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Palynological evidence of the replacement of the hygrophilous forest by field vegetation during the last 7,000 years B.P. in the northern coast of Rio de Janeiro, Brazil

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ABSTRACT

Historians claim that European colonizers of the northern coast of Rio de Janeiro State found vast herbaceous fields when arrived in this region. Hypotheses about the origin of these fields include forest burning by the Goitacás indians and periodical floods by the Paraíba do Sul River and the lagoon system. The palynologycal analysis of two lake cores obtained in the municipality of Campos dos Goytacazes revealed opening episodes of hygrophilous forest and the establishment of field vegetation, recorded at ca. 6,500 and ca. 4,000 ^{14}C yr BP. The partial replacement of forest by field vegetation in the first episode was probably caused by floods of the lower areas during the development of the Holocene lagoon phase. During the second episode, successions of vegetational patterns occurred due to lowering of the sea level. Drying and enlarging of the coastal plain have allowed its colonization by herbs and heliophyte plants. The palynological analysis does not provide any evidence that sustains the theories of use of fire and agricultural activities by indigenous groups during these periods.

Key words: Brazil, Campos dos Goytacazes, Holocene, palynology, vegetation dynamics.

INTRODUCTION

The geological features of the sea level oscillation during the Holocene in the coastal/deltaic plain of the Paraíba do Sul River, northern region of Rio de Janeiro State, were investigated by Martin et al. (1984, 1993, 1997). This region presents several shallow lakes, actually isolated or not from the sea, being relict bays of a large palaeolagoon system. Several palaeoenvironmental and palynological studies have demonstrated that the sea level oscillation during the Holocene changed the configuration of the Brazilian coast in many sites. These significant events affected the sedimentation process in lakes, and the regional vegetation (Cordeiro and Lorscheitter 1994, Lorscheitter 1997, Coelho et al. 1999, 2002, 2008, Barth et al. 2001, 2004, 2006, Macedo et al. 2007). The Campos dos Goytacazes Municipality, located in the northern coast region of the state of Rio de Janeiro, is an important area for palaeoenvironmental studies. The Atlantic Forest in this region represents a mosaic of different ecosystems, as xeromor-

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phic beach ridges, "Restinga" vegetation, Tropical Seasonal Semideciduous forest, Evergreen Rainfall forest, hygrophilous/swampy vegetation and grassland. Despite its environmental importance, the economical activities developed in this region since the arrival of Europeans have destructed large areas of the original vegetation and of the lake/lagoon sediments.

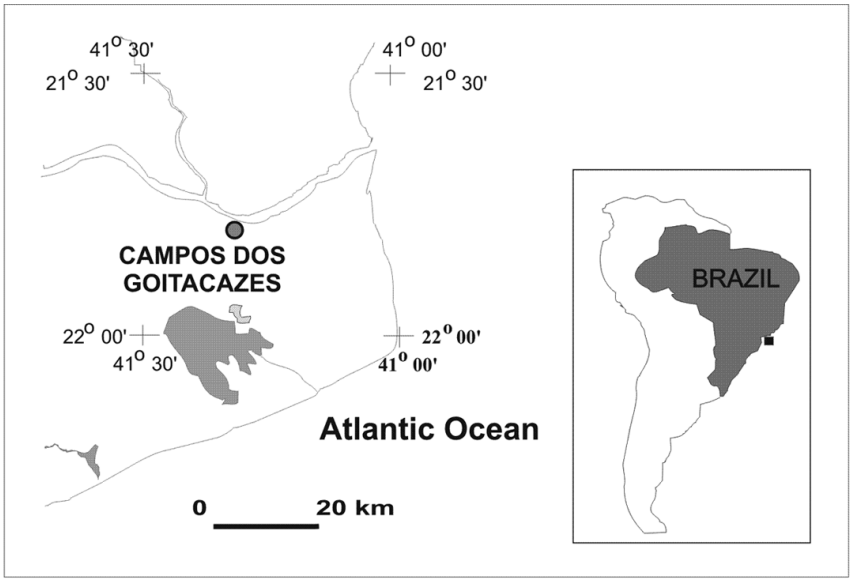
With the aim of reconstructing the temporal dynamics of the vegetation during the last 7,000 years, correlated to climatic changes and the sea level oscillation, palynological studies were performed on one core obtained in the Lagoa de Cima lake and on another in the Lagoa do Campelo lake, both located in the lowlands of the municipality of Campos dos Goytacazes. Palynological studies of surface sediment samples were conducted to elucidate the modern processes that have influenced the sedimentation of palynomorphs inside these lakes (Luz et al. 2002, 2003, 2005, 2010). The investigation was established upon the data obtained from palynological analyses of sediments, considering the palynomorphs as pollen grains, spores of Pteridophyta and Bryophyta, zygospores and coenobia of Chloroccocales algae.

Study Site

The coastal plain of Campos dos Goytacazes Municipality presents a group of lakes/palaeolagoons isolated from the sea during the Quaternary by the Paraíba do Sul River sediments (Lagoa de Cima lake), and by sand barriers or beach ridges (Lagoa Salgada lake and Lagoa do Campelo lake) (Fig. 1). These continental Tertiary sediments were invaded by seawater during the Holocene transgression phases, giving rise to numerous palaeolagoons. Their development into lakes can be related to the sea level oscillation during the last 7,000 years. The initial phase was established at south of Cape São Tomé with the formation of a large palaeolagoon and an intralagoonal delta related to the Lagoa Feia lake formation, the largest lake in the region. The establishment of a beach ridge system originated many isolated lakes during this phase. The Paraíba do Sul River changed to its actual position probably during the last sea transgression, remaining numerous palaeochannels. Another beach ridge system was developed later at the northern side of this cape, originating an additional lake system (Martin et al. 1984, 1993, 1997).

