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THE PALEO-ENVIRONMENTAL SETTING OF SEPETIBA BAY, RIO DE JANEIRO, BRAZIL, IN THE LATE PLEISTOCENE: INTERPRETATIONS FROM HIGH-RESOLUTION SEISMIC STRATIGRAPHY

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ABSTRACT. Single-channel high-resolution seismic profiles in Sepetiba Bay, Brazil, were collected to describe the recent geological evolution of this area. The seismic data showed the existence of a discontinuity surface and two seismic units (Top and Bottom). The seismic-data interpretation and radiocarbon dating indicate that before the Holocene transgression (late Pleistocene) Sepetiba Bay was exposed to erosional processes. The paleo-topography consisted of a plain with some higher elevations (now islands of bedrock), a topographic high in the southern part of the bay (now the barrier island) and a sinuous river channel that ran parallel to the topographic high, perhaps exiting near Marambaia Peak. Other nearly coastal environments (e.g., Barra da Tijuca and Recreio dos Bandeirantes) are at various stages of evolution, at present insights to past conditions in Sepetiba Bay.

Keywords: Pleistocene, geological evolution, seismic stratigraphy, radiocarbon dating.

RESUMO. Perfis sísmicos de alta resolução da Baía de Sepetiba, Brasil, foram coletados com o objetivo de descrever a evolução geológica recente desta área. Os dados sísmicos mostraram a existência de uma superfície de descontinuidade e duas unidades sísmicas (topo e base). A interpretação dos dados sísmicos e a datação por radiocarbono indicaram que antes da transgressão Holocênica (Pleistoceno Superior), a Baía de Sepetiba foi exposta a processos erosionais. A paleotopografia consistiu de uma planície com algumas elevações (atualmente ilhas do embasamento), um alto topográfico na parte sul da baía, (uma ilha barreira no presente) e um canal fluvial sinuoso que flui paralelo ao alto topográfico, provavelmente desembocando próximo ao Pico da Marambaia. Outros ambientes costeiros próximos (p.ex. Barra da Tijuca e Recreio dos Bandeirantes), em vários estágios de evolução, são exemplos atuais para a compreensão das condições do passado da Baía de Sepetiba.

Palavras-chave: Pleistoceno, evolução geológica, estratigrafia sísmica, datação por radiocarbono.

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INTRODUCTION

The Quaternary geological evolution of inner continental shelves and coastal areas has been investigated based on the interpretation of seismic-reflection data and cores (Posamentier & Vail, 1988; Diaz et al., 1990; Farrán & Maldonado, 1990; Gensous et al., 1993; Okamura & Blum, 1993; Tesson et al., 1993; Hart et al., 1995; Barnhardt et al., 1997). Sea-level fluctuations during the Quaternary period affected sedimentation patterns on continental shelves. These changes in sea-level and associated changes in sedimentary processes can be interpreted from seismic-reflection observations and can be used to reconstruct the geological evolution of coastal areas.

The main objectives of the present paper are to reconstruct the depositional environments that existed in Sepetiba Bay, a back-barrier environment in southern Brazil, before the Holocene transgression, and to place its evolution in a regional geological context. High-resolution seismic profiles and vibracores are used to define depositional units and the unconformity that separates them.

STUDY AREA

Sepetiba Bay is located in the State of Rio de Janeiro, along the southeastern coast of Brazil (Fig. 1). Sepetiba Bay is an elliptical embayment with an area of $\sim$ 300 km^2. It is open to the ocean at two sites: through a tidal channel at Barra de Guaratiba at the east end and through a series of larger channels at the west end (Fig. 1).

The western region is partially closed by a chain of islands including Itacuruçá, Jaguanum and Marambaia, which follow a structural lineation NE/SW of the area. Bathymetry between the islands shows maximum depths of 24-31 m. The bay, itself, is shallow: about 8 m deep in the center with depth decreasing toward the coast. A coastal mountain range with elevations from 800-2200 m forms the western limit of the area. The coastal plain adjacent to this mountain range has elevations of less than 100 m. Marambaia barrier island, which encloses the bay, is oriented east-west and is 45 km long. It is attached to Marambaia Island, a rock island 640 m high on the west side, and is separated from the mainland in the east by a 300-m wide tidal channel. The continental shelf adjacent to the barrier island is 200 km wide and has a moderate inclination of 1:700 (Zembruscki, 1979).

Granites, gneisses, and migmatites form the Precambrian and Paleozoic basement in the bay region. Basic and alkaline rocks represent the Mesozoic and Tertiary. The coastal plain, composed of mangroves, dunes, beaches, and alluvial plains, was formed in the Quaternary.

Currents inside the bay are driven by tides and can reach maximum speeds of 75 cm/s in the channels between the islands of Itacuruçá and Jaguanum at the western end (DHN, 1986; Villena, 2003; Villena, 2007; and Rocha et al., 2010). The seawater that enters the bay as a bottom current is relatively cold and dense. It circulates clockwise through the bay, becomes warmer, and exits at the surface between Marambaia Peak and Jaguanum Island (Fig. 2). The direction of alongshore transport on the ocean side of Sepetiba Bay is east-west (Fig. 2). The ocean waves and wind are predominantly east and northeast (US Navy, 1992; Borges, 1990). The tide in the area has a moderate to small amplitude of 110 cm during spring tide and 30 cm during neap tide. There is a difference in tidal phase of about 15 minutes between the entrances and the far interior of the bay (DHN, 1986; IBGE, 2011). Sepetiba Bay can be divided into three compartments based on its hydrographic and geographic characteristics: brackish (3-18‰, at Guandú river mouth), hyposaline (18-30‰, most of the bay) and hypersaline (30-40‰, near the islands and northwest and southwest parts of the bay) (Moura et al., 1982).

The fluvial contribution to Sepetiba Bay comes from Guandú, Itaguaí, Mazomba, Cabuçú, and Piracão Rivers (Fig. 2). Two of these rivers, the Itaguaí and the Guandú, were modified during the 1940s into artificial, fixed channels. After these changes the largest river, Guandú, received additional discharge from other small rivers of the region.

BACKGROUNG

A previous study of the geology in Sepetiba Bay, based on a high-resolution seismic survey, was undertaken by the Brazilian oil industry and is limited to a small area at the Guandú river mouth (Fig. 4) (Figueiredo et al., 1989). The data were collected with a Uniboom system and four seismic units were identified to a subbottom depth of 30 m (Fig. 3). These units are named Verde, Laranja, Roxa, and Azul.

