



**Pollen Analysis Revealing the Paleoenvironment of a 3520 years B.P. old
Sediment in the Guanabara Bay, Rio de Janeiro, Brazil**

Análise de Polens para a Interpretação Paleoambiental de Sedimentos com
3520 anos A.P. na Baía de Guanabara, Rio de Janeiro, Brasil

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Resumo

O presente trabalho visou indagar a dinâmica de diferentes tipos de vegetação que ocorriam na região da Baía de Guanabara, Rio de Janeiro, durante o Holoceno recente, analisando um nível de sedimento com a idade convencional de 3520 ± 50 anos A.P., coletado na enseada de Jurujuba. A análise palynológica do sedimento indicou a predominância da Floresta Ombrófila. Táxons botânicos de vegetação de Campo não eram frequentes. As condições ambientais eram favoráveis ao desenvolvimento de plantas higrófitas. Dinâmica similar deste evento transgressivo do nível do mar foi também observado em outras áreas litorâneas do estado do Rio de Janeiro, distantes da Baía de Guanabara.

Palavras-chave: análise polínica; sedimentos holocênicos; Baía de Guanabara; Rio de Janeiro; Brasil

Abstract

The intention of the present investigation was to understand the dynamic of different types of vegetation that occurred in the Guanabara Bay region, Rio de Janeiro, during the recent Holocene, analyzing a sediment level of conventional 3520 ± 50 years B.P. old, obtained in the Jurujuba sound. Palynological analysis of the sediment showed dominance of the Ombrophilous Forest, and plant taxa of the field vegetation were not frequent. Environment conditions were favorable to hygrophyte plant development. Similar dynamic of this transgressive sea level event was detected also in other coastal areas of the state of Rio de Janeiro, far from the Guanabara Bay.

Keywords: pollen analysis; Holocene sediments; Guanabara Bay; Rio de Janeiro; Brazil

1 Introduction

While exploring the Brazilian coastline during January, more than 500 years B.P. ago, Portuguese sailors decided to moor in a large River mouth, naming it Rio de Janeiro. This river mouth is nowadays known as the Guanabara Bay. It's description was particularly apt, as at 4210 years B.P., when the sea level was lower than today, this bay was actually a river, with its mouth further seawards than its present position inside the continental shelf. Many tributaries converged into this main river, forming an extensive hydrographic basin.

During the subsequent marine transgression (Suguio *et al.*, 1985), large areas of the paleobasin were inundated, until the bay reached its modern hydrographic configuration (Figure 1). Climate oscillations occurred during the period of the transgression, resulting in several phases of inundation. The reconstruction of the Bay's paleoenvironment, using the analysis of the pollen content of dated sediments, was started by Barth *et al.* (2004) and (Barth *et al.*, 2006).

The Guanabara Bay lies within a half-graben tectonic band of Tertiary age known as Guanabara rift (Amador, 1997). It's main extension runs for 28 km north-south, and it's maximal width in the east-west direction is 20 km. A 1.6 km width and more than 30 m deep channel connects the bay to the Atlantic Ocean, allowing daily changes between marine and fresh water. Around the bay, sediments were deposited, and several vegetation types exist (Catanzaro *et al.*, 2004). However, the development of urban areas has largely altered these original environments, and their management is now subject to ongoing investigations.

2 Pollen Analysis

Two sediment levels and its respective paleoenvironment were described formerly (Barth *et al.*, 2004; Barth *et al.*, 2006), the elder, located in the central part of the bay next to the island of Paquetá, 4210 years B.P. old, and the other located inside a protected area in the north-east site of the bay, 1760 years B.P. old. The first studied sediment was deposited during the last maximal sea regression,

