Internal Sedimentary Architecture and Geochronology of a Regressive Holocene Coastal Plain Under Fluvial Influence: An Example from Rio de Janeiro Coast, SE—Brazil

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Abstract The aim of the present work is to investigate the internal sedimentary architecture (ISA) and geochronology along a regressive coastal plain located between Rio das Ostras and cape Búzios, Rio de Janeiro, SE, Brazil. This study considers the role of mean sea-level fluctuations during the Holocene and the influence of fluvial-estuarine processes on its evolution, based on geomorphological characteristics, shallow geophysics (GPR), and geochronology (OSL). The OSL ages ranged from 6.880 ± 630 years to 1.940 ± 180 years. The geomorphology of the coastal plain shows a predominant set of beach ridges surrounded by fluvial deposits. The ISA presents four radarfacies indicated by beach/foreshore; upper shoreface; washover/overwash process and fluvial sediments. The depositional architecture showed the transition from a transgressive to regressive pattern, dating from 5.800 ± 750 years, occurred close to Holocene Transgressive Maximum (MTH). After MTH the coastal plain prograding by formation of beach ridges under sea-level fall, where the reflectors identified from marine-influenced by fluvial process, suggesting the relationship between modern fluvial sediment input and sea-level behavior.

1 Introduction

The coastal plains observed on wave-dominated coasts present, not rarely, sedimentary environments formed by sandy materials deposited by wave action, with or

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without fluvial contribution (Davies and Hayes 1984). For a better understanding in terms of paleogeographic evolution, these plains are normally described by sea-level oscillations during the Quaternary. Frequently, along these coastal plains, is possible to identify a complex of different environments as for example coastal lagoons, inlets, and foredunes, depending on predominant coastal process. When these plains are formed essentially by sequences of *sandy ridges*, *beach ridges,* or *beach/foredunes* ridges, these features can be identified as reliquary features, so passive to be associated as *Quaternary coastal geoarchives*, and in general characterize as regressive coastal plains (*strandplains*), where prograding process are predominant.

This progradation process promotes the relative projection of the coastline related to the ocean and is responsible for increasing the continental area over the sea. This mechanism can occur either eustatic sea-level falling (forced regression) or when the sediment input rate is greater than the accommodation space (normal regression), occurring even under conditions of gradual sea-level rising (Roy et al. 1994; Hesp et al. 2005; Dillenburg and Hesp 2009; Otvos 2012, 2019). This kind of process is relatively common along Brazilian coastline (Fernandez et al. 2019), mainly regarding during middle and late Holocene sea-level fall (Angulo et al. 2006).

Is a fact that regressive barriers investigated along Brazilian coast are dated by Holocene deposits (Dillenburg and Hesp 2009), and are associated with relative sea-level falling in the last 5500 years (Angulo et al. 2006). Some of these works focus specifically investigate this geomorphological process in specific sites along Northeast, Southeast, and South of Brazil, whose analyses are mainly developed from multiproxy analyses, usually involving the use of subsurface (shallow geophysics and boreholes), surface (geological/geomorphological mapping; digital and elevation models) and geochronological methods, normally using carbon isotopes and Optically Stimulated Luminescence (Martin et al. 1993; Lessa et al. 2000; Angulo et al. 2006; Barboza et al. 2009, 2011, 2014, 2021; Dillenburg et al. 2011; Souza et al. 2012; Silva et al. 2014a; Nascimento et al. 2018, Figueiredo et al. 2018, 2021; Rocha et al. 2019).

Along Rio de Janeiro coast, the evolution of Holocene coastal deposits does not present a predominant regressive characteristic, even the littoral submitted a falling sea level during the last 5500 years (Fernandez and Rocha 2015). For example, on the north-central coast of Rio de Janeiro, Silva et al. (2014b) and Figueiredo et al. (2018), investigated the evolution of Holocene barriers in Maricá and Massambaba, respectively, do not identify the regressive reflectors in the internal sedimentary structure. In both cases, Holocene coastal barriers are relatively narrow, usually around 300 m in length. The geophysical data present, in fact, identify some transgressive deposits (Silva et al. 2014b) and not rarely aeolian sediment deposits on the top of the barriers (Figueiredo et al. 2018), indicating a typical morphostratigraphic aggradational pattern (Fernandez and Rocha 2015). Along Paraíba do Sul wave-dominated delta, in the northern part of Rio de Janeiro, the Holocene evolution is marked by transgressive and regressive deposits, depending on the presence of river discharge or shoreface sediment supply. Rocha et al. (2013) show that in the area that receives sediments from the shoreface, the barrier experiments a retrogradational pattern, derived from overwash process and washover deposits, a transgressive barrier. On the other hand, Rocha et al. (2019) and Figueiredo et al. (2021) identify regressive features influenced by river sediment input, and/or changes in the wave climate, becoming a decisive mechanism for beach ridges and spits observed. Specifically, with respect to the internal sedimentary architecture in these examples from Rio de Janeiro, most of the morphostratigraphic barriers include GPR reflectors, and sometimes boreholes. Less attention was made about the influence of the fluvial-estuarine sediments, probably because of difficulties to obtain clear GPR data, and/or urbanization on most of these coastal plains.