The uppermost unit, Verde, was found throughout the area and is characterized by continuous, long, parallel reflectors. It is thicker to the north (8 m) and thinner to the south, filling depressions and river channels. Sedimentological analyses of samples recovered by drilling show that this unit is composed of fine-grained sediments. The second unit, Laranja, is separated from the upper unit by a strong, continuous and irregular reflector. Drill samples from this unit indicate it consists of sand alternating with fine-grained sediments. Its mean thickness is 5 m. The third unit, Roxa, is separated from the Laranja unit by an undulating continuous reflector. Internal reflectors indicate that this unit is composed of sand. The deepest unit resolved, Azul, underlies

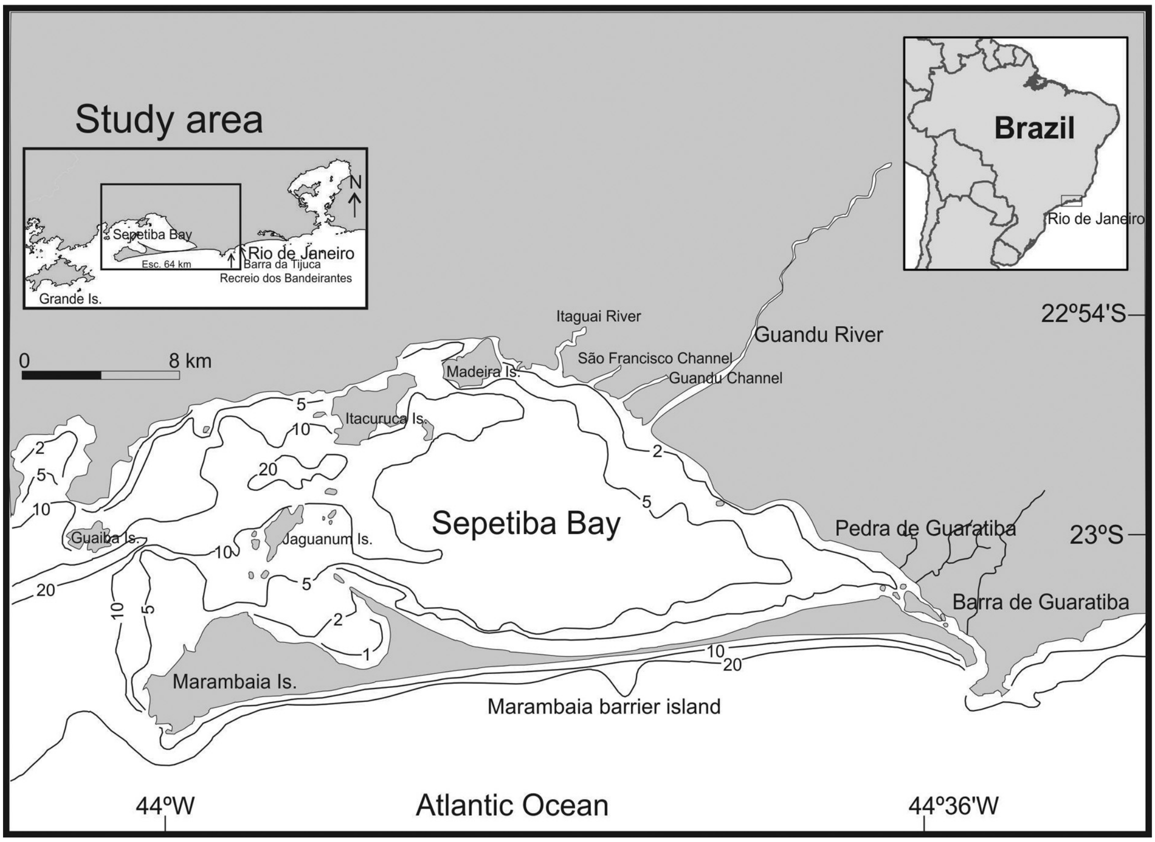


Figure 1 – Sepetiba Bay study area and general bathymetry. Right insert shows the area along the south Brazilian coast. Left insert shows location of Sepetiba Bay south of Rio de Janeiro City.

the Roxa unit and is limited in places by the crystalline basement. It is characterized by having few internal reflectors. According to Figueiredo et al. (1989), the Verde unit was deposited at the end of the most recent transgressive phase. The lower three units were deposited in terrestrial environments during one or more lower sea-level stages.

The results of the seismic interpretation from Figueiredo et al. (1989) provided a preliminary stratigraphic understanding of the area, but it was based on a limited spatial survey. The present work intends to describe the seismostratigraphy of Sepetiba Bay using a geophysical survey that covers the entire area. The interpretation of the seismic data will answer unresolved questions related to evolutionary history of the bay and formative processes for Marambaia Barrier Island.

METHODS

Seismic profiles

The field data for this study consist of 41 single-channel high-resolution seismic-reflection profiles (Fig. 4) collected in 1996 and 1997 with a 200-kHz acoustic source and recorded by analog techniques (Model SH-20, Senbon Denki Co., Numazu, Japan). The seismic-reflection profiles were plotted on a nautical chart with positions obtained by a Global Positioning System (GPS).

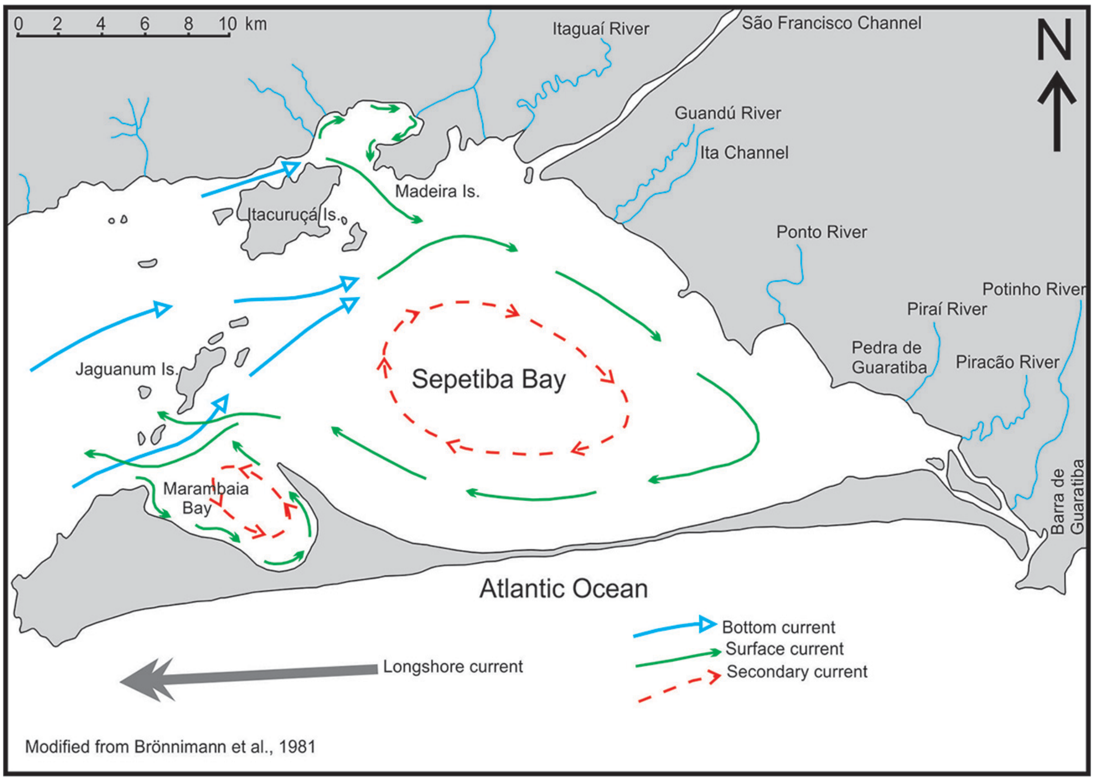
Identification of Seismic Units

Discontinuity-bounded sequences were mapped on all seismic profiles and their distribution in the area was plotted on a seismic navigation track. The depositional events and processes were interpreted by analyzing the configuration of these discontinuities and the nature of the boundary reflectors.

