben, 1999).

In general, the Foraminifera species composition was found to be diverse due the stable conditions in the TW present in the area. Environmental stability is characterized by a low range of environmental variation such as salinity, temperature and frequency of storm events (Levinton, 1995); and physically stable environments may accumulate more species than variable environments (Giller, 1984).

The abundance of Foraminifera was low with a total average of 26 ind m<sup>-3</sup>. No special pattern in abundance distribution was observed. The total abundance was found to range between 0.24 ind m<sup>-3</sup> (St. 10 - transect 2) and 45 ind m<sup>-3</sup> (St. 25 - transect 5). Highest average density was registered to *G. ruber* f. *rosacea* with 18.7+7.8 ind.m<sup>-3</sup> (Fig. 2). Besides the planktonic species, it was registered some benthic Foraminifera (*Amphistegina*, *Triloculina*, *Quinqueloculina*, *Elphidium*, among other genera), that probably were collected by the plankton net, mainly in coastal area, due to intense turbulence.

It can be concluded that the studied area is characterized by a high biodiversity but can be regarded as being among the most oligotrophic marine habitats in Brazil, when considering the magnitude of abundance of the Foraminifera. The narrow shelf allows nearshore incursion of oceanic populations and vice versa resulting in a strong interaction between these communities.

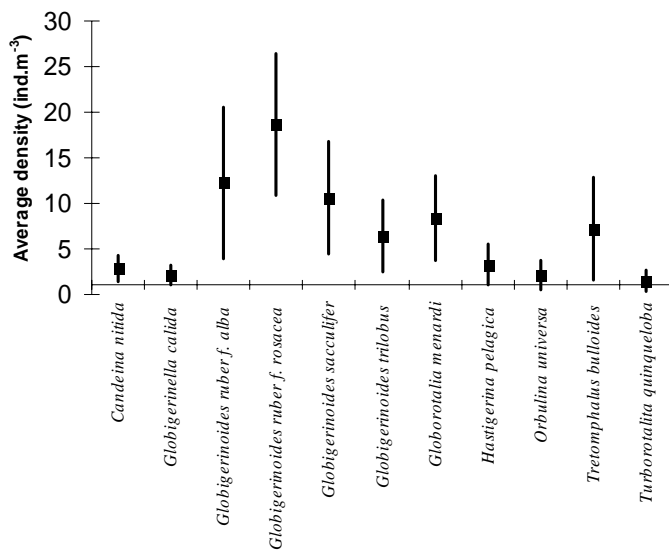


Figure 2 – Average density and standard deviation of the Foraminifera off north-eastern Brazil, February/March 1995.

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