That is not the case along Brazilian coastline. Some studies identify the role of fluvial materials on the barrier evolution. On the Southern coast of Brazil, Silva et al. (2014a, b); Barboza et al. (2014) and Bogo et al. (2015) show that interdigitation between fluvial and coastal deposits presents a fundamental role to understand the geochronological evolution of regressive barriers. Furthermore, Hein et al. (2016) demonstrated the impact of estuarine sediments and fluvial process in the Holocene evolution of regressive barriers, in Santa Catarina.

In this sense, this work aims to investigate the coastal plain evolution, based on internal sedimentary architecture and geochronology of the regressive coastal plain, located between the rivers Una and São João, center part of Rio de Janeiro coast, considering the role of mean sea-level behavior during the Holocene and the influence of estuarine/fluvial processes on its evolution.

2 Study Area

The Rio da Janeiro coast presents different coastal environments, distributed by coastal plains, where is possible to observe for example coastal lagoons, coastal dunes, mangroves, estuaries, and coastal sandy barriers (Fernandez et al. 2019). The Precambrian rocks define the length of most of these plains (Fernandez et al. 2019). The fluvial influence is limited in part of the coastline. Some of the fluvial input comes from Serra do Mar and reach the ocean, without accommodation space to form coastal plain, as observed in Southern part of the state (Fernandez et al. 2019). The influence of fluvial material is clearly along Paraiba do Sul wave-dominated delta, and in a embayment between cape Buzios and Rio das Ostras.

The study area, or the coastal plain located in this embayment, is markedly by influence of fluvial deposits, represented by São João, Una, and Das Ostras river, and marine processes (beach ridges), surrounded by Precambrian and Alkaline rocks (Fig. 1). In more detail, the coastal plain presents two depositional units, well-marked by the occurrence of fluvial and marine deposits, associated directly with São João river that controls fluvial deposits, and sequences of beach ridges regarding wave process. These deposits are accommodated by geomorphological units, associated with *Precambrian hills* and *Precambrian flatted surfaces* (Fig. 1). Two other relief units were also identified, such as coastal *massifs* lithologic associated with Cretaceous alkaline intrusive rocks (*Alkaline Intrusive Massifs*). The southernmost of the