SEDIMENTOLOGY AND GEOCHRONOLOGY

Field

Subsurface sediment samples in Sepetiba Bay were taken from a floating platform using a vibracore system (similar to Lanesky et al., 1979), with 7.5-cm-diameter aluminum vibracore barrels. The core (VC1, Lat. 23° 02.047'S, Long. 43° 38.025'W) was ∼ 5 m in length and the station was chosen so as to sample at least two seismically identified units (Fig. 4).



Modified from Brönnimann et al., 1981

Figure 2 – Current system at Sepetiba Bay. The cold and dense water enters the bay as bottom currents, circulates clockwise through the bay, becomes warmer, and exits as surface currents.

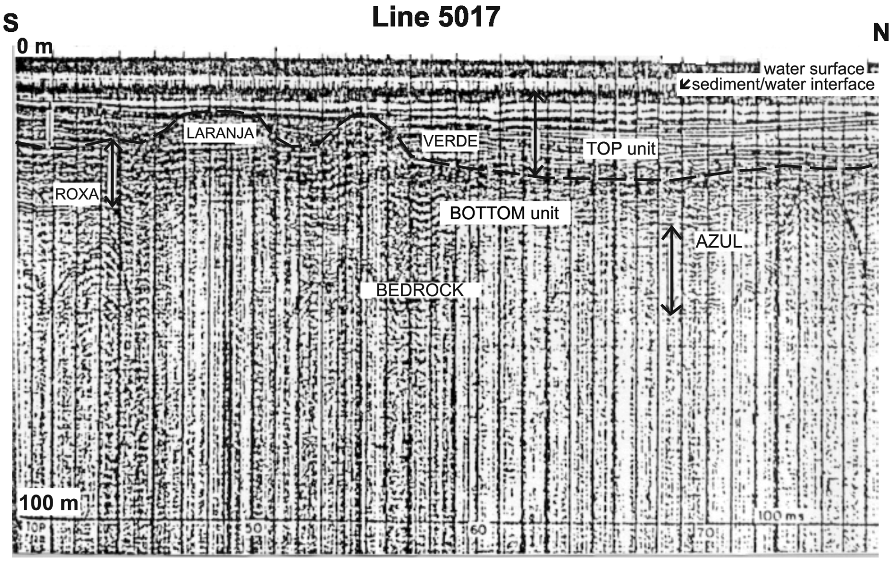


Figure 3 – Seismic profile from Figueiredo et al. (1989), showing units Verde, Laranja, Roxa and Azul. Profile is marked as '5017' on Figure 4.

Laboratory

Grain-size analyses were performed for surface and subsurface samples, using a SediGraph model 5100ET for the mud fraction (Coakley & Syvitski, 1991), and a 180-cm settling tube for the sand fraction (Syvitski et al., 1991).

The vibracore liner was cut lengthwise in the laboratory with a circular saw and split in 3 sections with a wire. The central part of the core was divided in 30-cm-long and 1.5-cm-thick sections,

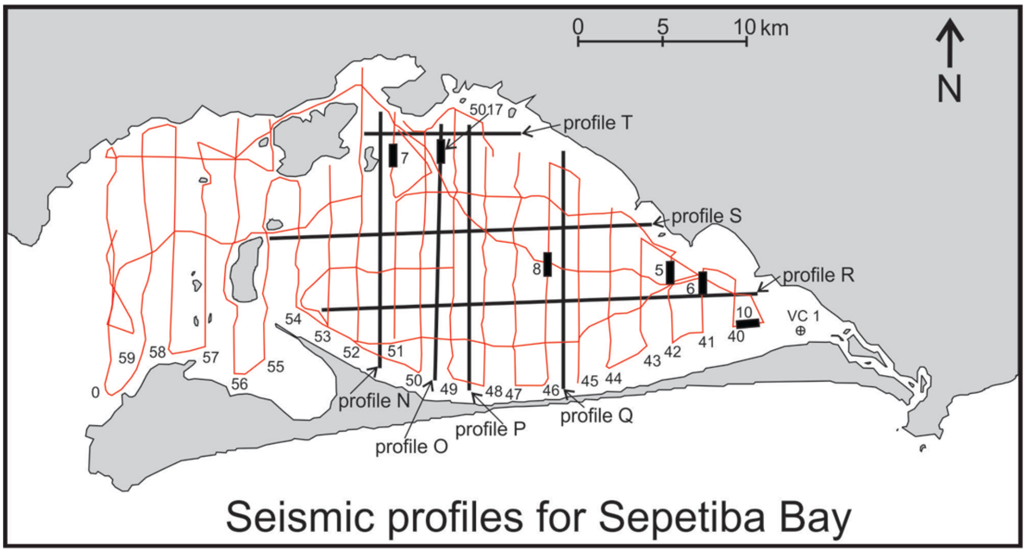


Figure 4 – Ship track of seismic profiles in Sepetiba Bay, collected during 1996 (numbered lines) and 1997 (lettered lines) with geographical location of vibracore (VC1). Profiles followed lines corresponding to minutes of latitude and longitude, parallel and perpendicular to Marambaia Barrier Island. Line names are shown at the south or east end of each line. Bold lines mark location of illustrated seismic profiles.

placed in Plexiglas trays, photographed, X-rayed and described for stratigraphy. Of the two remaining lengthwise parts, one was subsampled for bulk density, radiocarbon, and grain-size analyses, and the other was saved as an archive sample.

RESULTS

Seismic Stratigraphy

Two seismic stratigraphic units were identified in the geophysical survey of Sepetiba Bay: Top and Bottom. These two seismic units are separated by a discontinuity.

The discontinuity surface (i.e., interface with pre-Holocene sediments) is well represented in almost all profiles taken in Sepetiba Bay (Figs. 5, 6, 7 and 8).

Top unit: The layer represented by the Top unit is distributed throughout the bay (Figs. 5 and 6). The thickness of this unit is 9-11 m in the north, becoming thinner toward Marambaia Barrier Island, where it pinches out. In the northern Bay, at the present location of the Guandú river mouth (Fig. 1), a deltaic lobe with well defined progradation was identified within the base of Top unit, indicating the existence of a late Holocene delta (Fig. 7). As demonstrated by direct sampling at VC1 where the Top unit is 2.8 m thick (Fig. 4), there are different sedimentary environments within the Top unit, consisting of: a) bioturbated mud with shell fragments on the top, b) a laminated zone, characteristic of a tidal channel, and c) sandy mud to mud in the bottom of the unit (Figs. 9 and 10). These different sedimentary deposits are consistent with a marine origin.