The Lagoa de Cima lake is embedded in a valley (Imbé River basin) located between the Barreiras Formation and the bedrock, 50 km west from the coastal line at about 30 m high. This lake may have been formed by an obstruction of a palaeolagoon called Ururaí Bay, and, therefore, represents the oldest lake in this region. The water is fresh and presents a diatomite deposit at its margins. It is conditioned by the inflow of the rivers Urubu and Imbé, and presents an outlet called Ururaí that flows towards the Lagoa Feia lake. This last lake is connected to the sea by a narrow passage. Nowadays, its drainage basin occupies an area of circa 986 km^2 and does not present industry activities, but an intense sugar-cane agriculture, pastureland, and a small remnant fragment of the Atlantic forest bordering the lake (Soffiati Netto 1985, 1991, FEEMA 1993). The Evergreen Rainforest covers the high mountains of the drainage basin, especially inside the Parque Estadual do Desengano, a government area for protecting the forest that is located 5 km west from the Lagoa de Cima lake (RADAMBRASIL 1983).

The Lagoa do Campelo lake is located at 17 km west from the coastline, at about 8 m high, bordering the Barreiras Formation and coming in touch with the flattened sediments of the coastal plain, which cover the Cretaceous layers of the Campos Basin. Its drainage basin is not well limited and occupies an area of circa 98 km^2. Without tributaries and effluents, the lake receives fresh water and sediments from several swamps and bogs connected to the Paraíba do Sul River. The water of the lake was not naturally drained into the Atlantic Ocean (Tolentino et al. 1986). Nevertheless, in 1950 the extinguished Departamento Nacional de Obras de Saneamento – DNOS (National Sanitation Department) undertook several drainage alterations in the Campos dos Goytacazes Municipality, in order to control the natural floods in this region. The construction of a channel connecting this lake to the Paraíba do Sul River and another channel towards the sea resulted in a negative hydrological balance (Soffiati Netto 1985, 1991, Bidegain 2002). A small remnant of the Seasonal Semideciduous forest can be observed at 5 km southwest of the lake, and a small swampy forest fragment of "Restinga" vegetation in the northeastern margin of the lake. Pastureland, sugar-cane agriculture and subsistence plantations constitute the regional landscape of



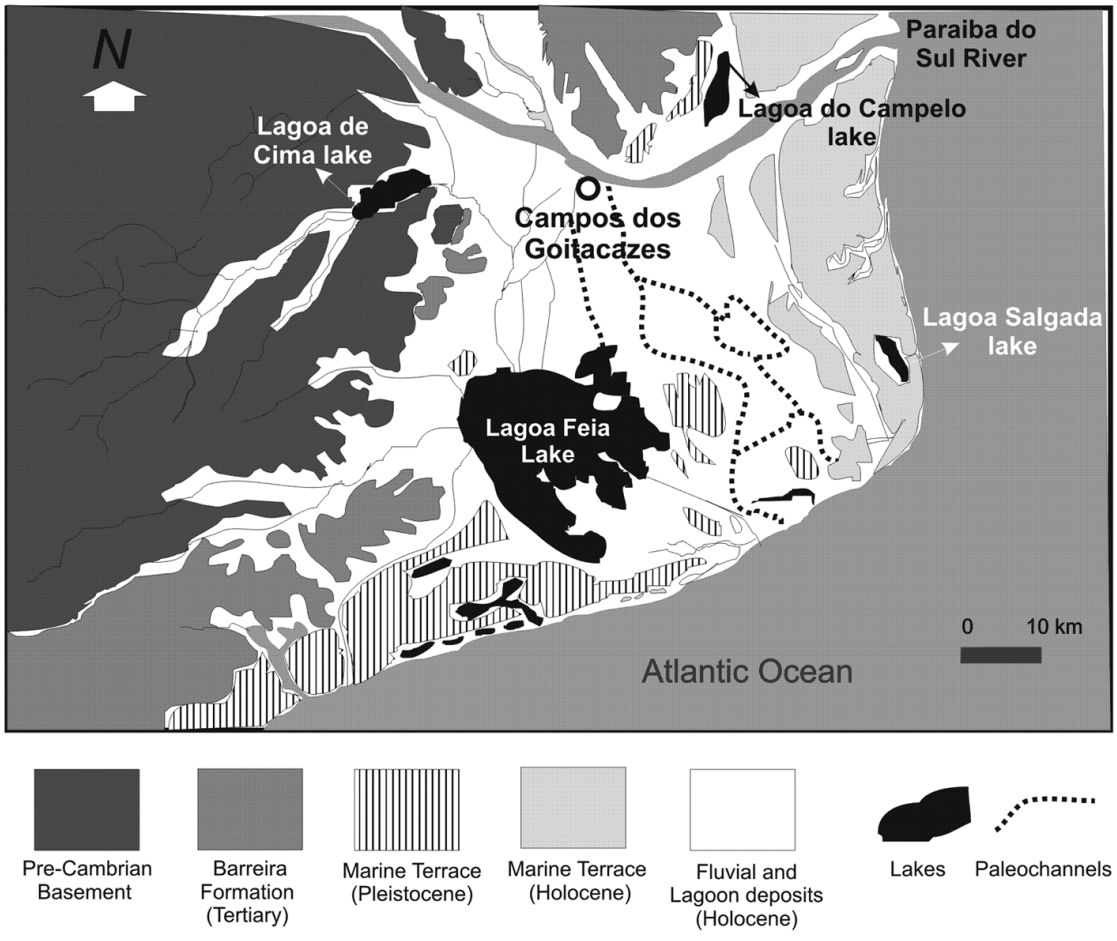


Fig. 1 – Geological map of deltaic plain of the Paraiba do Sul River and location of the Lagoa de Cima and the Lagoa do Campelo lakes, Campos dos Goytacazes Municipality (Martin et al. 1993, modified).

the drainage basin. The marsh vegetation next to the lake borders presents Cyperaceae, Poaceae, some additional plant taxa, and a characteristic large belt of cattail (*Typha*).

