# A seismostratigraphic approach to the study of the Quaternary sedimentary evolution of the São Sebastião Channel, North Coast of São Paulo

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## Abstract

The coastal areas are of great importance to the human development especially when the sustainability of the activities on the continent and the marine environment are taken in consideration. The São Sebastião Island represents an important geomorphologic mark of the North Coast of São Paulo evolution and the study of its stratigraphy will contribute even more to the knowledge of the area. A seismic survey was performed with a Meridata MD-DSS system composed by three sound sources: boomer, pinger and chirp. The data processing and the seismic profiles analysis were made with the softwares SView4® and MDPS®, respectively, both part of the Meridata system. The preliminary results of this work point to seismic unities with clear lateral continuity as well as stratigraphic patterns related to environments that were subjected to sea level changes along the Late Quaternary. In the future, more analyses will be made in order to get more complete interpretations of the profiles, volumetric and spatial variation and, consequently, an outline of the sedimentary evolution of the study area.

## Introduction

Seismostratigraphy is a method of interpretation of seismic data to better understand the tectono-sedimentary evolution of a basin (Ribeiro, 2001). This kind of approach has become very common, especially in face of the technological advances of survey, processing and analyses of seismic data.

Souza (2006) lists some characteristics and applications of seismic data to the study of submersed areas. Among them there we may cite coastal and oil engineering as well as oil and mineral researches, navigation and even eventual archeological studies. Moreover, the author highlights that the technic consists in non-destructive assays and without the need of physical penetration on the environment.

Lobo *et al.* (2005, 2008) used seismic profiles to study the sedimentary evolution on a region of the Mediterranean Sea and identified prograding patterns of the coastline and structures that match variations of the sea level.

Ercilla *et al.* (2009) performed seismic profiles in the shore of Spain and identified sedimentary structures and patterns related to the Holocene sea level fluctuations. Even without a chronology to this study the authors correlated the data to others in the same region and with the sea level curves established on them.

The sea level variations are of important consideration to study the sedimentary evolution of this region. In the State of São Paulo they were studied by Petri and Suguio (1973), Suguio and Martin (1978) and Angulo and Lessa (1997), among others.

In marine environments the work of Mahiques and Souza (1999) represents an important start to the utilization of marine geophysics to the study of sedimentation and Holocene sea level fluctuations in the region of the Flamengo Bay, in the city of Ubatuba, Northern Coast of São Paulo.

A seismic survey was performed at the São Sebastião Channel (Fig. 1), which is located at the northern coast of the State of São Paulo, between the latitudes 45°19'W and 45°30'W and longitudes 23°41'S and 23°53.5'S. The channel, which separates the São Sebastião Island to the continent, has about 25 km of extension with maximum widths of 6 and 7 km and minimum width at the central area of 2 km.

## Method

The seismic survey (Fig. 1) was performed with a Meridata MD-DSS system that belongs to IOUSP and it is composed by three sound sources: boomer, pinger and chirp, coupled to a Leica DGPS positioning system. The lines were performed at distances of 50 meters in average from one another. There are 37 lines in the direction NW-SE and 6 transversal lines in intervals of 200 meters.

The Meridata system allows the simultaneous utilization of different seismic sources according with the need and local characteristics. In this study, we used the three available sound sources. As described by Souza (2006), boomer works in low frequencies (from 0.5 to 10 kHz) and high potency. It is locked to a catamaran, towed by the boat and the signal of the sound is identified by a hydrophone also towed. In this work, the frequency of boomer was set in a range of 0.1 to 1.5 kHz.