Bottom unit: The top of the Bottom unit is defined by a discontinuity surface present in all profiles. The thickness of this unit is variable and difficult to evaluate from the seismic records in some areas. It is possible to measure its thickness in regions where crystalline bedrock is shallow (Fig. 5). Where sampled, the Bottom unit is composed of medium sand, semi-consolidated with a dark brown color, characteristic of subaerial deposits (VC1, Figs. 9 and 10).

A topographic diagram of each surface (top of the Top unit and top of Bottom unit) was constructed relative to present sea-level. The top of the Top unit (equivalent to the sediment surface) slopes toward the southwest with a depression parallel to Marambaia Barrier Island (Fig. 11a). Channels are found near the islands in the western part of the bay. The top of Bottom unit slopes toward the southwest, with an incised river valley along the southern part and a topographic high on the southern boundary (Fig. 11b). The channel has two possible paths where it approaches Marambaia peak, one through the depression going south towards Pombeba spit, and the other through a depression westward. A second channel occurs at the northwest of the area, near the modern Guandú river mouth. This channel runs southwest, between two highs, and exits in the depression between Marambaia and Jaguanum islands. Isolated highs (basement outcrops) are found in the northeast part of the bay (profiles 42 and 43), in the southeast near the topographic high (profile 45), and in northwest area, near the Guandú river mouth (profile 48).

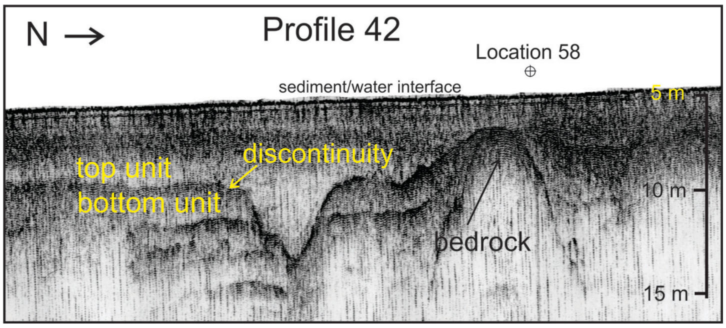


Figure 5 – Seismic record of Profile 42 showing Top and Bottom units, the discontinuity surface, a small buried channel, and bedrock. Subbottom depth is measured assuming a seismic velocity of 1500 m/s. "Location 58" marks a navigation fix. Profile is marked as '5' on Figure 4.

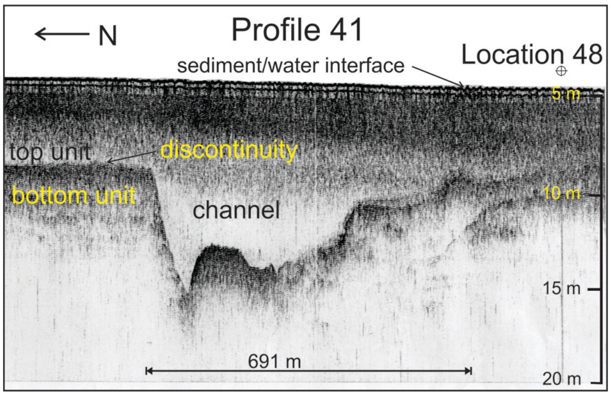


Figure 6 – Seismic record of Profile 41 showing, Top and Bottom units; discontinuity surface between the units; and a large buried channel (7 m deep and 390 m wide). Profile is marked as '6' on Figure 4.

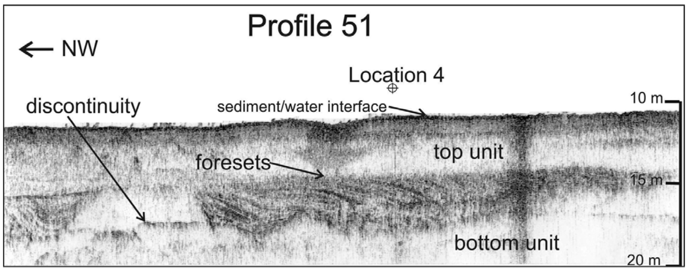


Figure 7 – Seismic record of Profile 51 taken in the northern part of the bay. This profile shows Top and Bottom units, a discontinuity surface, and buried prograding deltaic foresets. Profile is marked as '7' on Figure 4.

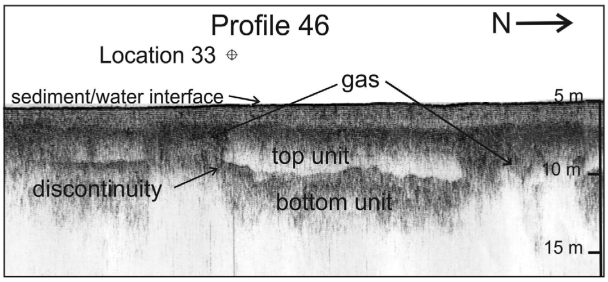


Figure 8 – Profile 46 (Location 33), located at center of the bay shows the presence of gas in the sediments. Profile is marked as '8' on Figure 4.