The studied region has a hot and humid climate with a strong seasonal influence. The rainfall pattern is related to a rainy summer with a dry season from May to September, during the winter, and with indices above 200 mm per month (AW of Koeppen). The average annual rainfall is around 900-1,100 mm, and the mean annual temperature around 22°C. The predominant wind comes from the NE (RADAMBRASIL 1983, Tolentino et al. 1986, FEEMA 1993, Bidegain 2002).

The anthropic influence in the northern region of the Rio de Janeiro State is intense and changed all the vegetation cover in the region. Assumpção and Nascimento (2000) conducted a floristic analysis of a few forest remnants of the "Restinga" vegetation in Grussaí (20 km southeast of the Lagoa do Campelo lake). The phytosociological structure of a Seasonal Semideciduous forest called "Mata do Carvão", the largest remnant fragment in this region located about 25 km north of the Lagoa do Campelo lake, was studied by Silva and Nascimento (2001). Moreno et al. (2003) performed the floristic analysis of the arboreal stratum at 50 m high in the Imbé Basin. Carauta and Rocha (1988) listed the vegetation composition in this region.

MATERIALS AND METHODS

The RJ93/1 core (410 cm long) was collected in the northeastern area of the Lagoa de Cima lake using a vibracore sampler presented in Martin et al. (1995). Several sedimentological sequences could be identified (Fig. 2). The following 23 levels from the Lagoa de Cima lake were analyzed: 02-03 cm, 12-13 cm, 22-23 cm, 34-35 cm, 44-45 cm, 56-57 cm, 62-63 cm, 72-73 cm, 83-84 cm, 92-93 cm, 102-103 cm, 112-113 cm, 129-130 cm, 146-147 cm, 169-170 cm, 182-183 cm, 202-203 cm, 212-213 cm, 222-223 cm, 232-233 cm, 242-243 cm, 258-259 cm and 292-293 cm. Three samples were submitted to radiocarbon dating at Bondy Laboratories (Institut Français de Recherche Scientifique pour le Développment en Coopération, France) and one at Beta Analytic Inc (Florida, USA) (Table I).

The Campelo 2001 core (205 cm long) was taken with a percussion sampler at the central part of the Lagoa do Campelo lake. From the base to the top of the core, several sequences were identified (Fig. 3). Six levels from the Lagoa do Campelo lake were analyzed: 20-21 cm, 98-99 cm, 193-194 cm, 200-201 cm, 203-204 cm and 204-205 cm. Two samples of this core were submitted to radiocarbon dating by Beta Analytic Inc. (Florida, USA) (Table II).

The 4 cm^3 of sediments from each level were prepared using the standard procedure (Ybert et al. 1992). More than 500 pollen grains of each level, besides the introduced *Lycopodium clavatum* L. spores, were counted. The concentration of palynomorphs was plotted considering the number of marker spores per cm^3 of sediment (Stockmarr 1971). TILIA software was used for statistical treatment of the palynological data. Pollen percentages were calculated based on the total pollen sum, excluding the pollen grains from hidrophyte/swampy plants (Typhaceae, Cyperaceae, Onagraceae, Scrophulariaceae, *Utricullaria*, *Eicchornia*, Nymphaceae and *Sagittaria*). The diagrams comprised all pollen grains that were grouped according to their plant habitat types: arboreal (shrubs and trees), non-arboreal (herbs and herbs/shrubs), other (all variable habitus) and hidrophytes, apart from fern spores, bryophytae spores and algae.

RESULTS

At the Lagoa de Cima lake the sandy base sediments, from 410 up to 292 cm, were devoid of palynomorphs (Fig. 4). In sequence, four main zones could be defined based on chronology and palynomorph assemblages (Table I).

Zone 1 (292 up to 171 cm, a clay-sandy sequence corresponding to an early period of 6,985 ± 50 yr BP until circa 5,725 yr BP – interpolated age)

The first analyzed sediment sample was from the 292/293 cm level. All pollen grains and spores were broken, degraded or corroded, and palynomorphs concentration was very low. It increased gradually in this zone until sample 212/213 cm (418962 palynomorphs/cm^3, the highest concentration in the whole core), falling abruptly down in the 202/203 cm sample (8228 palyno-