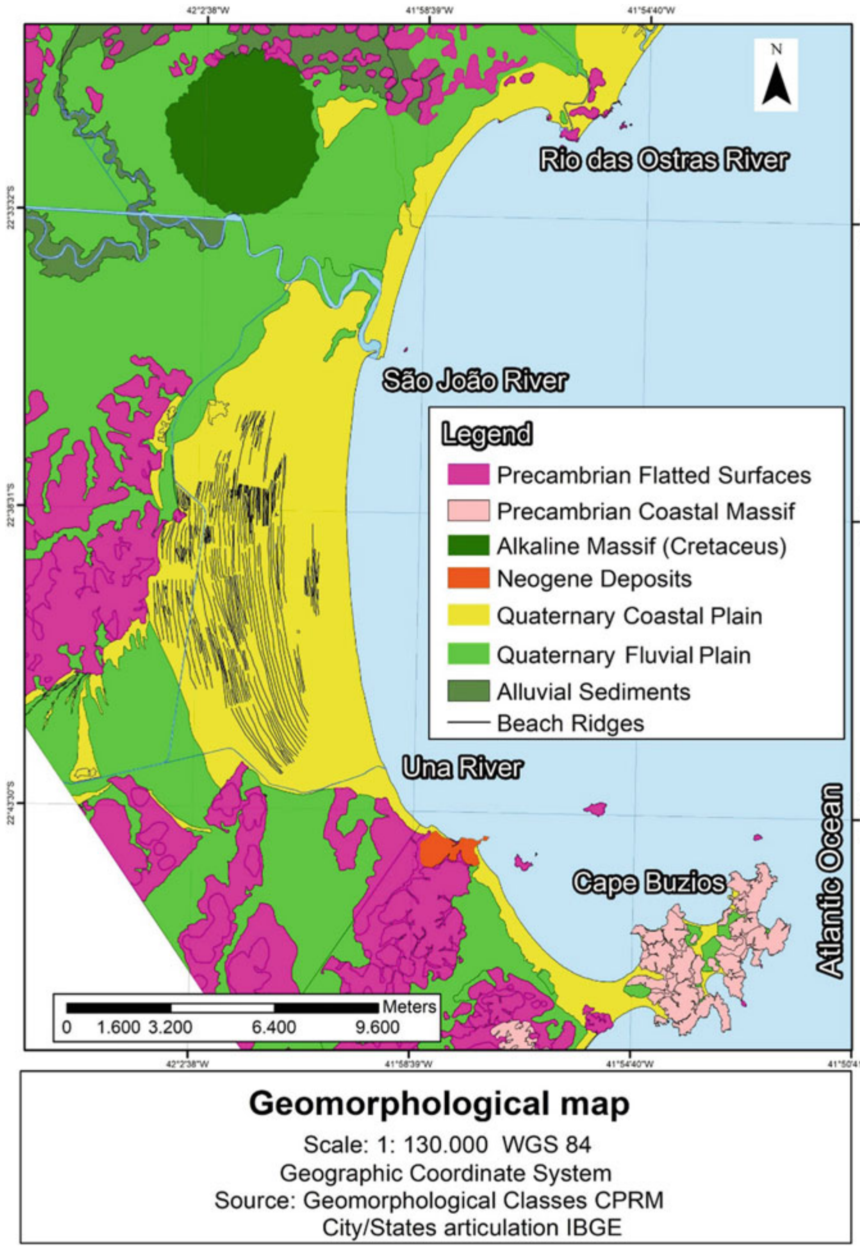

Fig. 1 Geomorphological map of the compartment between Cabo Búzios and Rio das Ostras with emphasis on the asymmetry of the extension between the coastal plains located to the South and North of the São João river. Adapted from classes mapping in scale 1:50,000: Brazilian Geological Survey—CPRM

area is markedly by tablelands developed over sediments associated with the Neogene (Fig. 1).

The coastal plain presents an intrigant asymmetry of fluvial-marine area, described by variable width, between north and south of the São João River. The marine sediments that compose the northern part extend for no more than one kilometer, while to the south, the wave-dominated plain (beach ridges) develops for approximately six kilometers (Fig. 1). This asymmetry probably is explained by the fluvial sediment contribution from São João river, toward the north by predominant northeast waves.

Regarding the wave and tide coastal processes, the area is characterized by a microtide regime, with maximum amplitude of 1.3 m. The main incidence waves come from north to northeast directions associated with fair-weather conditions. Waves from south and southwest indicate storm surges, formed by cold fronts.

Fernandez and Muehe (1995) describe the sedimentation of the inner continental shelf and found that is formed by reliquary sediments proximal to the coast, with occurrence of fine sediments from the 25 m bathymetric. The fine materials were associated with modern fluvial sedimentation, while the reliquary sands indicate probably exposed substrate of coarse sands related to the last Holocene marine transgression.

In a detail, Fernandez and Muehe survey the shoreface between Rio das Ostras and Cape Búzios, and show that fine and very fine sands close to beach, deposited in the southward part of the embayment, and associated from São João river source. On the other hand, coarse sands dominate the northern part of the area. This distribution defines the beach morphodynamics, which was classified as dissipative, due to the influence of fluvial fine sediments in the south, and reflective beaches domain the north, by coarse materials.

3 Methodology

This work is based on geomorphological, geochronological e geophysical methods. The geomorphology was determined by series of topographic profiles, to obtain the altitude of beach ridges for further adjustment of geophysical data. To obtain these profiles, we use Geodesic GPS and total station to extract the altimetric data directly from the terrain. The regional topographic was extracted in *Google Earth Pro*, and adjusted with the topography obtained in field.

During the geomorphological survey, series of ground-penetrating profiles was performed to obtain raw data for internal sedimentary structure analyzes (Fig. 2). The GPR lines were made in common-offset mode, using 270 and 400 MHz antennas. We survey the GPR and topographic profiles, in a cross-shore direction, i.e., from continental to the ocean.

Along the GPR profiles, geochronological samples were collected to be analyzed by the Optically Stimulated Luminescence (OSL) method (Fig. 2). The sample collection was carried out from manually opened trenches, at depths ranging from 1.2 m to 2.3 m and lateral dimension approximately of one meter. Seven samples were collected and distributed along the coastal plain (Fig. 2). In two points (sample OSL

