Characterization of the sedimentary wedge off São Sebastião Island, São Paulo

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Abstract

The São Sebastião Island, located in the Bight of São Paulo, southeastern Brazil, holds a kilometric scale deposit whose distribution, internal structure and age are still unknown.

Due to its geographical position, it is believed that the deposit genesis is the result of the combined influence of the Brazil Current to the north, and the sediment plume derived from the La Plata River to the south of the island.

Geophysical and sediment data were collected in the region between 2013 and 2015 in order to study the genesis and evolution of the sedimentary wedge off São Sebastião Island. The available data will be complemented with additional sedimentological data to be collected in 2015.

The available seismic data indicates that the sedimentary wedge extends along the shelf for approximately 32 km, oriented SW-NE and exhibiting an average sediment thickness that varies from 12 to 20 m.

Introduction

The interaction between sediment dynamic processes and water mass circulation has given rise to a complex depositional system along the southeast Brazilian coast (Mahiques et al., 2010). Located in the São Paulo Bight, between the latitudes 23º 43' and 23º 58' south, the submerged region southeast of São Sebastião Island (Fig. 1) is covered by a progradational sedimentary wedge whose sedimentary dynamics, origin and structure are still unkonwn.

Deposits of this type are characterized by elongated distributions paralleling the adjacent coastlines with lateral continuity of tens of kilometers and kilometric widths. The sediment depocentres show maximum thickness of tens of meters and progradational internal seismic configuriations, with variable (i.e., sandy versus muddy) grain sizes (Ercilla et al., 2010; Hernández-Molina et al., 2000; Lobo et al., 2005; Marsset et al., 2003; Xu et al., 2012).

Due to the absence of large rivers in the region next to the island that could transport enough material to form the wedge, it is believed that the São Sebastião Island is configured as the crossing point of the sediment transported from the La Plata River runoff and reworked sediments by the meanders of the Brazil Current.

Sedimentary processes to the north of São Sebastião Island are affected by a complex circulation pattern in which vortices, both clockwise and counterclockwise, and meanders from the Brazil Current are formed. These vortices generate upwelling to the north and downwelling to the south of the region between Cabo Frio and São Sebastião Island, increasing the biological productivity and, hence, the deposition of organic matter (Mahiques et al., 2002). To the south of the island, sediment supply is mainly provided by the plume from the La Plata River runoff. This low temperature and salinity water mass is responsible for the transportation of the modern sediments and organisms from the La Plata Estuary up to 24ºS northwards (Mahiques et al., 2004; 2010).

This study is aimed at providing the initial characterization of the distribution patterns and the internal structure of the sedimentary wedge. To achieve these goals, geophysical and sedimentological surveys were conducted in the region from 2013 to 2015, according to the map illustrated in Fig. 2.

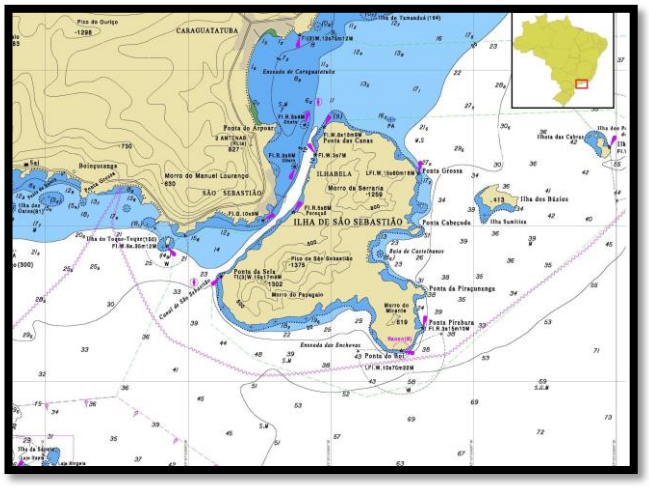

Figure 1 – Location of the São Sebastião Island in the São Paulo Bight.

Methods

Geophysical data were collected from the surface (multibeam bathymetric and sonographic data) and the

sub-bottom (chirp and boomer seismic data). Additionally, a single sediment core was collected. The data were collected during two oceanographic surveys:

(1) GeoSedex cruise in 2013, (Figure 2), when sub-bottom profiler (3.5 kHz) seismic data and a 4 m long core (NAP61) were collected.

(2) Cunha cruise in February 2015, when diverse data were collected. Seismic data were acquired using boomer (300-1000 Hz, 75-300 J) and chirp sources (2-8 kHz and 10-20 kHz, 2kW). Additionally, we collected surface geophysical data (multibeam bathymetry and side scan sonar records) and ADCP data.