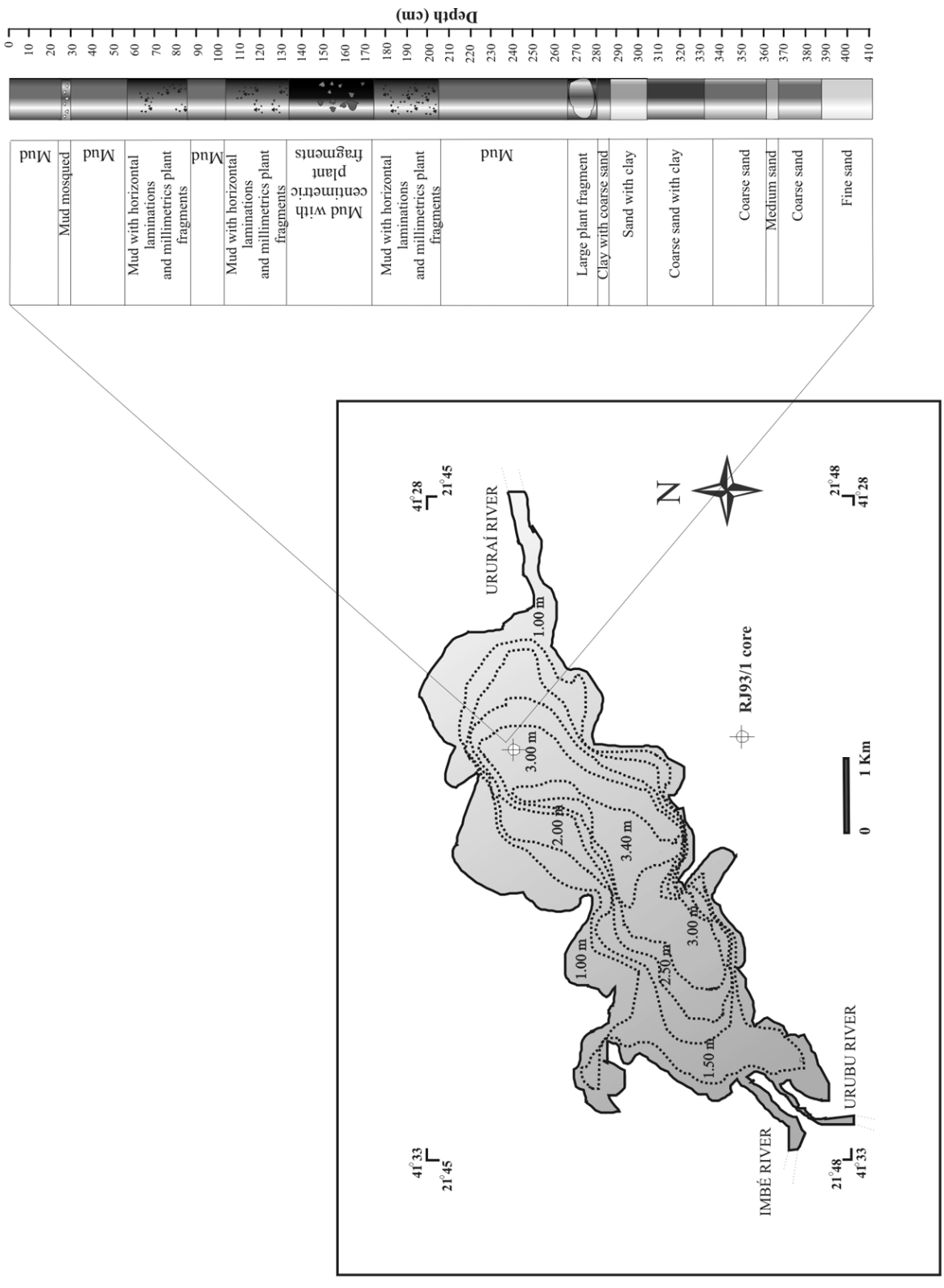


Fig. 2 – Bathymetric map of Lagoa de Cima lake with the location of the RJ93/1 core, Rio de Janeiro, Brazil.

TABLE I

Radiocarbon dates of Quaternary sediments at four levels of the core RJ93/1 from the Lagoa de Cima lake, Campos dos Goytacazes Municipality, Rio de Janeiro, Brazil.

Reference code from Bondy Laboratories and Beta Analytic Inc.	Conventional radiocarbon age	Calibrated radiocarbon age	Depth of the samples	Material
LY-10214	6,985 ± 50 BP	Cal BP 7,930 to 7,690	260-272 cm	Wood fragment
LY-10213	6,880 ± 65 BP	Cal BP 7,795 to 7,605	234-240 cm	Mud
LY-10310	6,225 ± 50 BP	Cal BP 7,510 to 7,320	190-194 cm	Organic Mud
Beta-170237	3,220 ± 40 BP	Cal BP 3,490 to 3,360	23-28 cm	Mud

TABLE II

Radiocarbon dates of Quaternary sediments at two levels of the core Campelo 2001 from the Lagoa do Campelo lake, Campos dos Goytacazes Municipality, Rio de Janeiro, Brazil.

Reference code from Beta Analytic Inc.	Conventional radiocarbon age	Calibrated radiocarbon age	Depth of the samples	Material
Beta-157950	2,790 ± 40 BP	Cal BP 2,970 to 2,780	204-205 cm	Peat
Beta-157947	2,320 ± 80 BP	Cal BP 2,500 to 2,140	16-23 cm	Peat

morphs/cm^3), and slightly increased again up to the 182/183 cm sample, the top of the rich mud sequence. Neither arboreal pollen grains nor algae were detected. The deposition of a vegetal remain dated from 6,985 ± 50 yr BP caused a perturbation in the clay sedimentation. Cyperaceae pollen grains were only observed in low percentage and concentration regarding the hidrophytes, as well as Poaceae of the herbs, and Moraceae of variable habitus plants. The highest concentration of palynomorphs was observed in sample 212/213 cm, presenting hidrophyte (mostly Cyperaceae and Typhaceae), herbs (*Althernanthera* and Poaceae), variable habitus plant (*Mimosa pudica* presenting 59% and Moraceae 4,7% of the pollen sum), shrub (*Piper* and *Geonoma*) and arboreal/shrub (*Cecropia* of 5,6% and *Myrcia* of 1,9%) pollen grains. Fern spores comprised about 25% of palynomorphs counted. Bryophyta spores showed in the 242/243 level their second largest concentration value in the core. Of the algae in this zone, *Botryococcus* disappeared after the 212/213 cm level, *Spyrogira* was only observed in the samples 212/213 cm and 182/183 cm, and *Pseudoschizea* was seen in sample 182/183 cm only presenting its highest concentration in the core.