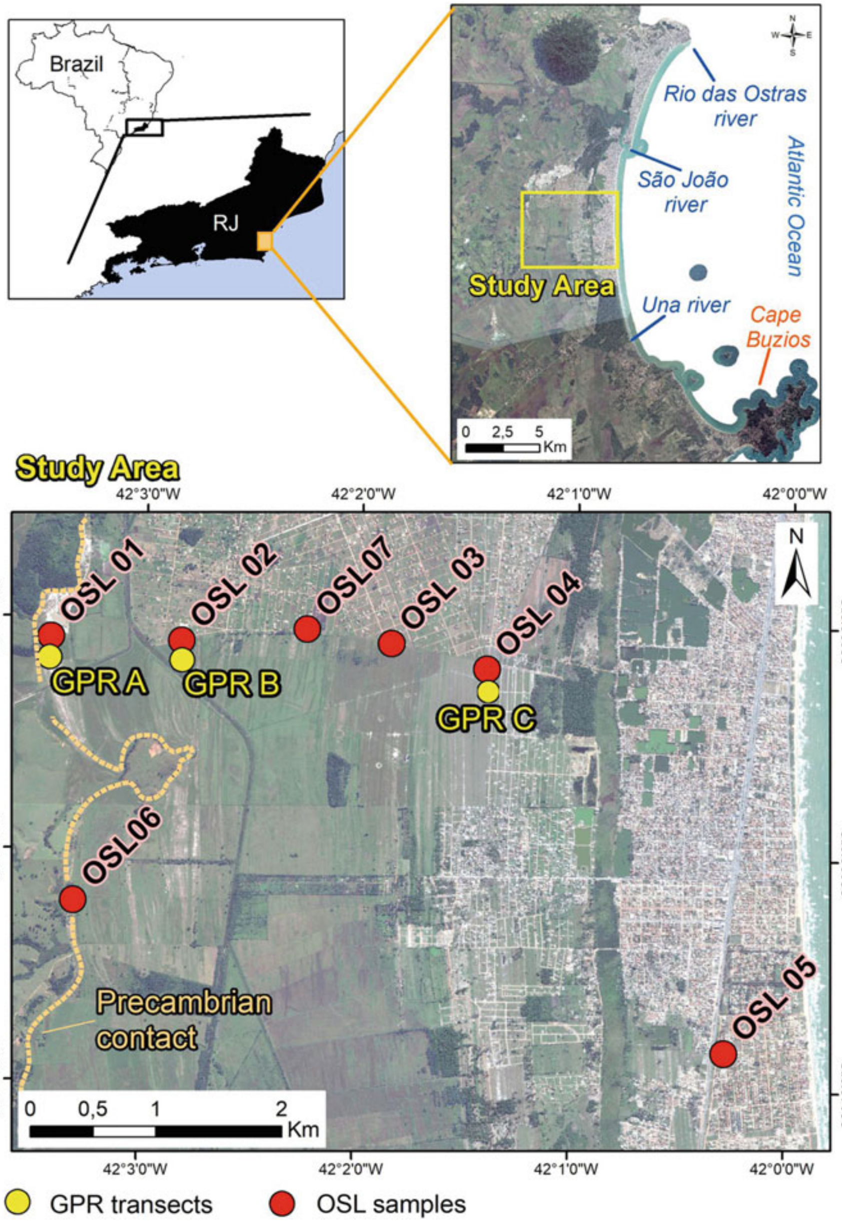

Fig. 2 Location of the GPR and topographic profiles and OSL samples, distributed along study area

1 and OSL 7), we collect two samples at different depth levels, to compare the data at two different depths. The geochronological analysis was defined according to the Single-Aliquot Regenerative-dose *(*SARs) protocol (Murray and Wintle 2003), using 24 aliquots.

In the laboratory, the processing of the GPR lines in RADAN™ 6.6 software for typical GPR procedures. To convert the depth obtained in GPR data from time (ns) into depth (m), we generate a velocity profile by Common-Mid-Point (CMP) mode with 80 MHz antenna, using the same procedures from Rocha et al. (2013). The velocity ranged from 0.15 to 0.06 m/ns, considered coherent for sandy sediments according to Nilsen and Clemmensen (2009). For the interpretation of the radarfacies, we consider some principles of stratigraphy interpretation, where we identify the morphology, terminations pattern, unconformities, dip direction, and continuity of the reflectors, as suggested by Neal (2004).

4 Results

4.1 Description and Interpretation of Radarfacies

Four radarfacies (Rf) were identified on radargrams showing the marine and fluvial process described in 6 m thickness. We select three GPR profiles, where the first one cover 230 m, second reach 185 m, and the last one 155 m. The radarfacies obtained are described above, and plotted in Figs. 3 and 4:

(a) Rf 1—Foreshore (berm and beachface): These radar-facies are characterized by sloping, sub-parallel geometry, slightly sigmoidal, moderately continuous reflectors, dipping toward the sea, and *downlap* termination. This Rf is interpreted as foreshore (berm and beachface). This Rf is identified in all three GPR line transects (*A*, *B*, and *C*), marking the upper limit of Rf 2, and may also be marked by erosional truncations related to the deposition of Rf 3 and Rf 4.

(b) Rf 2—Upper Shoreface: This Rf presents discontinuous reflectors, with irregular geometry, and may present a concave-convex pattern, with concordant upper limit in relation to Rf 1. In GPR A and GPR B lines, its occurrence tends to present an attenuated reflection, probably indicating the presence of shoreface fine sediments. It was not possible to establish the lower limit of these radarfacies due to the attenuation of the GPR signal, and limitations of the signal depth surveyed by high-frequency antenna used in this work.

(c) Rf 3—washover/overwash: This Rf presents sub-parallel to inclined geometry, predominantly dipping direction toward the continent. It presents upper and lowers limits identified by erosive surfaces, sometimes ending in *onlap.* Rf 3 was observed in GPR line A, whose transect is located near the contact between Precambrian and Quaternary deposits.