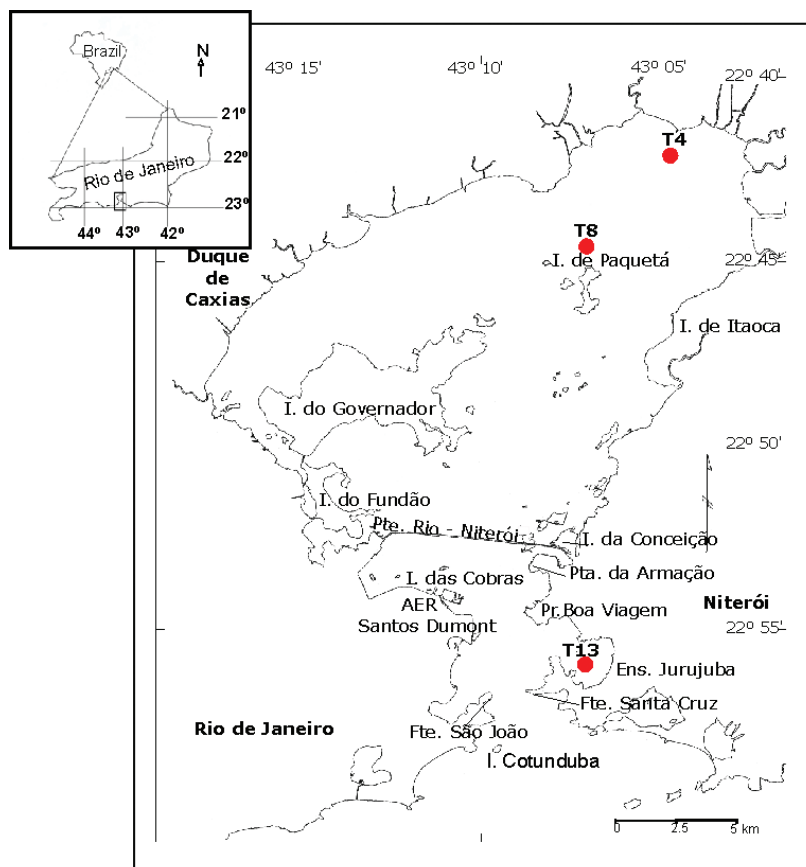


Figure 1 Position of studied sediment cores (T4, T8) and of a core under investigation (T13) inside the Guanabara Bay.

and the second, during a transgressive event, when mangrove formation was effective. The intention of the present investigation is to understand better the dynamic of the different types of vegetation that occurred in the Guanabara region during the recent Holocene, analyzing another sediment obtained inside a secondary bay next to the Bay's entrance.

A 223 cm long core (T13) was obtained in the Jurujuba sound (22°55'256''S and 43°06'346''W) using the percussion method and PVC pipes (Figure 2). The basis of this core was formed of compact mud and the 202-204 cm level sediment was dated by Beta Analytics Radiocarbon Laboratory (Florida, USA) using the ¹⁴C-AMS method resulting in conventional 3520 ± 50 years B.P. Palynological investigation followed the methodology described in Ybert *et al.* (1992), using HCl, HF, KOH, acetolysis and a Cl₂Zn gradient. *Lycopodium clavatum* spore tablets were introduced during sample processing. Counting comprised at least 300 pollen grains, and was expressed as relative percentages and absolute concentration. The classification of vegetation followed Veloso *et al.* (1991).

Palynological analysis of the sediment showed dominance of the Ombrophilous Forest. Tree taxa were represented mainly by pollen types of *Alchornea* (Euphorbiaceae), *Arecaceae*, *Astronium* (Anacardiaceae), *Hedyosmum* (Chloranthaceae), *Lecythis* (Lecythidaceae), *Myrsine* (Myrsinaceae), *Sebastiania* (Euphorbiaceae) and *Tapirira* (Anacardiaceae), and less frequently by *Anadenanthera* (Mimosaceae), *Ilex* (Aquifoliaceae) and *Meliaceae*. Common pioneer trees or shrubs were *Piper* (Piperaceae), *Celtis* and *Trema micrantha* (Ulmaceae), and lianas as *Arrabidaea* (Bignoniaceae).

The influence of mountain vegetation, due to wind transport, was documented by the presence of few pollen grains of *Podocarpus lamberti* and *Drymis brasiliensis* inside this sediment level. Plant taxa of field vegetation, like the pollen types of *Amaranthus*/Chenopodiaceae, *Brassica* (Brassicaceae), *Borreria densiflora* (Rubiaceae) and *Poaceae* were not frequent.

The sea level at this time was higher than the actual, corresponding to a period of a transgressive sea level (Martin, 2003). Environment conditions were favorable to hygrophyte plant development, occurring *Ludwigia* (Onagraceae), several species of Scrophulariaceae and *Typha* (Typhaceae), ferns and algae like *Botryococcus*.

No pollen grains of mangrove plant species could be detected, showing that this type of vegetation was absent or very restrict along the Guanabara Bay borders.

Similar dynamic of this transgressive sea level event was also detected in few other coastal areas of the state of Rio de Janeiro, far from the Guanabara Bay, using palynological and ¹⁴C (Beta Analytics) analysis of sediments (Figure 2). One of these was obtained in the Lagoa de Cima lake (Barth *et al.*, 2001; Luz *et al.*, 1999, 2005), northern region of the state, 3220 years B.P old, showing mixed natural open-land and tropical forest vegetation. Nearby, a sediment level in the Lagoa do Campelo lake, 2790 years B.P old, demonstrated the dominance of a hydrophite vegetation with low contribution of trees. Pollen analysis of a 3520 years B.P. old sediment, belonging to a sedimentary column collected in a fragmented forest area in the Poço das Antas National Biological Reserve, distant ca. 100 km northeast from the Guanabara Bay, recognized a expanding hydrophitic vegetation (Coelho *et al.*, 2008). More close to the Atlantic Ocean, a 2500 years B.P. aged basal sediment from a core obtained in the Lagoa Salgada lake, showed mainly the occurrence of a field vegetation, in accordance to a low sea level (De Toledo *et al.*, 2009).