ZONE 2 (170-131 CM, A MUD SEQUENCE CORRESPONDING TO THE INTERVAL FROM 5,725 YR BP – INTERPOLATED AGE – UNTIL CA. 4,925 YR BP – INTERPOLATED AGE)

The tendency of low palynomorph concentration was maintained, and the majority of pollen and spores has damaged exines. The arboreal pollen types prevailed over the non-arboreal. The hidrophytes were well represented by Cyperaceae. Arboreal/shrub pollen types of *Alchornea*, *Cecropia*, Myrtaceae and *Piptadenia*, as well as *Trema* (arboreal), *Piper* (shrubs), Araceae and Poaceae (herbs) and Moraceae (variable habitus)

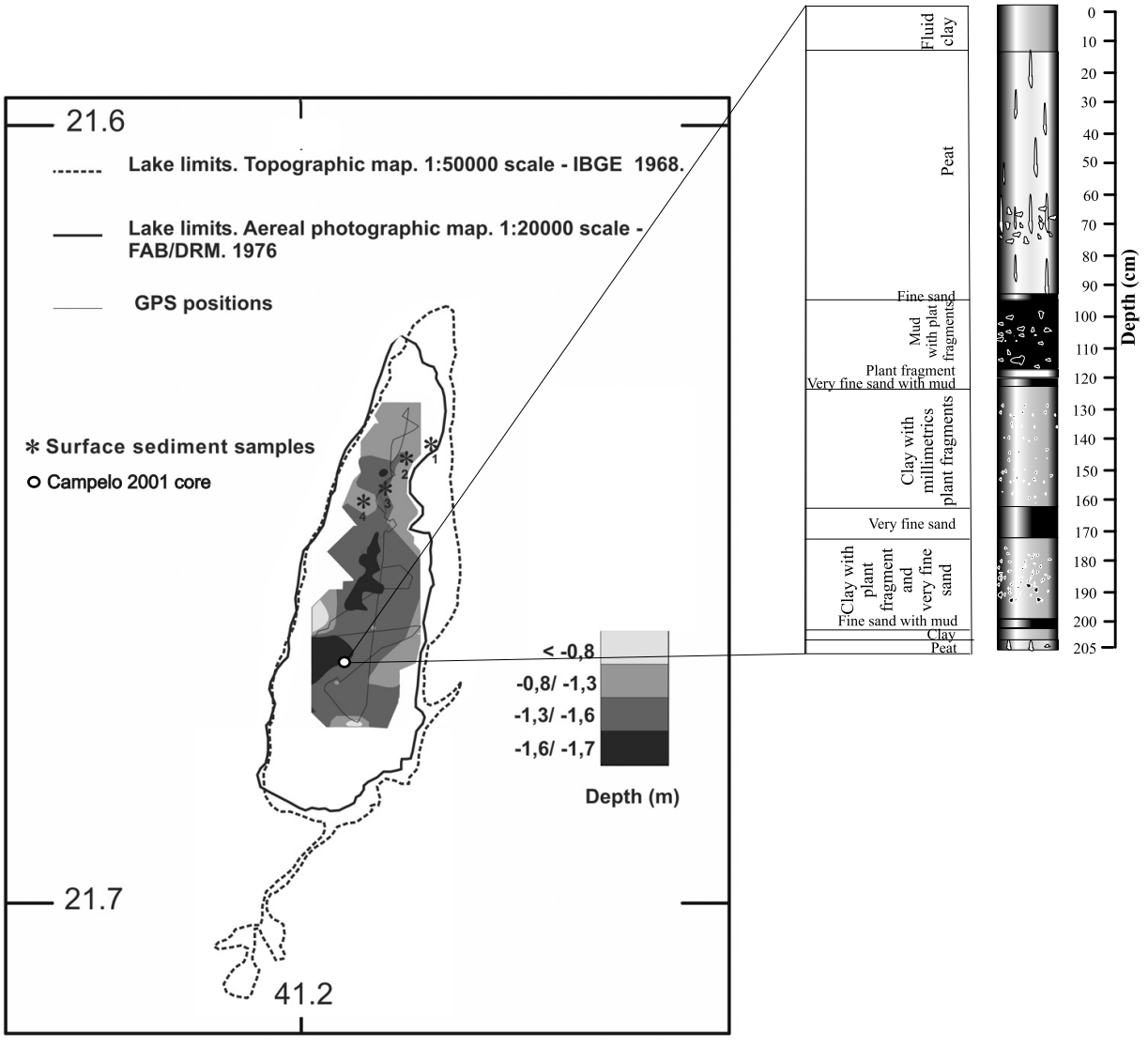


Fig. 3 – Bathymetric map of Lagoa do Campelo lake with the location of the Campelo 2001 core, Rio de Janeiro, Brazil (Luz et al. 2005, modified).

predominated. Herbs/shrubs were only represented by *Tetrapteris*. Fern spores were uncommon. *Spyrogira* was only seen among the algae.

ZONE 3 (130-11 CM, A MUD SEQUENCE CORRESPONDING TO THE INTERVAL FROM 4,925 YR BP – INTERPOLATED AGE – UNTIL CA. 3,000 YR BP)

Pollen and spores were well preserved at the beginning of this zone only. In the basal level of this zone (rich in vegetable remains) occurred a gradual increase in the concentration of hidrophytes and arboreal pollen types. The arboreal pollen types latter gradually decreased from the 112/113 cm level to the top of this zone due to the over-representation of *Mimosa pudica* (more than 70% of the pollen sum). However, the concentration values grew up gradually mostly because of *Anadenanthera*, *Celtis* and *Trema* arboreal pollen types. *Serjania* was detected. Arboreal/shrub pollen types of *Alchornea*, Arecaceae, *Cecropia*, *Ficus*, Myrtaceae and *Piptadenia* predominated. *Piper* presented high concentration. *Althernanthera*, Apiaceae, Araceae, *Borreria*, *Gomphrena* and Poaceae were observed among herbaceous pollen types. *Ichthyothere/ Aspilia*, *Phyllanthus* and *Tetrapteris* prevailed among herbs/shrubs. Asteraceae, Melastomataceae/Combretaceae, Monocotyledonous, Moraceae, *Psycothria*, sev-