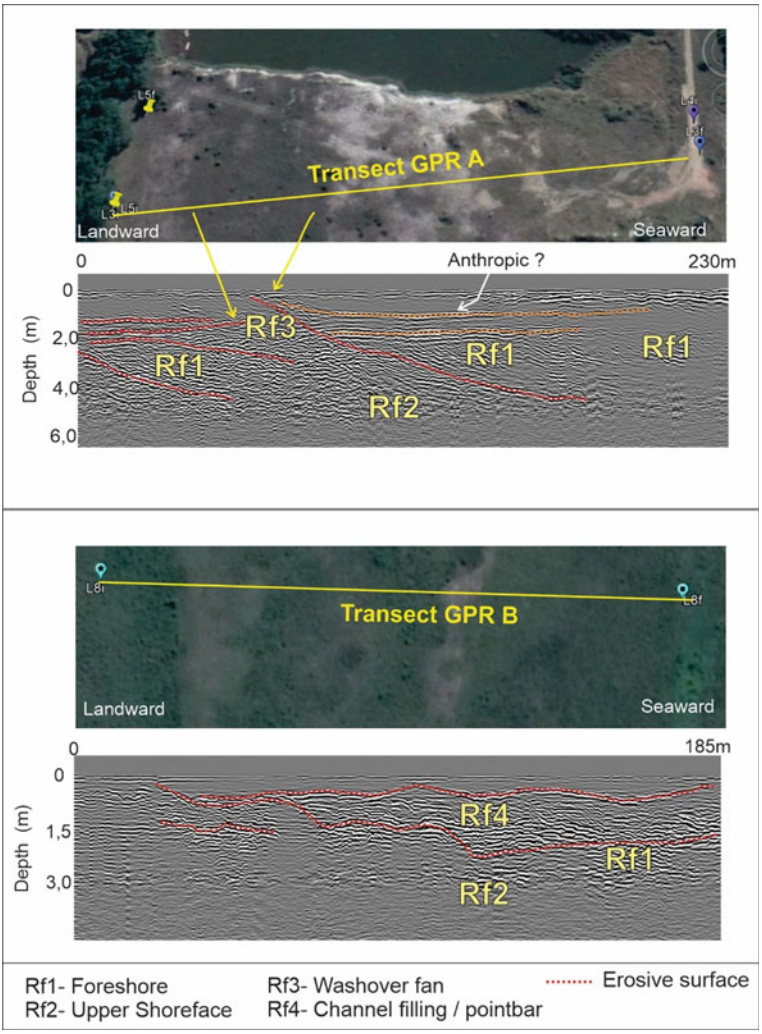

Fig. 3 Interpretation of GPR line A and GPR line B reflectors

(d) Rf 4—Channel filling/point-bar: It presents a sub-parallel to inclined geometry, with dip predominantly toward the sea. It presents limits marked by erosive surfaces that, in the case of the lower limit, appear indicating a paleochannel. This configuration was interpreted by fluvial channel filling by sediments derived from fluvial and marine processes, probably in the form of point bars (inlets), as identified in GPR line B.

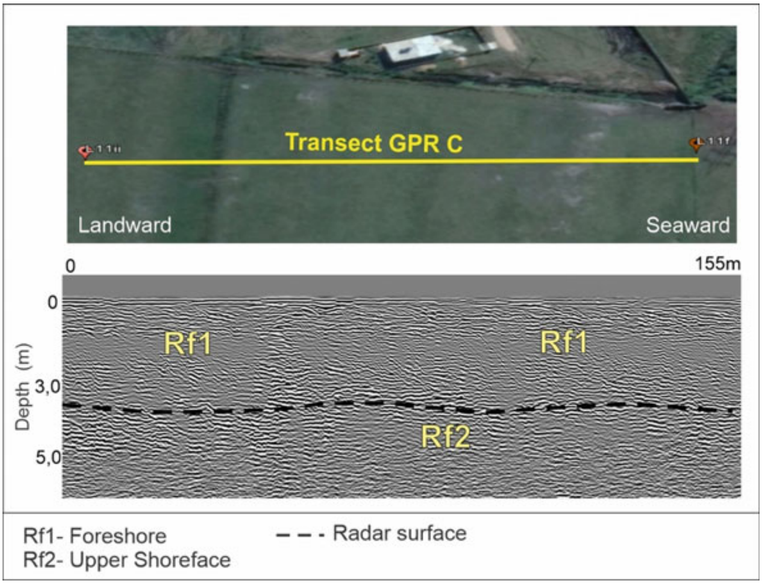

Fig. 4 Interpretation of the GPR line reflectors C

4.2 Geochronology of Beach Ridges and Progradation Rates in the Holocene

The results of the OSL samples indicated ages from middle to late Holocene, whose values ranged between 6.880 ± 630 years and 1.940 ± 180 years (Table 1). The samples positioning in the contact between Precambrian and Quaternary deposits (see Figs. 1 and 2) presented results of 4.140 ± 490; 5.800 ± 750 (OSL 1 A and

Table 1 Numerical ages obtained by the OSL method from samples collected in the coastal plain between the São João and Una rivers

Code	Sample	Depth (m)	Height (m)	Annual dose (μGy/y)	P (Gy)	Age (Ka)
5256	OSL 01 A	1.20	2.9	710 ± 47	2.9	4.140 ± 490
5257	OSL 01 B	2.30	1.8	625 ± 45	3.6	5.800 ± 750
5258	OSL 02	1.50	1.7	780 ± 50	1.8	2.390 ± 210
5259	OSL 03	1.50	1.5	550 ± 40	2.8	5.080 ± 460
5260	OSL 04	1.20	2.9	640 ± 45	2.5	3.880 ± 400
5261	OSL 05	2.00	0.7	760 ± 40	1.5	1.940 ± 180
5262	OSL 06	1.40	2.5	760 ± 50	5.2	6.880 ± 630
5263	OSL 07 A	1.20	1.9	1.000 ± 50	4.0	4.000 ± 330
5264	OSL 07 B	2.20	0.9	800 ± 45	3.7	4.550 ± 325