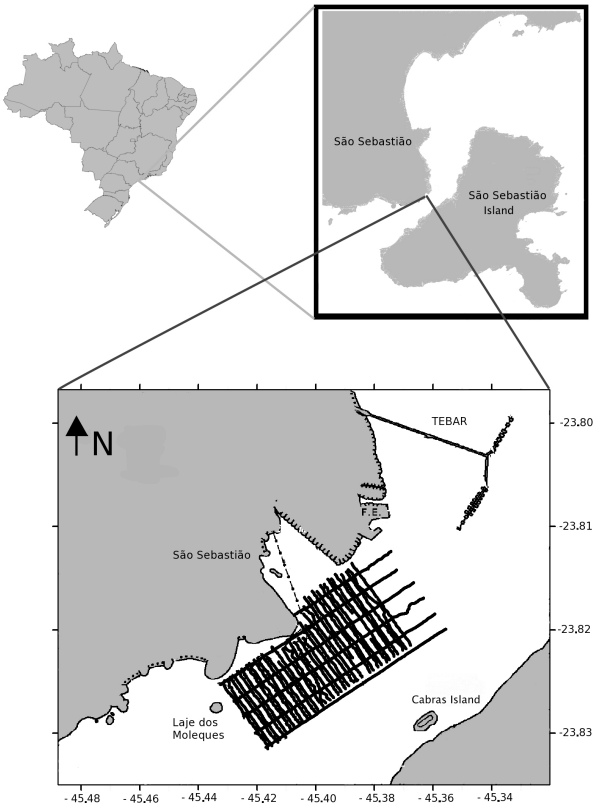


**Figure 1.** *Study area: São Sebastião Channel, on the North Coast of São Paulo.*

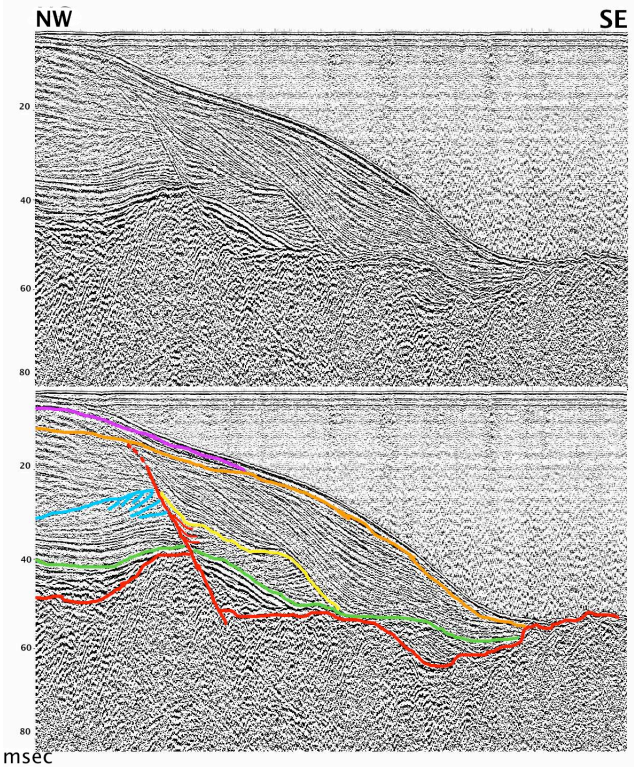


**Figure 2.** *Above it is represented the seismic profile after treatment on SView4 and below the interpretation of the reflectors.*

At first, only the data obtained with the boomer source was analyzed, as it is a lower frequency/higher energy source, resulting in the identification of deeper reflectors.

The seismic profiles obtained after processing on the SView4® software were analyzed according with the fundaments of the Sequence Stratigraphy.

## Results and Discussion

The analysis of the seismic profile made it possible to recognize important sedimentary characteristics such as prograding structures with downlap advance, reflectors that indicate erosional truncation and even faults.

On the figures 2 and 3 there is a well marked fault characterized with the presence of three structures well defined: the reflector vertically positioned, curved reflectors against the fault (in red) and the divergent reflectors at the region anterior to it (in light blue).

In all profiles there are erosional surfaces as the one represented in yellow, which separates the set of parallel reflectors of the prograding seismic unity, which is marked by the downlap advance.

The divergent reflectors (light blue) have an upper contact in an erosive truncation, possibly the same event that should have produced the erosional surface in yellow, in the opposite way of the fault.