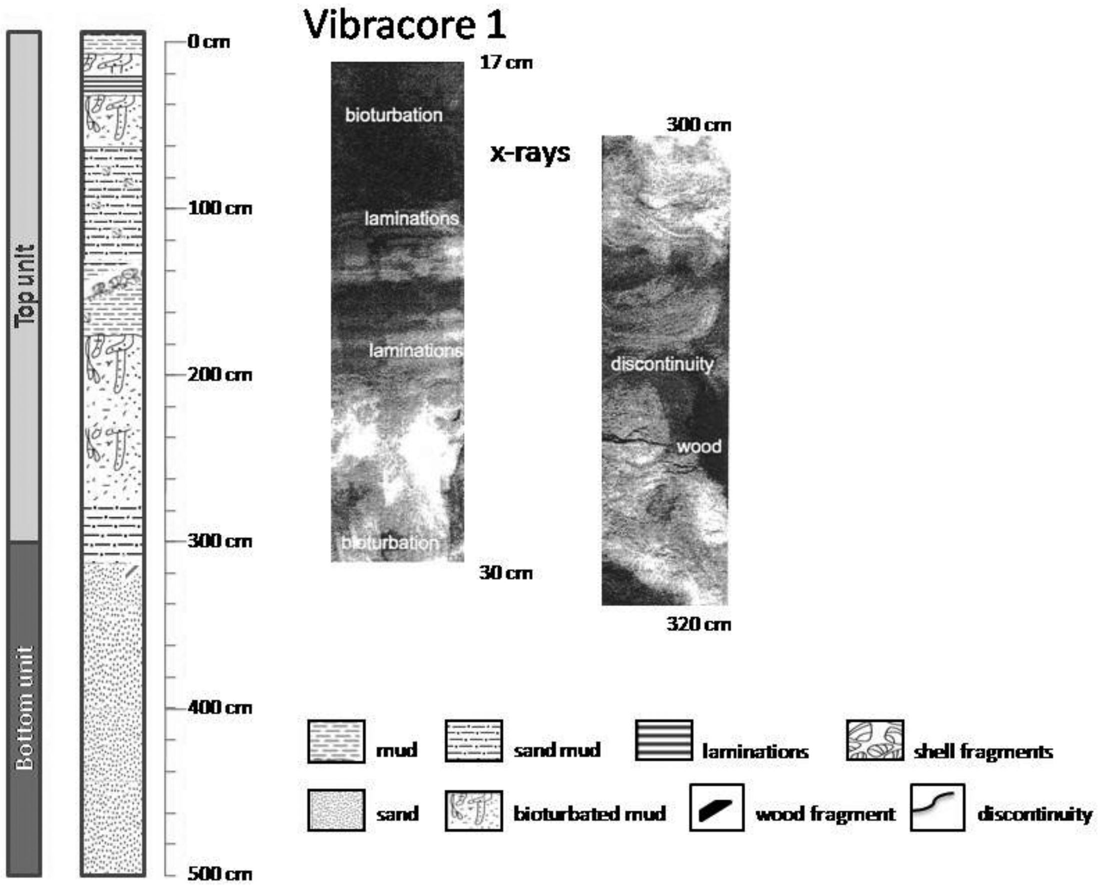


Figure 9 – Sedimentary environments identified along the vibracore, X-rays of sections showing laminations, bioturbation, and shell and wood fragments. Correlation of seismic units and the sedimentary environments is shown on the left side of the vibracore.

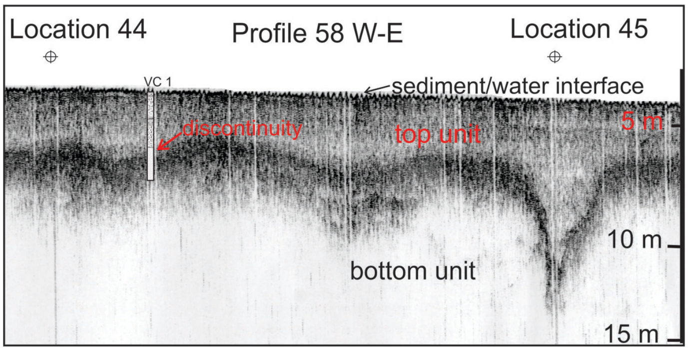


Figure 10 – Profile 58 W-E (Location 44) with vibracore showing the two units and sedimentary environments associated. The core stratigraphy is projected onto the seismic profile. The actual core position is about 2 km from the profile. The location of the core and profile (marked as '10') is shown on Figure 4.

Radiocarbon dating

A wood fragment was collected from vibracore 1 (VC1) at a depth of 317 cm, just below the discontinuity surface (Fig. 9). The sample was dated by AMS radiocarbon analysis at the NOSAMS Facility (Woods Hole), and indicated an age of 6890 ± 40 yr. B.P.

The age of the sample was placed in a general sea-level curve for the area (Angulo & Lessa, 1997; Fairbanks, 1989) and this date is interpreted to mark the Holocene transgression at this site (Fig. 12).

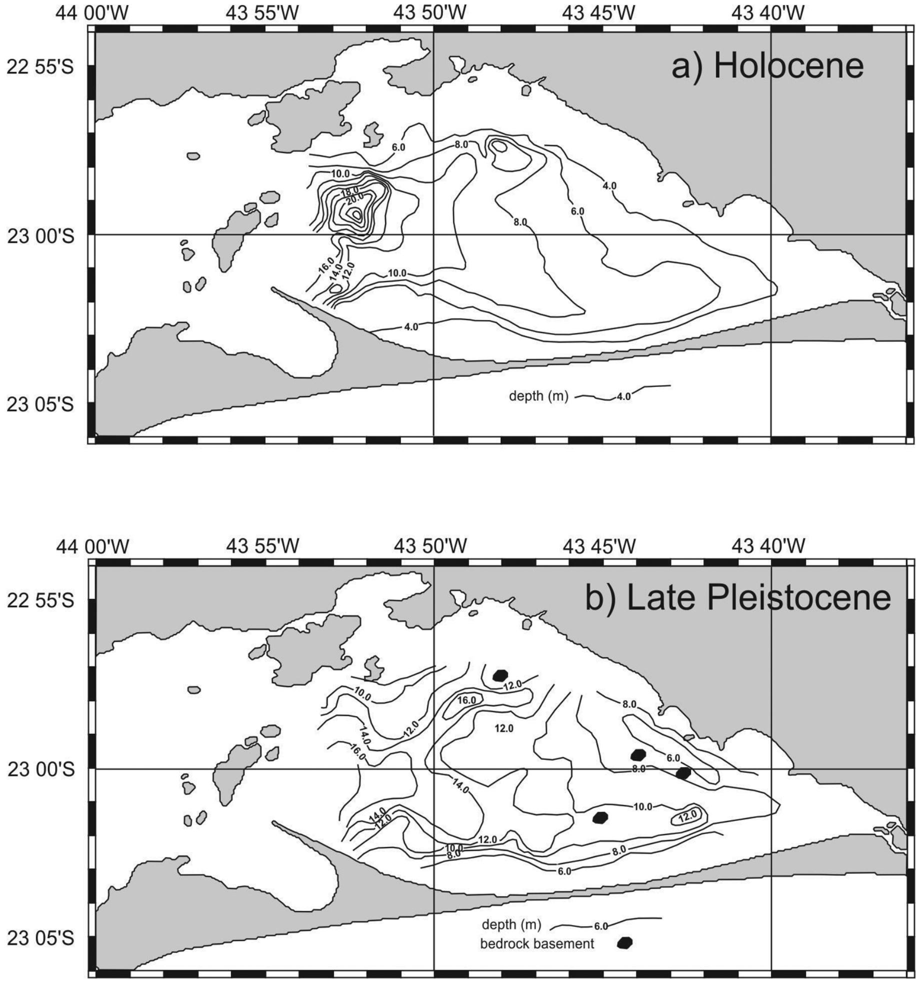


Figure 11 – Bathymetric diagrams of Sepetiba Bay contoured in meters, showing: (a) Holocene topography (top of Top unit); and (b) paleo-topography of Sepetiba Bay at the end of the Pleistocene (top of Bottom unit) in relation of present sea-level. Top unit thickness in meters and long term sediment accumulation rates in cm/yr.

Paleo-channel

A buried river channel was identified from profiles 40 to 52 (Fig. 4) in an area on the bay side of the modern barrier island. From profile 53 west, it is not possible to identify it. This could be because the channel turned and headed seaward east of this line or because the geological record was destroyed, when sea-level was rising, during the Holocene transgression.