Archaeological investigations detected an interruption in the sambaqui deposition at this time, correlated to a high sea level, which obliged the local population of collecting and fishing people to dislocate and occupy more distant places, where new sambaquis started (Amador, 1997; Kneip, 2001).

In summary, hygrophytic tropical rain forest elements was the dominant type of vegetation occurring during a transgressive sea level event, at circa 3500 years B.P., around the Guanabara Bay and in the coastal region of the state of Rio de Janeiro. Field vegetation was not so frequent, restricted to the lowlands between hills, and mangrove areas were nearly absent at this time.

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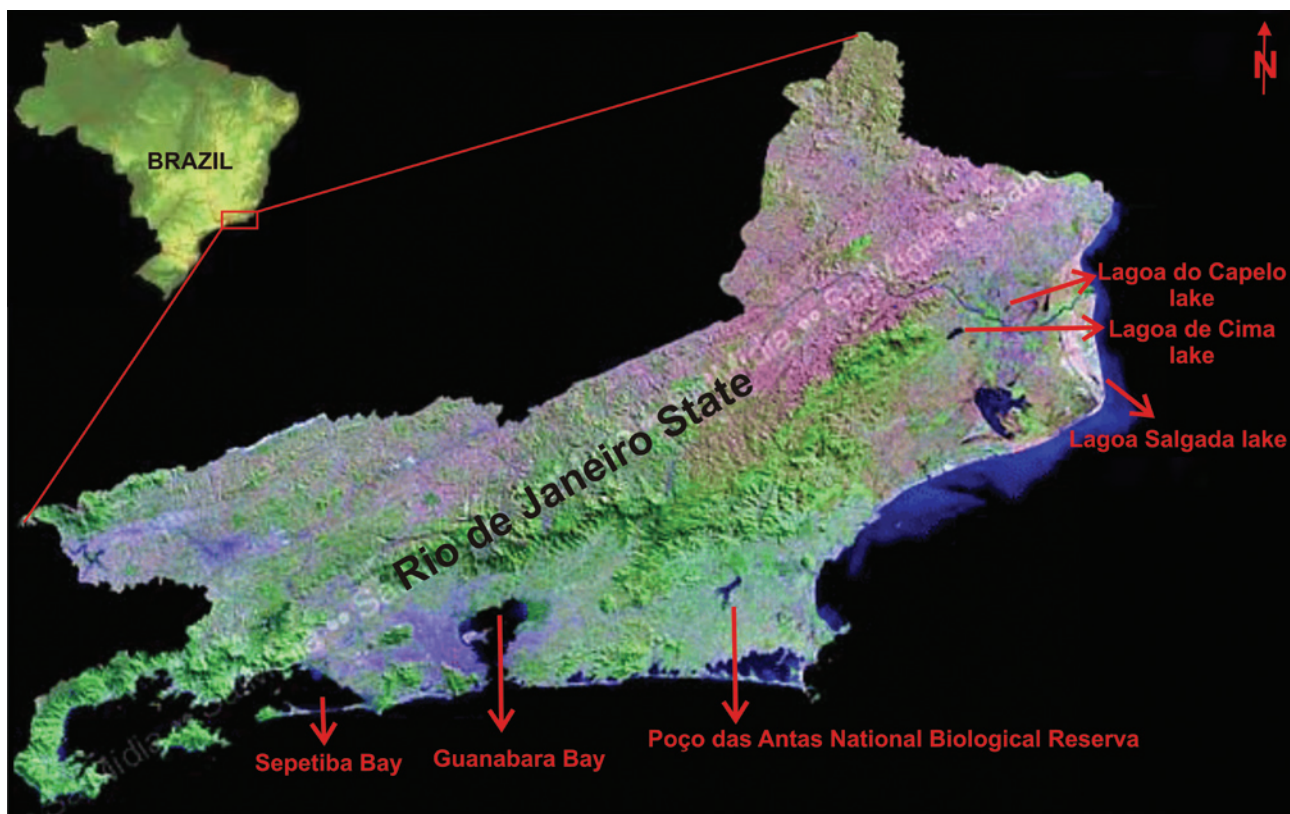


Figure 2 Map of the state of Rio de Janeiro pointing out coastal localities where pollen analysis of Quaternary sediments was realized.

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