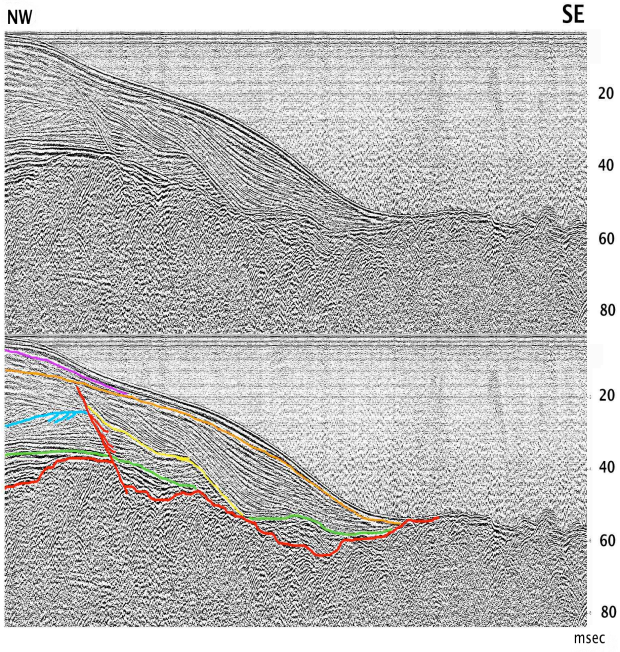


**Figure 3.** *Above it is represented the seismic profile after treatment on SView4 and below the interpretation of the reflectors. Both figures 2 and 3 are of direction NW-SE.*

The characteristic shape of all profiles corresponds to a set of prograding reflectors that may represent the development of infralittoral prograding wedges as defined by Hernández-Molina *et al.* (2000).

The reflectors marked in orange and pink represent the limit of these prograding units and the seismic unit defined by the pink reflector corresponds to the most recent deposition conditions in the region. Even being result of one same depositional system, the two of them were separated because of the presence of a truncation in the deep of 10 msec.

However, the prograding wedges of Hernández-molina *et al*. (*op. cit.*) were defined as characteristic of depositional systems dominated by waves, what do not matches the conditions of the São Sebastião Channel.

The transversal profile (Fig. 4) also shows curved reflectors in the proximity of the basement that may also represent a synchronic deposition with a seismic event. Moreover, it can be seen two distinct and different prograding units separated by an erosive truncation (orange).

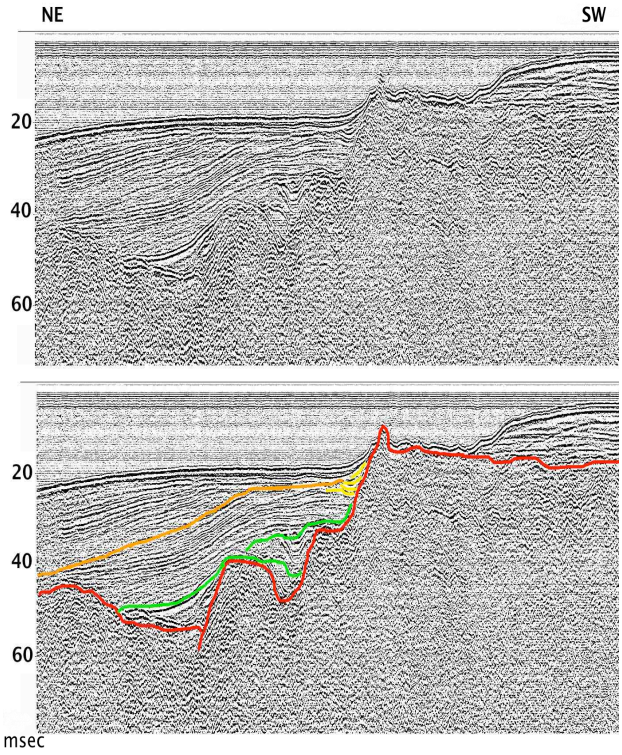


**Figure 4**. *Seismic profile on the direction transversal to the channel an the others profiles presented on the figures 2 and 3. Above it is represented the seismic profile after treatment on SView4 and below the interpretation of the reflectors.*

## Conclusions

Erosional surfaces are present in all profiles showing that important events may be related to the variations of the mean sea level along the Late Quaternary.

The prograding units are dominant in terms of thickness of the sedimentary cover and represent the depositional conditions of today. These unities are similar to the infralittoral prograding wedges identified in the coast of Spain, in the Mediterranean Sea. However, the authors that defined those types of structures related them to wave-dominated environments, which is not applicable to the São Sebastião Channel.

## Acknowledgments

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