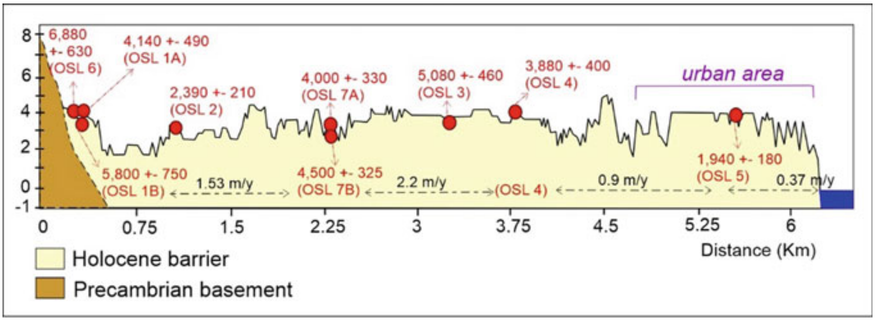

Fig. 5 Spatial distribution of OSL ages along the coastal plain between the São João and Una rivers, and evolutionary rates calculated by ages obtained

B, respectively); and 6.880 ± 630 years (OSL 6). Figure 5 shows the distribution, along with the topographic profile from the Precambrian basement to the shoreline, covering the Holocene coastal plain.

The geochronological distribution of OSL samples indicates that OSL 6 and OSL 1B mark the first Holocene deposits and the evolution of the coastal plain. In sequence, the OSL 2 (2.390 ± 210) presents the second most modern result, showing an unexpected result, compare to previous age, and the next deposition (see discussion for a better explanation). The sequence ages define from the geochronology continue from 4.500 ± 325 obtained on OSL 7B, 5.080 ± 460 identified by OSL 3, and 3.880 ± 440 on OSL 4. In the last sample, close to the beach, the age obtained was 1.940 ± 180 (OSL 5). With the geochronological results, we calculated the coastal plain prograding rate, by the comparison of the space between samples, and the ages. We notice that the coastal plain evolution presents 1.53 m/year between OSL 1B and OSL 7B. These rates increase from OSL 7B to OSL 4, where we calculate 2.2 m/yr. From OSL 4 to OSL5 we found a decrease in the velocity, changing to 0.37 m/yr (Table 2).

5 Discussions

5.1 Relationship Between OSL Ages and Mean Sea Level Behavior in the Holocene

Beach ridges are considered *Quaternary coastal geoarchives* that showed the wave process according to the mean sea level (**e.g.**, Tamura 2012; Dougherty 2014; Brill et al. 2015). Specifically, in the case of strandplains or regressive plains, the wave process forms a successive ridge deposit, by incorporating sub-horizontal and shore-oriented sandy materials (foreshore). This mechanism not only proves the incorporation of successive beach environment, and abandoned of the previous deposits

Table 2 Measured concentrations of the radioactive isotopes ^{232}Th, $^{238}U + ^{235}U$, ^{40}K were used to calculate the annual dose

Code	Sample		Th (ppm)	U (ppm)	K (%)	Humidity (%)
5256	OSL 01 A		2.459 ± 0.215	0.196 ± 0.085	0.347 ± 0.053	3.2
5257	OSL 01 B		2.809 ± 0.221	0.115 ± 0.083	0.285 ± 0.051	3.8
5258	OSL 02		3.069 ± 0.245	0.327 ± 0.095	0.352 ± 0.057	2.9
5259	OSL 03		2.875 ± 0.213	0.281 ± 0.079	0.170 ± 0.047	16
5260	OSL 04		2.436 ± 0.213	0.487 ± 0.088	0.234 ± 0.052	11.9
5261	OSL 05		3.531 ± 0.235	0.498 ± 0.083	0.322 ± 0.049	14.8
5262	OSL 06		3.662 ± 0.256	0.185 ± 0.089	0.325 ± 0.055	3.6
5263	OSL 07 A		2.728 ± 0.244	0.201 ± 0.098	0.669 ± 0.062	8.2
5264	OSL 07 B		3.411 ± 0.255	0.186 ± 0.093	0.487 ± 0.058	17.9

(Tamura 2012), but favor the exposure of these sediments to the sun-light (Brill et al. 2015). In this sense, these features are able to be used as sea-level indicators, considering the actual beach as modern analog (Rocha et al. 2019) and provide confident OSL results (Brill et al. 2015).

