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TL dating of sediments from Ilha do Mel, Brazil

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ABSTRACT

Twelve samples of sediments collected from Ilha do Mel in the eastern coast of the State of Paraná have been dated using thermoluminescence (TL) technique. Assuming that sunshine exposure zeroed the previously induced TL, somewhat overestimated ages have resulted. Residual TL has been inferred for each of the samples from laboratory UV bleaching and also from sunlight bleaching. The correction carried out using the ratio between naturally accumulated TL-value, TL_0, and the residual TL_r, has resulted in geologically expected ages for the sediment samples.

1. Introduction

Ilha do Mel is located at the mouth of the Baía de Paranaguá estuarine complex at 25°S along the southern Brazilian coast (Fig. 1). The island is constituted by two geological–geomorphologic domains: (a) Precambrian to Mesozoic igneous and metamorphic rocks, which form the hills; and (b) Quaternary sand deposits, which form the coastal plains. According to Angulo and Souza (2005), the paleogeographic evolution of Ilha do Mel could be reconstructed from the Late Pleistocene. At the last interglacial maximum, when sea-level reached 8 ± 2 m above the present level (Martin et al., 1988), the island was reduced to a rocky archipelago with a small sedimentary terrace between two rocky hills. During the last glacial period, the sea-level lowered more than 100 m and the island was attached to the mainland. During the postglacial period, the sea-level rose at high rates (ca. 10 mm/y) until 8000–7000 years before present (BP), and subsequently the rates diminished significantly (1.0–3.3 mm/y) (Pirazzoli, 1996). Since that time, the sea-level at southeast Brazilian coast has changed only 2–4 m (Angulo et al., 2006). Sea-level stabilization allows the building up of coastal plains at positive sedimentary balance areas. Therefore, the ages of southeastern Holocene coastal plains of Brazil are younger than 7000 BP (Angulo et al., 2006). The same is true for the Ilha do Mel Holocene coastal plain. Angulo and Souza (2005) recognized five progradational Holocene stages (Fig. 1). The morphology and spatial distribution of foredune-beach ridges suggest that during stages 2 and 3, progradation occurred mainly from west to east (Fig. 1).

This work presents the dating of 12 samples collected from Ilha do Mel. These sediment deposits were chosen as they can help to reconstruct the latest Quaternary history of Ilha do Mel.

2. Materials and methods

Twelve samples have been collected for dating using 100 cm long and 5 cm diameter PVC tubes. Ten samples were taken from the cliffs along the northwestern and southwestern coasts of the island (Figs. 1 and 2a). Two samples were taken from an outcrop of the dune ridge between the Morro do Miguel and Morro do Meio hills at the southern part of the island (Fig. 1).

The samples were taken from three different sedimentary facies: massive sand (Sm), low-angle cross-stratified sand (Sl), and sigmoidal cross-stratified sand (Ss). These three facies were interpreted as deposited in different sedimentary environments: foreshore, flood tidal delta, foredune, and aeolian dune (Table 1). Sl facies is characterised by thick tabular and wedge-shaped beds, composed of fine to very fine and well to very well-sorted sand, and corresponds to the swash cross-stratification at the beach swash zone of the foreshore (Fig. 2b). Ss facies is characterised by thick tabular beds composed of fine to very fine, moderate- to well-sorted sand, and corresponds to straight-crest subaqueous dunes of a flood tidal delta (Fig. 2c). Sm facies is composed of fine to very fine well-sorted sand and corresponds to aeolian dunes identified