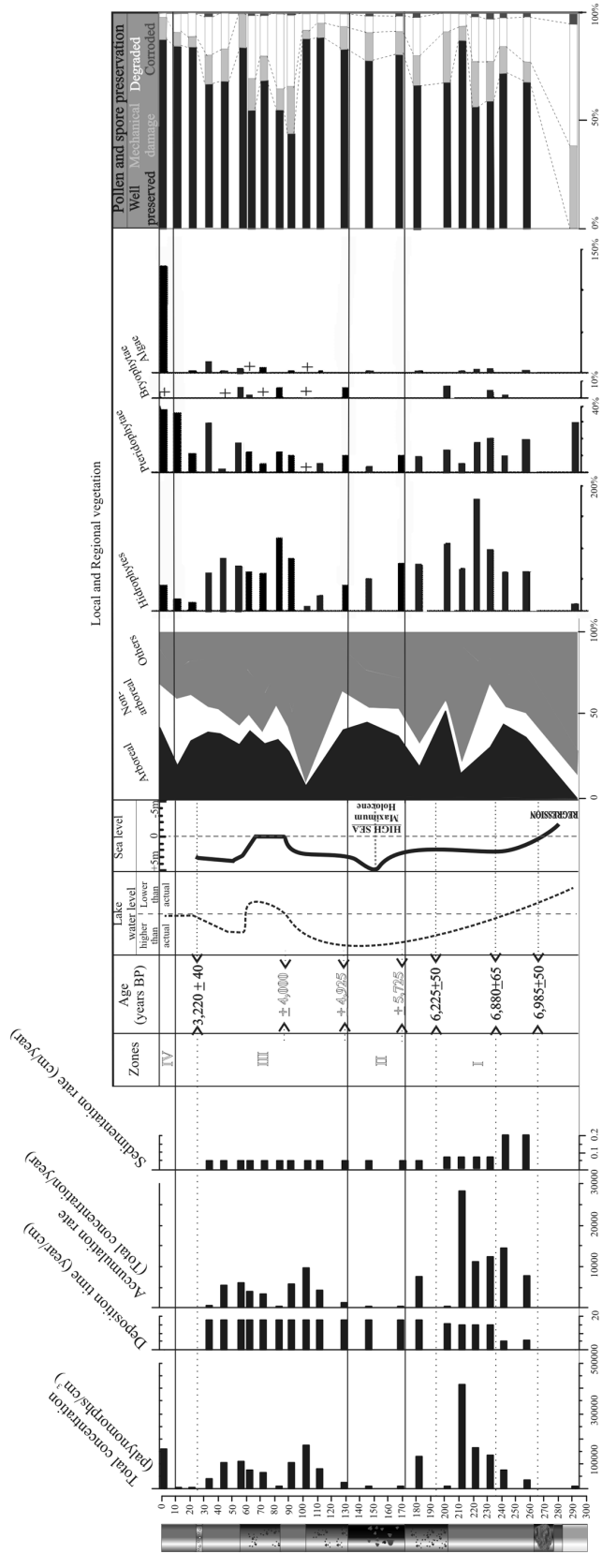


Fig. 4 – RJ93/1 core × total palynomorph concentration × deposition time × accumulation rate × sedimentation rate × water level of the Lagoa de Cima lake × sea level (based on Martin et al. 1997) × local and regional pollen types frequencies × frequencies of damaged pollen grains.

eral Fabaceae, Rubiaceae, Solanaceae and *Mimosa pudica* prevailed among the variable habitus category.

From the 92/93 cm level (without visible vegetal remains) to the 62/63 cm level (a new organic interval) occurred an increase of degraded palynomorphs and arboreal types. The sample 92/93 cm presented the second largest values of arboreal pollen concentration in the core (4873 pollen grains/cm^3), mostly due to *Anadenanthera*, *Celtis*, *Platymiscium* and *Trema*. *Alchornea*, *Erythroxylum*, *Ilex*, *Lamanonia*, Myrtaceae, Olacaceae, *Ouratea*, *Piptadenia*, *Rapanea*, *Vochysia*, *Weinmannia* and *Zanthoxylum* prevailed among the arboreal/shrubs pollen types. *Piper* and *Struthanthus* were present. Asteraceae, Melastomataceae, Moraceae, Fabaceae and Rubiaceae prevailed in the variable habitus category. Cyperaceae predominated among hidrophytes. Araceae and Poaceae were observed among the herbs. Fern spores of *Selaginella*, *Pseudoschizaea* and *Spyrogira* were observed among the algae.

In the 56/57 cm level (rich in vegetal remains), the percentage of well-preserved pollen grains and fern spores was high, prevailing the arboreal pollen types. Podocarpus pollen grains were observed only in this sample. Fern and Bryophytae spores presented their highest concentration in the core. *Cosmarium* and *Spyrogira* were observed.

ZONE 4 (11 CM UNTIL THE TOP OF THE CORE, A MUD SEQUENCE)

This zone included only the 02/03 cm level analyzed. Pollen and spores showed well-preserved sporoderms, and a richness of pollen types occurs. Palynomorphs concentration increased, and arboreal pollen grains (21826 pollen grains/cm^3) predominated over the non-arboreal (13997 pollen grains/cm^3). Fern spores comprised about 40% of the palynomorphs and presented their highest concentration in the core. The algae predominated among the palynomorphs and reached their maximum values in the core (mostly *Spyrogira*, *Scenedesmus*, *Pediastrum*, *Mougeotia* and *Coelastrum*).