In Fig. 6a, we plotted the OSL results distributed along sea-level curves from the most representative Brazilian coastline (Angulo et al. 2006), or local (Jesus et al. 2017). Considering the margin of accuracy of the foreshore deposits, the ages obtained are relatively well adjusted. In our case, the OSL samples were collected along the foreshore deposits described by RF1 and RF2, which indicates that these samples are confident to use for coastal evolution geochronology, even compared with the two curves. To compare the pattern observed for foreshores Rfs, we analyze an actual beach profile. The Rf is comparable, in-depth, as the foreshore reaches around 3.5 m from the berm crest to sea level, and fits with the depth obtains in GPR lines (Fig. 6b).

The age of sample OSL 1B is well adjusted to the Holocene Transgressive Maximum (HTM), which according to Angulo et al. (2006) would have occurred between 5,000 and 5,800 cal years AP. Considering the curve of Jesus et al. (2017), more specific for Cape Buzios area, the age also appears well adjusted using the altimetry and the age (Fig. 6a). In both curves, the MTH the mean sea level would be around 2.4 m above the current level. After MHT, the sea-level curves present a slow fall, and our ages are in according with this pattern (Fig. 6a).

5.2 Discussions on the Radarfacies and Internal Sedimentary Architecture of Holocene Beach Ridges

The identification of four Rfs, distributed in the three GPR transects, shows the regressive process related to the evolution of the coastal plain, where is possible to

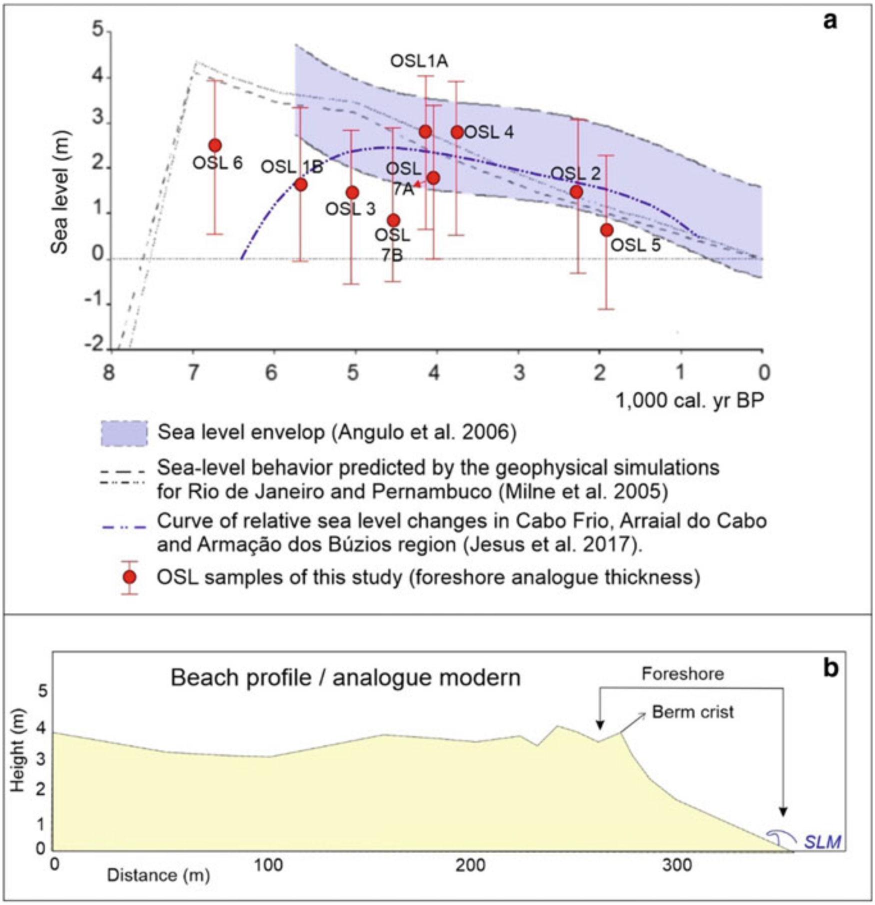

Fig. 6 **a** Overlay of the OSL samples collected in the present study with the sea-level change curve envelope for Brazilian coast established by Angulo et al. (2006); and with the curve for Cabo Búzios area established by Jesus et al. (2017). **b** Current beach topographic profile collected from the study area, to serve as a modern geomorphological paleoindicator analog

attribute fluvial/estuarine and marine processes, by the identification of foreshore and fluvial patterns. In adjustment with the geochronological data, different rates of progradation were established in addition with sea-level behavior. The GPR A (Fig. 3), positioned in the contact between Precambrian and Holocene coastal plain, shows a predominant foreshore pattern defined by Rf 1, but with an upper limit truncated by deposits described by overwash process (Rf 3). Considering that in this line is the OSL 1B sample, dated at 5.800 ± 750 years, which corresponds to the Holocene Transgressive Maximum (MTH) (Angulo et al. 2006), this depositional architecture may represent the transition from a transgressive to regressive pattern. This type of radarfacies presents the same structure as identified by Silva et al.

(2014b) and Nascimento et al. (2018) that probably indicate the changes between the maximum sea level, forming a transgressive barrier to regressive conditioned by sea-level falling.

