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Foraminifera and thecamoebians from São Francisco River Delta, NE Brazil: Environmental applications

Décio Luis Semensatto-Jr & Dimas Dias Brito

Laboratório de Análises Microbióticas, Micropaleontológicas e de Ambientes (LAMBdA), DGA, IGCE, Universidade Estadual Paulista (UNESP), Avenida 24A, 1515, C.P. 178, 13506-900, Rio Claro, SP, Brazil - semensattojr@terra.com.br

The São Francisco river delta estuarine system, in Sergipe State, northeastern Brazil, has undergone severe changes in recent years. The system includes - mangroves, fluvial and tidal channels, a narrow lagoon and a barrier island segmented by an inlet. Foraminifera and thecamoebians of this ecosystem were studied from 104 samples collected in March 1996 (48 samples) and in March 2004 (56 samples), the majority of them precisely repeated in the same point in both years. The composition and the structure of communities of the two periods were compared among themselves and to the respective abiotic data (salinity, pH, mud, heavy metals, nutrients and organic matter). An ecofaciological mosaic was recognized, in which ecofacies have changed and have shifted their boundaries as a response to hydrodynamic and hydrohalinic changes that have occurred in the system, mainly caused by the expressive inlet shift:

- a) *Centropyxis-Miliammina fusca* (CM) ecofacies (1996) and *Centropyxis-Difflugia-Miliammina fusca* (CDM) ecofacies (2004), typically under influence of oligohaline waters strongly affected by fluvial discharges, with high diversity and equitability ($H' = 1.77 \pm 0.49$ and $J' = 0.66 \pm 0.16$ for CM; $H' = 2.03 \pm 0.32$ and $J' = 0.74 \pm 0.07$ for CDM);
- b) *Miliammina fusca-Arenoparrella mexicana* (MA) ecofacies (1996 and 2004), occupying oligohaline realms under minor fluvial influence, with the lowest diversity and equitability found in the system ($H' = 1.03 \pm 0.58$ and $J' = 0.40 \pm 0.17$ for 1996; $H' = 1.21 \pm 0.20$ and $J' = 0.54 \pm 0.07$ for 2004);
- c) *Ammotium-Arenoparrella mexicana-Trochammina-Miliammina fusca-Ammonia* (AATMA) ecofacies (1996) and *Ammotium-Ammobaculites* (AA) ecofacies (2004), typical from meso-polihaline environments, with the highest diversity and equitability found in the

- system ($H' = 2.00 \pm 0.23$ and $J' = 0.71 \pm 0.06$ for AATMA; $H' = 2.22 \pm 0.28$ and $J' = 0.81 \pm 0.05$ for AA); and
- d) *Quinqueloculina-Ammonia-Elphidium* (QAE) ecofacies (1996) and *Quinqueloculina-Elphidium-Ammonia* (QEA) ecofacies (2004), associated to the poli-euhaline lagoonal channel, absent of thecamoebians, with diversity and equitability respectively higher than the CM and CDM, but lower than AATMA and AA ($H' = 1.85 \pm 0.50$ and $J' = 0.64 \pm 0.14$ for 1996; $H' = 2.26 \pm 0.42$ and $J' = 0.79 \pm 0.08$ for 2004).

The recognized microfaunistic distribution pattern allowed delineating the hydrodynamic model operating in the system, which is a strategic tool to plan actions in the case of eventual oil spills in the region. These ecofacies indicate that the system became fresher in 2004. Additionally, they represent structural and distribution microfaunistic models in a non-polluted estuary, as revealed by geochemical data, especially considering biologically available trace-metal concentrations (e.g. from 0.4 to 23.2 ppm for Cu and from 1.5 to 49.7 ppm for Zn); thus, they can be used as a reference to indicate to what level a similar ecosystem have already been impacted by anthropogenic pressure. They can also be applied to the diagnosis and monitoring of impacts caused by oil spills that eventually may reach this Brazilian coastal area in the future. This study is also useful to paleoecological analysis dealing with ancient depositional systems and to investigate relative sea level changes.