At the Lagoa do Campelo lake core the chronology embraces a period of nearly 500 years, from circa 2,800 yr BP to 2,300 yr BP (Fig. 5, Table II). It reflects the change of vegetation and environment in the region.

The basal peat sequence, dated from circa 2,790 yr BP, showed a great richness of palynomorphs, with the predominance of arboreal over the non-arboreal, herbs and hidrophyte pollen types. The percentages of corroded and degraded pollen grains and of palynomorph concentration were high. *Pseudoschizaea* was frequent.

The richness and concentration of palynomorphs strongly decreased in the posterior clay sequence in sample 203/204 cm. Exine degradation and corrosion were soft, but mechanical damages increased. The arboreal and non-arboreal pollen types were of similar percentages. Hidrophyte pollen and fern spores predominated.

The following mud-sand layer (sample 200/201 cm) showed no palynomorphs.

The palynomorph concentration decline progressively in the following clay layer of sample 193/194 cm. Preservation of palynomorphs showed a high percentage of broken and corroded pollen grains and fern spores. The arboreal pollen types presented a slight dominance over the non-arboreal, with higher values of *Inga*, *Cecropia* and *Piper*. Hidrophytes and fern spores also prevailed. No algae were observed.

In the sample 98/99 cm (a mud layer) the concentration of palynomorphs remained low. The percentage of degraded palynomorphs increased, the corroded and mechanical damaged decreased. The arboreal predominated over the non-arboreal pollen types. For the first time in the core, *Mougeotia* zigospores were observed.

A sample near the top of the core (20/21 cm sample) demonstrated a great richness of pollen types and a high concentration of palynomorphs. Non-arboreal pollen types increased. Not corroded pollen grains and fern spores were observed, although the percentage of the degraded ones remained high.

DISCUSSION

The composition and accumulation of palynomorph assemblages in the sediments of Lagoa de Cima and Lagoa do Campelo lakes changed since the Mid-Holocene due to several factors as follows (Figs. 4 and 5).

The analysis of the RJ93/1 core from the Lagoa de Cima lake can corroborate the results of Martin et al (1997), i.e. that the sea level before 7,000 yr BP (^{14}C age) was probably lower than the current sea level, which was demonstrated by a sandy sequence in the

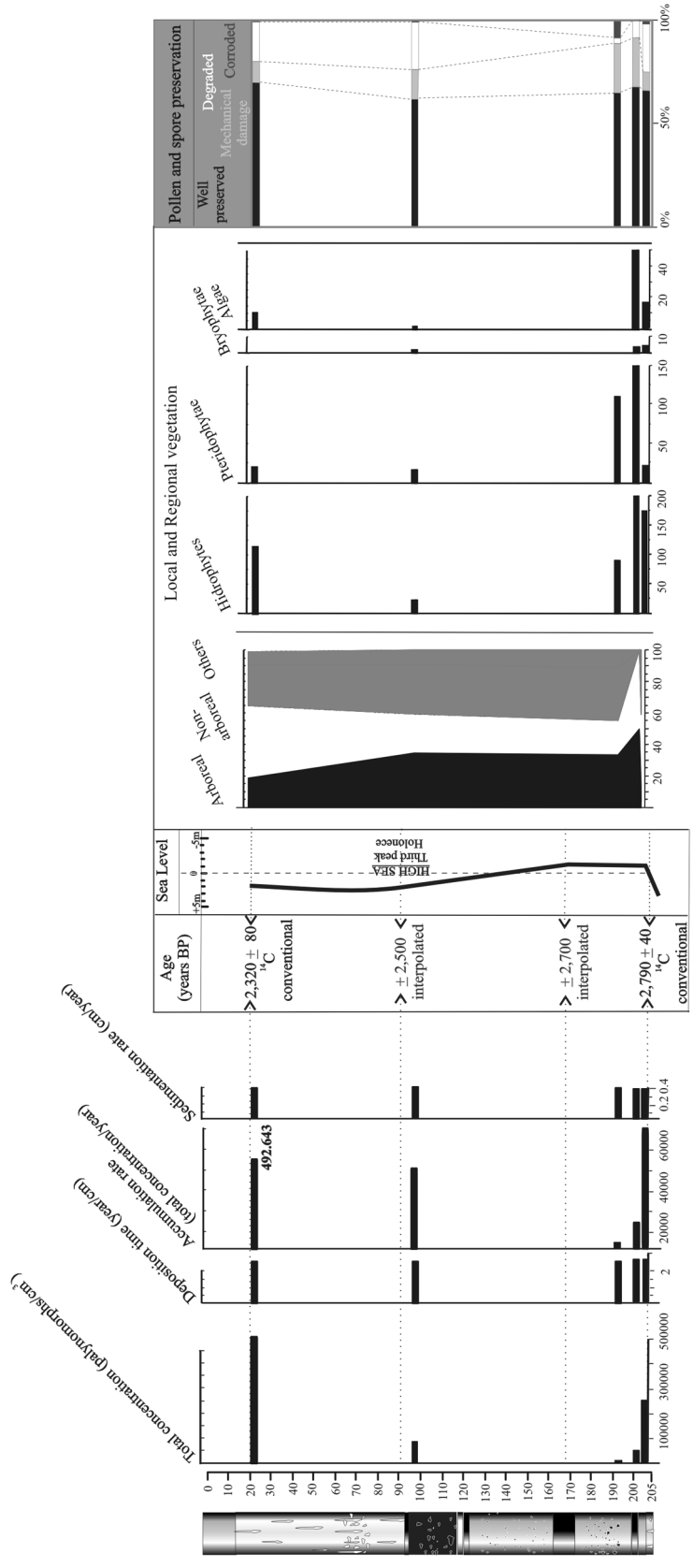


Fig. 5 – Campelo 2001 core × total palynomorph concentration × deposition time × accumulation rate × sedimentation rate × chronology × sea level (based on Martin et al. 1997) × local and regional pollen types frequencies × frequencies of damaged pollen grains.