It was not possible to correlate this channel with any of the present rivers in Sepetiba Bay although the river most probably entered the region near the Guaratiba region. In order to understand the river size, channel cross-sections were drawn from the seismic survey for each profile, and were measured for channel width, depth and slope (Fig. 13). These parameters were used to calculate probable values for mean velocity, hydraulic radius, and water discharge. The discharge allows us to evaluate the approximate size of this ancestral river.

Hydrological calculations

a) Manning's Equation Eq. (1) for broad and shallow channels (Leopold et al., 1992) was used to estimate the likely mean flow velocity of the paleo-channel at bankfull conditions (Table 1).

$$U = 1.49\frac{R^{2/3}s^{1/2}}{n} \tag{1}$$

were

$U =$ mean flow velocity,

$R =$ hydraulic radius (area/wetted perimeter)

$s =$ slope,

$n =$ Manning's n (0.04 is a reasonable value for a natural channel with rocks, protuberances and irregular alignment).

One value for the river gradient calculation was obtained from buried riverbank depths measured in relation to the present sea-level. Profile 40 (east end of Sepetiba Bay) and Profile 51 (west end of channel) can be compared, as shown on Figure 13, to

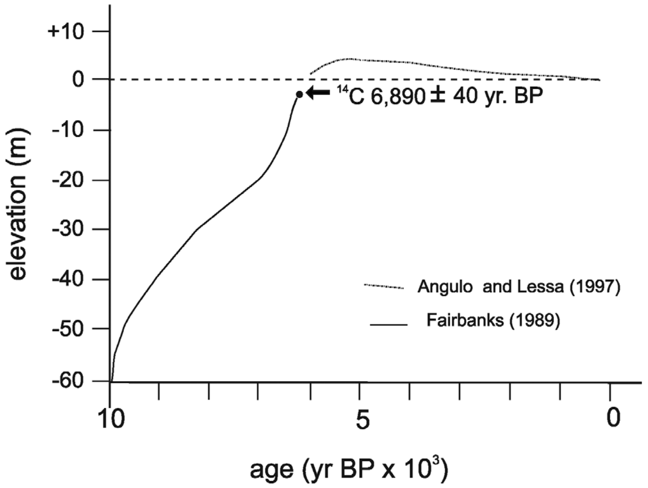


Figure 12 – Two sea-level curves were combined, Fairbanks (1989) and Angulo & Lessa (1997), to reconstruct the local sea-level at Sepetiba Bay for the last 10,000 years. Sea-level rose rapidly from 10,000 to 6,000 when it reached 5 m high. From 5,000 to present sea-level has being dropping slowly to 0 m.

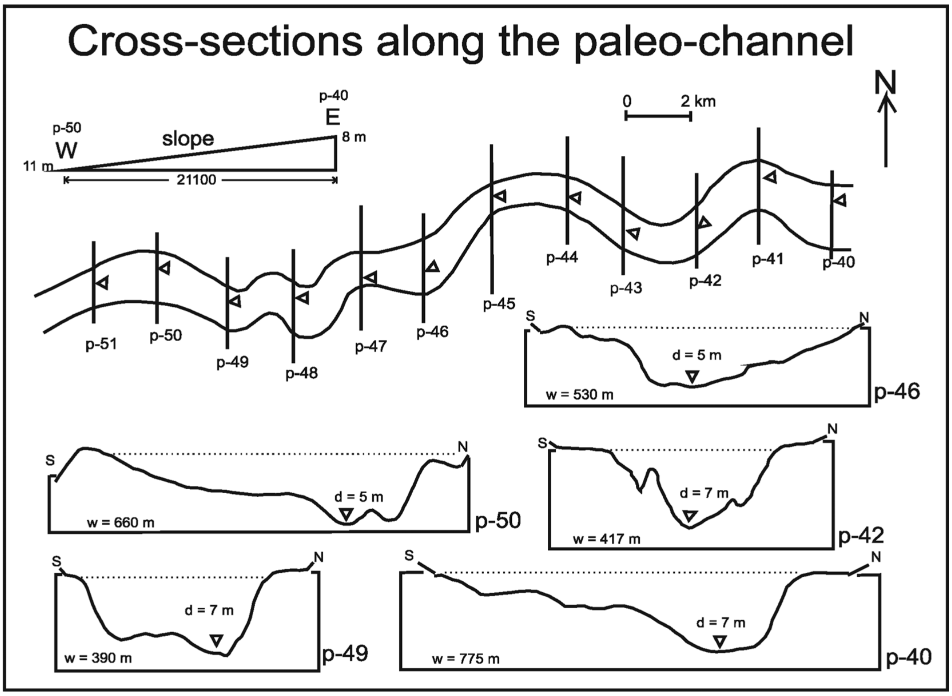


Figure 13 – Seismic profiles crossing the paleo-channel. Lower inserts represent the bottom morphology of the paleo-channel and values of depth and width obtained from seismic records of profiles 40, 42, 46, 49, and 50. The overall channel slope is also seen. Triangles mark the positions of the channel thalweg.

demonstrate a drop of 3 m over a horizontal distance of 21,100 m. This results in a slope of 1.42×10^{-4}. This is characteristic of slopes calculated from other pairs of cross-sections (Figs. 14 and 15). Substituting for n and s in Eq. (1), we get $U = 0.4439 * R^{3/2}$.

b) Water discharge (Q) was estimated by multiplying channel area (A) times calculated mean flow velocity (U) Eq. (2). The area of the channel correspondent to each profile was calculated plotting cross-sections with a digitizer table and AutoCAD software (Table 1).

$$Q = AxU \tag{2}$$

Calculated velocities range from 0.52 to 1.20 m/s and calculated discharges range from 300 to 2000 m^3/s (Table 1).

Table 1 – Values of channel characteristics calculated for each profile of the paleo-channel, assuming a uniform value for slope.

Channel parameters					Paleo-channel discharge		
Profile	Area (m^2)	Width (m)	Slope (m/m)	Wet. Per (m)	R (m)	U (m/s)	Q (m^3/s)
40	2380	775	1.42×10^{-4}	775	3.07	0.94	1200
41	1252	691	1.42×10^{-4}	691	1.81	0.66	690
42	1486	417	1.42×10^{-4}	417	3.56	1.03	1300
43	1025	274	1.42×10^{-4}	274	3.74	1.07	900
44	546	298	1.42×10^{-4}	298	1.83	0.66	300
45	783	267	1.42×10^{-4}	267	2.93	0.91	600
46	1346	530	1.42×10^{-4}	530	2.52	0.82	900
47	525	293	1.42×10^{-4}	293	1.79	0.52	300
48	1904	540	1.42×10^{-4}	540	3.52	1.03	1600
49	1858	390	1.42×10^{-4}	390	4.76	1.20	2000
50	1804	660	1.42×10^{-4}	660	2.73	0.87	1300
51	1555	388	1.42×10^{-4}	388	4.00	1.12	1500