In the central part of Rio de Janeiro coast (Maricá coastal plain), Silva et al. (2014b) and Silvestre et al. (2015) identified dip reflectors in inland direction, which the authors interpreted as records of the retrogradational phase of the barrier, corresponding to the MTH. In the coastal plain of the Itabapoana River, on the southern coast of Espírito Santo, Nascimento et al. (2018) also identified from GPR reflectors, the transition zone between the retrogradational and progradational pattern, characterized by reflectors with dip direction toward the continent, close to reflectors with dip direction toward the sea. The authors also associated this change with the transition from MTH to the sea-level falling.

After the MHT, our GPR results show a typical progradational pattern, which would result from the post-MHT phase, which is well characterized in the GPR C, where Rf 1 lies over the reflectors of Rf 2, indicating the migration of the beach deposits (*Foreshore*) over shoreface environment*,* indicating a regressive behavior. This pattern is compared to Niedoroda et al. (1985) and Holz (2012) and is morphologically characterized by a sequence of beach ridges. Considering the altimetric information obtained with geodetic GPS, coupled with MDE data provided by *Google Earth Pro* platform, the topography of the coastal plain indicates that this progradation probably occurred due to normal regression, i.e., when the sediment input rate is higher than the creation of accommodation space (Holz 2012). In this case, even the relative mean sea level has been falling, especially since the last 5500 years (Angulo et al. 2006; Jesus et al. 2017), the directly fluvial sediment input seems to present an important role on the evolution of regressive coastal plain.

The influence of fluvial sedimentation on the evolution of the coastal plain is also corroborated by the internal sedimentary architecture, as identified in GPR B (Fig. 3). In our interpretation, the beach deposits (Rf 1) observed in GPR B are interdigitated by a fluvial radarfacies, interpreted as probably paleochannel, formed parallel to the shoreline, which is subsequently filled by point-bar deposits (Rf 4). Using a modern analog (Fig. 7), this process was actually identified in the Una River. In 2014, the Una River channel present a morphology parallel to the shoreline before inflected to the ocean, where it is even possible to observe the formation of point bars near the concave margin. In 2016, probably after a climate and/or oceanographic event characterized by heavy rainfall and/or high-energy waves, the Una River suffered an avulsion process and abandoned part of the channel on the coastal plain. In 2017, it is possible to identify the reworking of these fluvial deposits abandoned by the action of storm waves and the partial covering in 2018 by beach sediments.

According to Barboza et al. (2014), the association of marine and fluvial processes can generate an interdigitation between coastal and fluvial sediments, and be preserved in the internal sedimentary architecture. Similar reflectors were also identified by Silva et al. (2014a) and Bogo et al. (2015) as examples of regressive barriers on the southern coast of Brazil. In the same geological/geomorphological context, Hein et al. (2016) identified in Tijucas Plain, Santa Catarina, by sediment analyses in

Fig. 7 *Google Earth* images showing the current example of interaction between coastal and fluvial processes, where it is possible to observe the Una River sectioning the coastal plain, with its channel flowing parallel to the coast; subsequently occurring processes of channel avulsion, abandonment, and reworking of the fluvial deposits by wave action

boreholes, marine materials identified by decreasing the diameter of sands that characterized a typical regressive Holocene plain, over fine (stilts and clays), associated by fluvial/estuarine environments.

Despite the absence of borehole data, the morphological characteristic of the strandplain, surrounded by gentle depressions associated with fluvial materials, over shoreface, characteristic from Rf 2, as observed on GPR A and B, is interpreted as beach ridges interdigitated with fluvial/estuarine pattern. Even trying to use a low-frequency antenna (200 MHz), we do not succeed to obtain deeper reflector, probably because of the attenuation of signal, caused by fine sediments on the shoreface. In fact, this can be attributed by the modern fluvial sedimentation on the shoreface, according to surficial sediment map.

6 Conclusions

The coastal plain between cape Búzios and Rio das Ostras is formed by fluvial and marine deposits, surrounded by Precambrian and Cretaceous geology. The coastal plain, divided by São João river present in the southern part, series of beach ridges and fluvial sediments. The geochronological data obtained along the strandplain showed that the transition from a retrogradational to progradational pattern, with an age of 5.800 ± 750 years, which was associated with the Holocene Transgressive Maximum (THM). The OSL ages varied between 6.880 ± 630 years and 1.940 ± 180 years and reveals variations in the coastal evolution rates during the Upper Holocene, whose rates were faster from 4.500 ± 325 years (2.2 m/yr) and slower from 1.940 ± 180 years (0.37 m/yr).

After MHT, the sea level tends to fall till actual level. This condition favors the formation of beach ridges that occurred under normal regression conditions, indicating that the sedimentary input rate seems to be a determining factor for the progradation, corroborating the importance of fluvial sedimentary input in the construction of the plain. This fluvial-estuarine influence was also identified from reflectors showing the filling of a paleochannel sectioning the coastal barrier.

In possible future scenarios marked by projections of sea-level rise, climate change and anthropic interventions in drainage basins that directly contribute to the coastal system and investigations about the fluvial-estuarine influence on the coastal sedimentation are relevant in the temporal context of the Anthropocene.

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