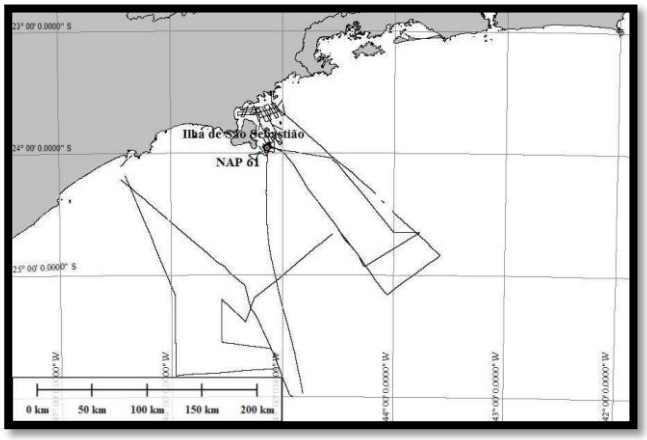

Figure 2 - Positioning of all the seismic lines available and NAP61 core.

Seismic data were processed and interpreted by using Meridata MDPS and Global Mapper softwares. ArcGIS software was used for mapping and spatial analysis.

Grain size analyzes and radiocarbon dating were performed in the sediments from the NAP61 core.

Preliminary results

A preliminary analysis of the seismic data enabled us to define the sediment wedge lower boundary, its lateral limits and its thickness. The wedge is imaged in light blue and its base in green in the seismogram illustrated in Fig. 3 (position of this profile is shown in Figure 4). The sediment wedge shows a maximum thickness ranging from 12 to 20 m.

The lateral extent of the sediment wedge can be inferred from the delimitation of its boundary basinwards in the available seismic profiles, and then, with the connection between these points. The result is shown in Fig. 4, where the red line corresponds to the lateral extent of the sedimentary wedge, which is approximately 32 km long and SW-NE oriented.

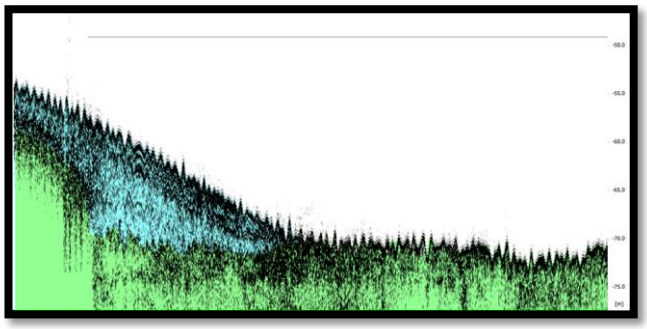

Figure 3 - Seismogram showing the sedimentary wedge (blue unit) and the basement (green color) on which it is deposited.

At the end of this work it is expected to perform the dating of the onset of the wedge sedimentation, the generation of isopach maps related to the seismic units as well as the characterization of the internal structure of the sedimentary wedge in relation to the sea level variation in the region.

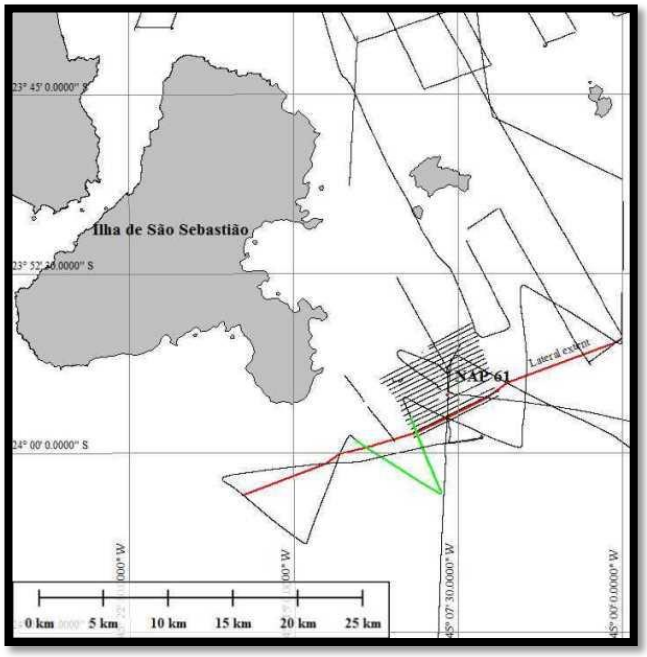

Figure 4 - Lateral extension of the sedimentary wedge (red line) determined by the identification in each profile of its limits. The black lines represent the seismic profiles acquired in the region. The green line represents the seismic profile shown in figure 3.

Final remarks

The preliminary results allowed to map the limits of the sedimentary wedge as well as to define its dimensions.

Future works will complete the characterization of the deposit regarding to its internal structure and stratigraphic evolution.

The project is of great interest because it aims at the characterization of shallow-water deposits that have not yet been described in the southeast Brazilian continental margin, contributing to the knowledge about the deposit genesis and the link with regional sediment dynamics and paleoceanographic conditions.

Acknowledgments

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