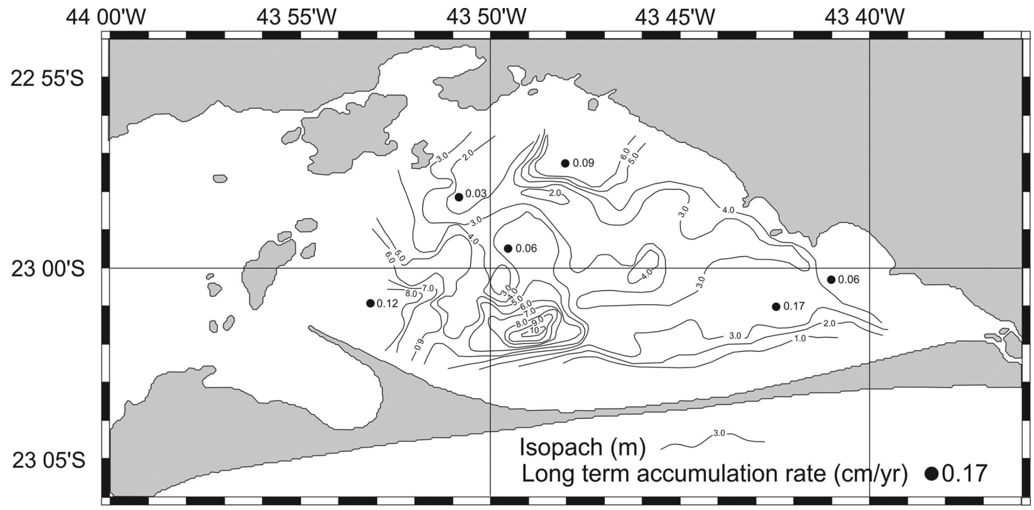


Figure 14 – Top unit thickness in meters and long term sediment accumulation rates in cm/yr.

DISCUSSION

The two seismic units (Top and Bottom) and the discontinuity surface separating them were identified in seismic profiles. These observations revealed the recent geological evolution of Sepetiba Bay. The two units and the discontinuity represent sedimentary processes during different sea-level stages. The Top unit, composed largely of fine-grained sediments at VC1, represents a transgressive and a high-stand condition with associated marine sedimentation. The Bottom unit, capped by a medium sand layer at VC1, represents a lower sea-level stage, characterized by terrestrial sedimentation.

Of the four units identified by Figueiredo et al. (1989), only two were similar to the units found in this study. The Top unit is similar to the Verde unit, in sediment composition and spatial distribution. The three other units, Laranja, Roxa and Azul, have sediment composition similar to the presently defined Bottom unit. If they are classified as one unit, it would be correlated to the Bottom unit of the present study.

The age obtained by radiocarbon analysis from a sample collected just below the discontinuity surface, 6890 ± 40 yr. B.P, gives time control of the upper unit. Assuming that this stratigraphic boundary is time-correlative throughout the bay,

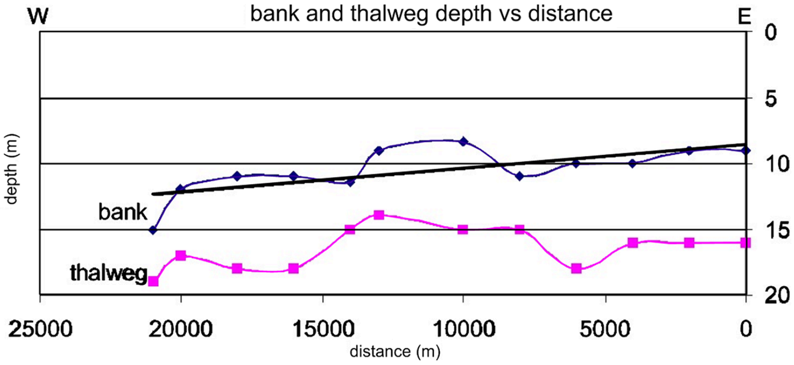


Figure 15 – Plot of thalweg and channel bank depths in relation to sea-level versus distance along the channel. The figure shows the general slope of the area from east to west.

accumulation rate can be determined for sediment above the boundary. The thickness of the layer, determined from high-resolution seismic profiles, divided by its age gives an approximate value of accumulation rate. The thickness of the Top unit in Profiles 40, 41, and 42 (Fig. 15) ranges from 3 m to 12 m (maximum values in the thalweg of the buried river channel), with accumulation rates of 0.04 and 0.17 cm/yr.

The discontinuity surface is well represented in all profiles, and delineates the paleo-topography of the bay prior the Holocene transgression. This topography consisted of an incised river valley and topographic highs (Fig. 11b), sloping westward as seen in the plot of bank and thalweg depths versus distance along the channel profile (Fig. 14). What is now Sepetiba Bay was a plain that had high bedrock protrusions; some of them presently islands (Fig. 16).

A similar geological setting, presenting essentially the same topographic characteristics as Sepetiba Bay did in the late Pleistocene, is found today in Barra da Tijuca and Recreio dos Bandeirantes, a large coastal plain located in an area east of Sepetiba and west of Rio de Janeiro City (Fig. 1).

The late Pleistocene setting of Sepetiba Bay started to change at 7,800 years B.P. when sea-level reached the –16 m, the entrance of the present bay (Fig. 12). Based on its subbottom depth, the paleo-delta located near the modern Guandú river month was deposited from 7,000 to 7,700 years B.P., changing its location eastward with the continuing rising of sea-level. At 6,500 years B.B. sea-level was at –12 m high, drowning the bottom of river channel at the east and of the bay. By 6,400 years B.P. the river channel was completely filed with sediments (from west to east). The present sea-level high was reached at 6,000 years B.P. when the whole bay was drowned, reaching its maximum high of +5 m until 5,000 years. A series of beach ridges 5-7 m high, found at Sepetiba coastal plain, are evidence of the maximum sea-level high in the Holocene transgression of Sepetiba Bay (Maio, 1985; Pereira et al., 2012). From 5,000 years B.P. to present sea-level has been slowly dropping to its present high.

The topographic high, where Marambaia Barrier Island is now located, certainly was an obstacle to the river channel that flowed westward, parallel to it. Seismic data show that Marambaia barrier island probably existed as a terrestrial feature by the end of the Pleistocene because fine-grained sediment deposits on the flank of the ridge. The feature was probably created as a spit during an earlier high stand of sea-level. The old spit may have been shorter than the modern barrier island. This fact could explain the difference in sedimentary environments in the east and west sections of Marambaia Barrier Island today. The apparently older east section is composed of a large dune field (30-m high) stabilized by well-developed vegetation and a mangrove fringe on the bay side of the barrier island. The younger west end of the barrier island is composed of a series of beach ridges 1-m high, forming Pombeba spit, which was formed when Sepetiba Bay reached its modern configuration following the last sea-level rise (Lamego, 1945; Roncarati & Barrocas, 1978; Ponçano et al., 1979; Borges, 1990).