lower part of the core and very low palynomorph concentrations. This can indicate that the waterflow velocity in the Lagoa de Cima lake increased due to falling sea level, resulting in transport of sediments of coarser particles to the drilling place and a palynomorph deposition downstream. A sandy-clay interval covered this sandy sequence and provided an evidence of a transitional phase between a continental deposition (probably fluvial) and a muddy sequence of lake sediments. The paleogeographic reconstruction of the coastal plain of the Paraíba do Sul River (Martin et al. 1984, 1993, 1997) showed that the Holocene sedimentation started with the formation of a barrier-island/lagoon system. The sediments transported by the Paraíba do Sul River began to be deposited into this lagoon, starting the construction of an intralagoonal delta. With the gradual elevation of the sea level, the delta sediments were deposited gradually at higher altitudes, damming the valley of the Imbé River. Pollen grain deposition of hydrophylous plants increased in the place of core drilling. The hygrophilous forest settled around the lake since its origin and co-inhabited at around 6,500 years BP with grassland vegetation. The flooded areas spread through the low valley of the Imbé River during the maximum of the Holocene sea level (± 5,100 yr BP), and large hygrophilous forests developed. Around 4,000 yr BP, the sudden lowering of the sea level caused the downfall of the accumulation values of palynomorphs in the drilling place, indicating again their preferential deposition away from the outlet side of the lake. The grassland vegetation developed again at this time and co-inhabited with the hygrophilous forest. The second lagoon phase started at circa 4,000 yr BP and facilitated the development of the hygrophilous forests. The rate of sedimentation in the drilling place was very low after 3,000 yr BP probably because of the removal of fine sediments due to the increasing flow of the Ururaí River towards to Lagoa Feia lake. The hydraulic activities performed by the Brazilian Government in the region may be also responsible for this occurrence. The sample of the top of the core probably corresponds to the actual sedimentation in the lake and presents pollen types of plants actually cultivated in the region.

Luz et al. (1999) established four main biostratigraphic zones based on the palynological analysis of another core (RJ92/6) also collected in the Lagoa de Cima lake. The results obtained were incomplete due to a clear inversion of sediments in this core demonstrated by radiocarbon dates, as a consequence of deposition of a sandy barrier in the core, taking away the previous stratigraphic sequence and influencing the interpretations.

The sediments of the core Campelo 2001 from the Lagoa do Campelo lake comprised a period of 500 years of sedimentation, and their base corresponded to ± 2,800 yr BP (^{14}C age). The palynological analysis reflected a well-represented hydrophytic vegetation of low richness of pollen types and high deposition of *Pseudoschizaea* in its basal sediments, characterizing the development of a swampy environment and a low water level. This time corresponded to a lowering of the sea level and originated a protrusion of the Paraíba do Sul River mouth into the ocean. The sea level remained low during circa 100 years, and the deposition of palynomorphs occurred away at the outlet side of the drilling point. Several swamps connected to the Paraíba do Sul River supplied the lake, but the water flowed into the channels of adjacent plains, carrying the fine sediments. With the rise of the sea level since 2,700 yr BP, the erosion in the outlet of the Paraíba do Sul River and the progressive damming of waters in the plain ocurred. Next to the positive eustatic peak (in about 2,500 yr BP), the pollen deposition was facilitated by the increase of the water level of the lake. At this time, the representation of pollen types from pioneer plants was high, and the richness of forest types increased. About 2,300 yr BP, the rate of total accumulation of palynomorphs was very high mainly by the increase of herbs and hydrophilous pollen types. The rate of sedimentation was very low after 2,300 yr BP (Luz et al. 2006).

CONCLUSION

Periods of the establishment of herbaceous areas replacing the hygrophilous forest during the Holocene in the northern Rio de Janeiro State were probably due to a natural changing process related to sea level oscillations, which reflected sometimes in the damming of the Paraíba do Sul River and sometimes in the draining of the plain. These environmental variations prevented the establishment of continuous arboreal and shrub vegetation, causing the fragmentation of the forest or even the

substitution of the forest by a vast field vegetation into the landscape.

Evidences of the use of fire and the presence of pollen grains of cultivated plants by indigenous groups were not observed in the sediments of these lakes during the studied period.

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RESUMO

Os historiadores citam que os europeus colonizadores da costa norte do Estado do Rio de Janeiro encontraram vastos campos herbáceos quando chegaram a essa região. As hipóteses sobre a origem desses campos incluem aplicação de "queimada" pelos índios Goitacás e periódicas inundações do rio Paraíba do Sul e sistemas lagunares. A análise palinológica de dois testemunhos de sondagem obtidos no município de Campos dos Goytacazes revelou epsódios de abertura da floresta higrófila e o estabelecimento da vegetação campestre, datados em ca. 6.500 e 4.000 ^{14}C anos AP. O primeiro epsódio de substituição parcial da floresta pela vegetação campestre se deu provavelmente pelas inundações das áreas baixas durante o desenvolvimento da fase lagunar holocênica. No segundo epsódio, os padrões de sucessão da vegetação ocorreram como consequência do abaixamento do nível do mar. O ressecamento e a progressão da planície costeira permitiram sua colonização pelas plantas herbáceas heliófitas. A análise palinológica não forneceu qualquer evidência que apoie as teorias do uso do fogo e da prática de atividades agrícolas por grupos indígenas durante esses períodos.

Palavras-chave: Brasil, Campos dos Goytacazes, Holoceno, palinologia, dinâmica da vegetação.

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