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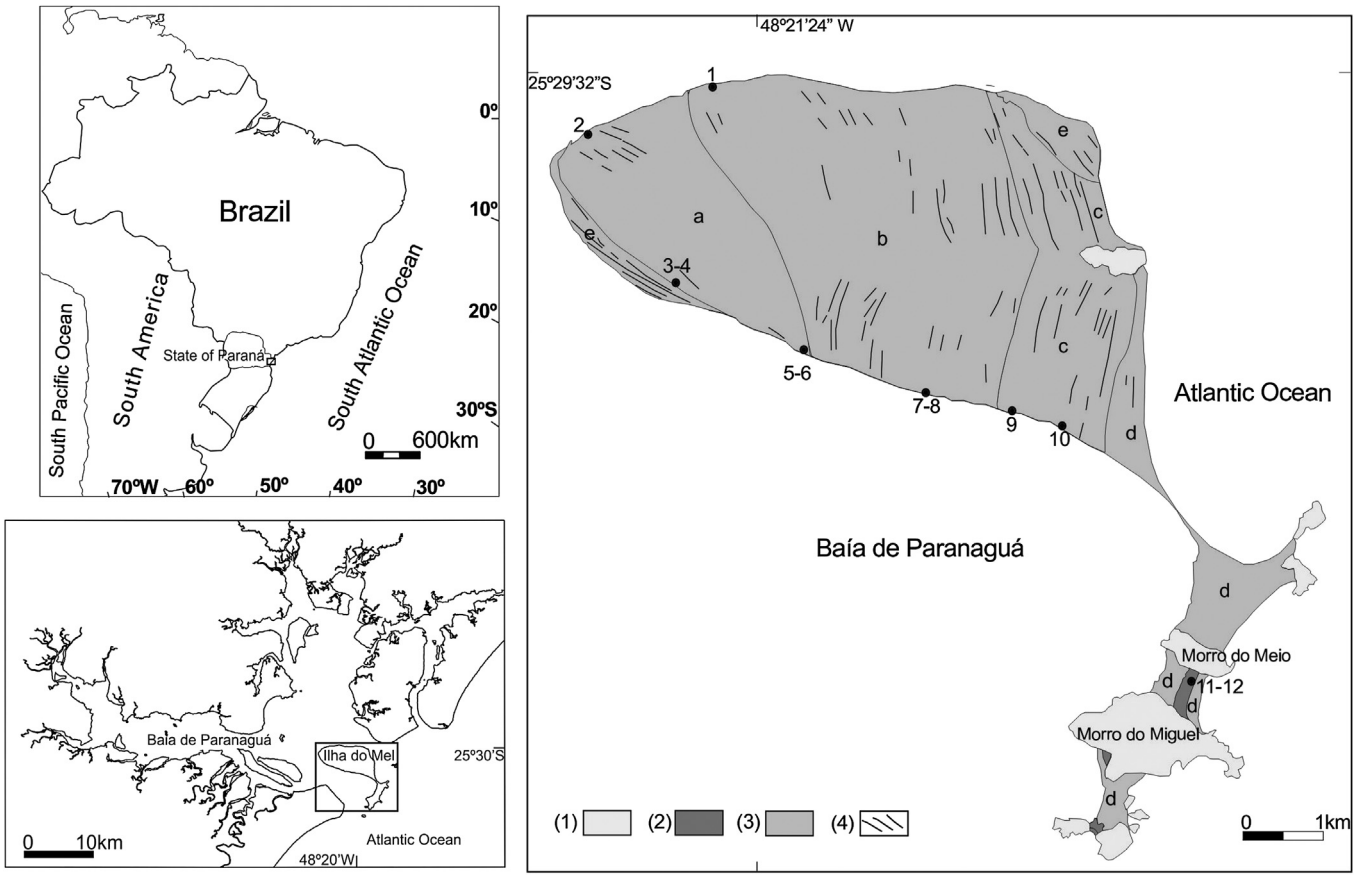

Fig. 1. Location of the study area: (1) Hills supported by igneous and metamorphic rocks; (2) Pleistocene sedimentary terrace; (3) Holocene coastal plain; (4) foredune-beach ridges alignments; (a–e) older to younger Holocene stages of island progradation (after Angulo and Souza, 2005). 1 to 12 sample location.

by morphological characteristics (samples IM08, IM11 and IM12, Fig. 2d) or to a pedogenetic horizon where sedimentary structures were eliminated by eluvial processes (sample IM01, Fig. 2a). The samples were taken from E (eluvial), Bh (spodic), and C (Espodossolo) horizons. The E horizon is characterized by white structureless sand (sample IM01), the Bh horizon by brown sand with organic matter and iron sesquioxides, and the C horizon corresponds to white Sl sand sedimentary facies (sample IM07). The depth from the sample to the coastal plain surface that corresponds to the top of the original depositional surface was between 0.8 and 3.0 m (Table 1).

Sediment from the ends of each tube was discarded. About 50 g of the sample to be used for thermoluminescence (TL) measurements was dried and sieved to retain grains with diameters between 0.080 and 0.180 mm. These grains are natural and did not result from crushing of larger grains. These grains were subjected to chemical treatment to separate quartz grains. A wide range of concentrations of H_2O_2, HF and HCl acids and reaction times have been reported in the literature for the extraction of quartz. In the present study, it was decided to evaluate the efficacy of a method which uses these acids. Watanabe et al. (2008) have concluded that the optimum reaction time when using a solution of 40% HF and

Table 1
Sample location and characterization.

Identification[a]	Latitude south	Longitude west	Depth[b] (m)	Sedimentary facies[c]	Sedimentary environment	Soil horizon[d]
IM01	25°29′58.38″	48°22′43.28″	1.1	Sm	Foreshore	E
IM02	25°29′38.46″	48°21′49.14″	1.2	Sl	Foreshore	Bh*
IM03	25°31′15.00″	48°21′33.24″	3.0	Ss	Flood tidal delta	Bh**
IM04	25°31′15.00″	48°21′33.24″	1.7	Sl	Foreshore	Bh*
IM05	25°31′18.54″	48°21′29.34″	2.0	Sl	Foreshore	Bh**
IM06	25°31′18.54″	48°21′29.34″	1.1	Sl	Foreshore	Bh*
IM07	25°31′34.26″	48°20′50.16″	1.4	Sl	Foreshore	Bh*
IM08	25°31′34.26″	48°20′50.16″	0.8	Sm	Foredune	C
IM09	25°31′38.84″	48°20′10.14″	1.2	Sl	Foreshore	Bh*
IM10	25°31′50.04″	48°19′19.92″	1.8	Sl	Foreshore	Bh**
IM11	25°33′28.20″	48°18′18.42″	1.0	Sm	Aeolian dune	Bh*
IM12	25°33′28.20″	48°18′18.42″	0.8	Sm	Aeolian dune	Bh*

[a] The pairs of samples IM-03-04, 05-06 and 07-08 were collected at the same places at different depths.
[b] Depth is referred to the terrace surface that corresponds to the original depositional.
[c] Sm: massive sand; Sl: low-angle cross-stratified sand; Ss: sigmoidal cross-stratified sand.
[d] E: eluvial, Bh*: spodic with incipient illuviation, Bh** spodic well developed, C: parent material.