Progradation of the spit by alongshore currents is a likely mechanism for the complete extended of this spit to Marambaia Island (Fig. 2). This hypothesis needs to be tested with further seismic interpretations in a survey offshore of Sepetiba Bay.

The Top unit was deposited during rising sea-level associated with the Holocene Transgression. It is a marine deposit composed of mud and sandy mud with tidal-channel and deltaic sedimentary environments. The tidal-channel deposit is located at the entrance of a modern channel near Barra de Guaratiba, therefore, it must have been open. The paleo-delta in the northern part of the

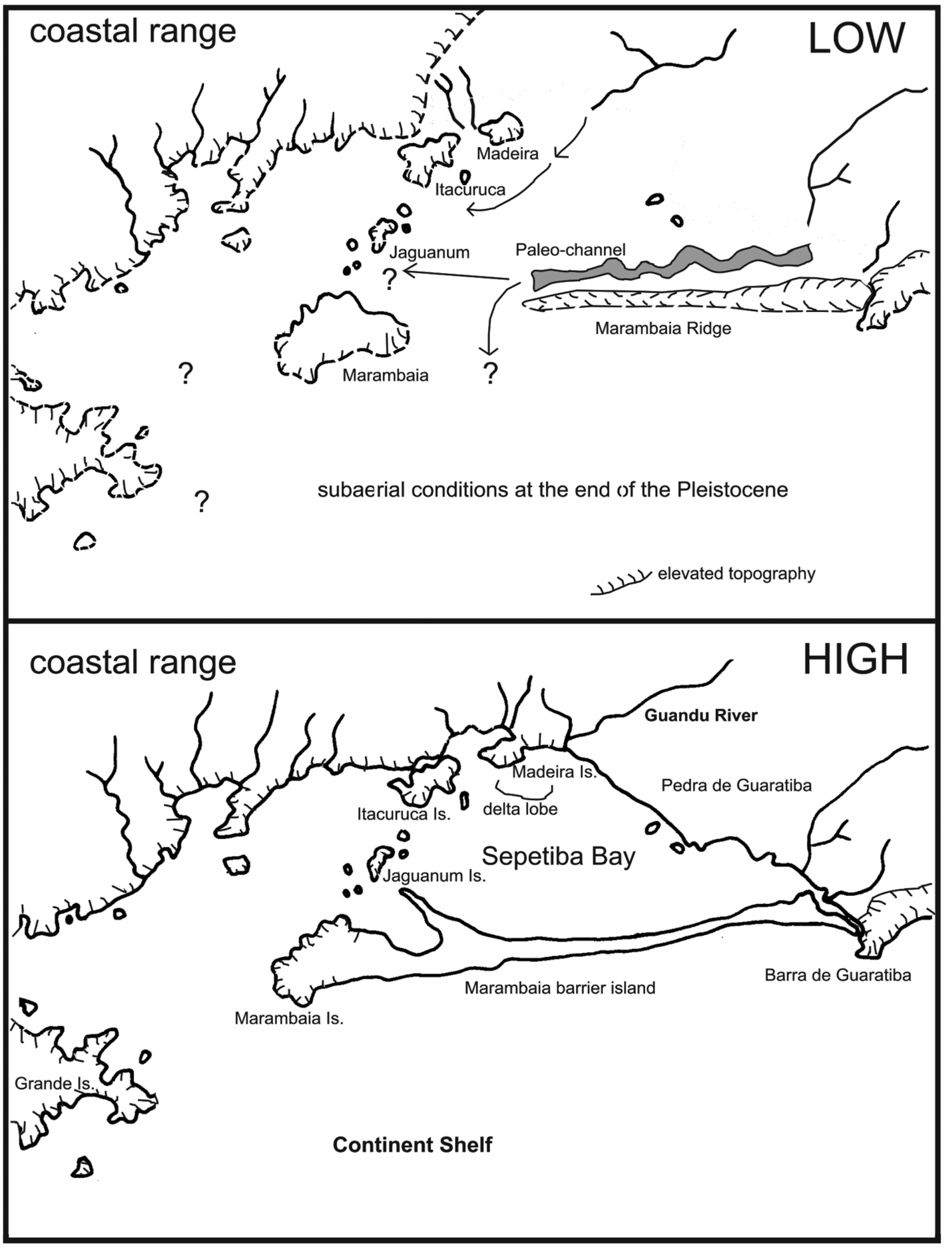


Figure 16 – Interpretation of Sepetiba Bay at two different sea-level stages. A) Lowstand sea-level in the late Pleistocene. The paleo-topography of the Sepetiba Bay area consisted of a plain with high mounds and a topographic high in the southern part of the plain. A sinuous river channel ran parallel to the topographic high at that time, perhaps exiting east Marambaia peak. B) Highstand sea-level. Sepetiba Bay in its present configuration with islands, Guandú deltaic lobe, and a barrier island enclosing the bay.

bay may represent a modern subaqueous delta of Guandú River, deposited during the rising sea-level and abandoned before the maximum of the Holocene transgression.

Hydrological calculations for bankfull discharge of the paleo-channel showed values of 300-1700 m^3/s. Because we do not know the environmental characteristics surrounding Sepetiba Bay, during the Pleistocene, the bankfull condition for calculations is used to approximate the maximum value of river discharge. The highest flood discharges documented for the Guandú River, the largest river in the area, were 190 m^3/s in the 1940s (Goes, 1942; Barcellos et al., 1997) to 288 m^3/s during the last 20 years (oral communication, Superintendência Estadual de Rios e Lagoas – SERLA, 1997). The bankfull discharge obtained for the paleo-river is equivalent to or larger than the modern values of Guandú River. This suggests that the paleo-channel, which ran through what is now Sepetiba Bay, was formed by a river similar the modern Guandú River.

CONCLUSIONS

The geological evolution described by the interpretation of the seismic profiles, hydrological calculations of a paleo-channel, and radiocarbon data, reveal a partial history of Sepetiba Bay during the last 7,000 years.

Interpretations of seismic profiles allowed recognition of two major units, Top and Bottom units. These units are separated by a discontinuity surface well represented in all profiles collected from Sepetiba Bay. The Top unit was deposited during a rising and highstand of sea-level, filling depressions and river channels with local deltas. The average accumulation rate for Sepetiba Bay during the late Holocene was approximately 0.17 cm/yr. The Bottom unit, a sandy layer, corresponds to a lowstand of sea-level and was deposited in a terrestrial environment.

The paleo-topography of the Sepetiba Bay area in the late Pleistocene consisted of a plain with high mounds, a topographic high south of the plain, and a sinuous river channel that trended parallel to the topographic high at that time, perhaps turning seaward at a location east of Marambaia peak (Fig. 16). The hydrological calculations for this paleo-channel show that it was equivalent to or possibly larger than the rivers entering the modern Sepetiba Bay. Based on its location and general slope, the paleo-channel could have flowed through the general vicinity of the Piracão River (Fig. 2), a stream that occurs in Barra de Guaratiba, east end of Sepetiba Bay.

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