Sonographic patterns and reef mapping in Abrolhos shelf, Brazil

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This paper was prepared for presentation during the 11th International Congress of the Brazilian Geophysical Society held in Salvador, Brazil, August 24-28, 2009.

Abstract

A regional sidescan survey was undertaken along the northern portion of the Abrolhos shelf, comprising a total of 898 nm. Results showed 6 distinct sonographic patterns associated to the shelf: P1 and P2 represent reef structures; P3 dominates the surveyed bed and is related to nodulos of calcareous algae (rhodoliths); P4, P5 and P6 showed high heterogeneous reflection patterns and may represent changes in bed sediment textures and composition. These findings will allow a new and important estimative of submerged reef coverage.

Introduction

Seabed imaging by side scan sonar is an important tool in mapping reefal and inter-reefal areas, which may have relevant impact on conservation planning. Side scan sonar surveys have been widely used to map marine habitats, including reefal and inter-reefal areas (*e.g.* Souza and Moura, 2005; Kendall *et al*. 2005; ,Lindberg *et al*. 2007; Collier and Humber, 2007; Degraer *et al.* 2008). Sonographic patterns of reef structures usually show a strong acoustic reflection with a degree of roughness and a positive relief. The region comprises a mosaic of coastal and marine environments, including estuaries, mangrove forests, seagrass, rodoliths, muddy beds and the largest coral reef area in the South Atlantic. Despite its importance, most of the studies carried out so far are limited to very shallow and coastal waters. Most of the areas of the shelf deeper than 20 m remains unmapped in terms of the extension and distribution of its habitats (Klein *et al.*, 2008). In order to investigate the marine habitats distribution along the Abrolhos shelf, a regional side scan sonar survey was undertaken. The objective of this contribution is to describe the different sonographic patterns associated to a carbonate shelf observed in this survey. The studied area is the northern Abrolhos shelf which is the largest known occurrence of coral reef area, including the important Marine Protected Areas – MPAs (Figure 1).

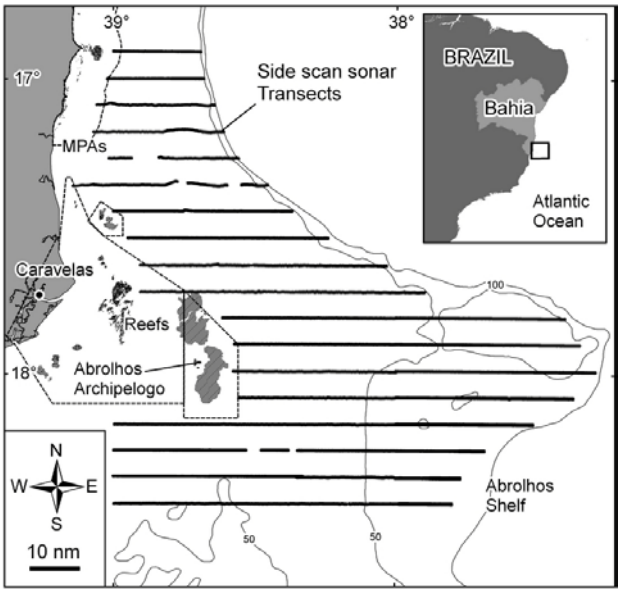


Figure 1: Study area in the Abrolhos shelf, Brazil. Black lines represent the side scan transects.

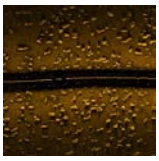
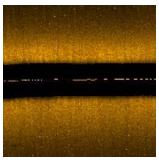
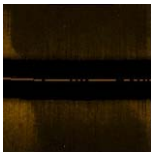
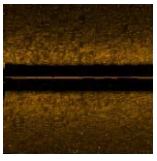
Method

Acoustic seabed imaging by sidescan sonar is a well known geophysical technique based on principles of acoustics signal reflection. Indirect images are generated (sonograms) by different intensity of acoustic signal return (backscatter). Patterns of acoustic return are based on a series of factors, such as: bed sediment and morphology, incident angle, attenuation of acoustic waves, water depth, etc. Side scan sonar surveys were undertaken along eighteen E-W transects, from the inner shelf to the shelf break. An Edgetech 4100 side scan system with a 272TD towfish were used operating with 100 kHz and the swath was 200 and 400 m (Figure 1). Bathymetric data was acquired with a Skipper 417 echosounder. Side scan data was processed with SonarWiz Map4 software. Georeferenced mosaics were produced and exported as *.GeoTiff* images with a resolution of 1.0 m/pixel. Images were then interpreted using a GIS software (ArcGIS 9.2). Sonograms were interpreted and acoustic patterns were defined based upon reflection intensity, roughness, shapes, shadows and heights and bed texture.

Results - Sonographic patterns

Sonographic analysis allowed the recognition of 6 distintic acoustic patterns. Results are shown in Table 1. Sonograms revealed a great variety of substrates indicating the complexity of the Abrolhos shelf. Image analysis showed isolated (pinnacles) and grouped reef structures, flat and irregular beds with varying backscatter intensity and low relief areas as paleochannels. These features occurs across the entire shelf, but no direct relation to the water depth was observed. Figure 2 (a,b,c) shows examples of morphological profiles and sonographic representation.

Table 1: Summary of sonographic patterns

Pattern	Description	Example
P1	Isolated reef structures (pinnacles) in a flat bed (distance between structures ≥10 m). rough high backscatter sonar pattern.	
P2	Grouped reef Structures. Strong acoustic reflection and high bed roughness	
P3	Flat Bed – uniform high backscatter pattern.	
P4	Flat or low relief beds – uniform low backscatter pattern	
P5	Irregular to flat relief beds – irregular low backscatter pattern	
P6	Irregular to flat relief beds – irregular high backscatter pattern	

In general, reef structures occurs surrounded by flat beds, usually with a strong heterogeneous backscatter return, which may indicate bioclastic sands or gravel. Further analysis and surveys must be carried out, but at this stage, it seems that these morpho-sedimentary features are the combined result of modern carbonate sedimentation processes and Pleistocene-Holocene sea-level changes.

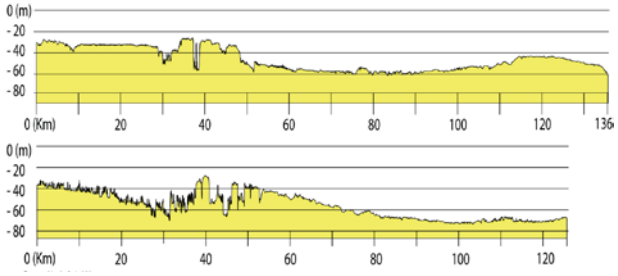


Figure 2a: Two cross-shelf bathymetric profiles.

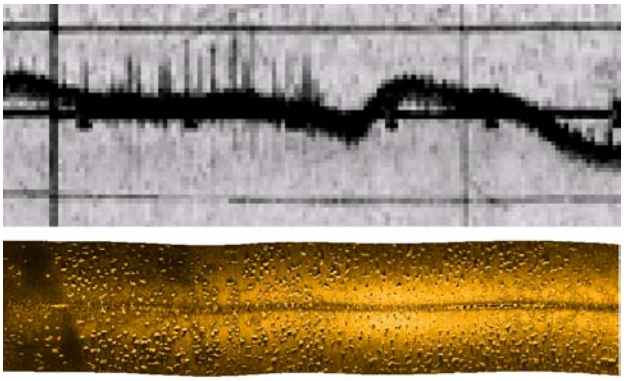


Figure 2b: Sonogram and echo sounder record showing isolated reef structures (P1).

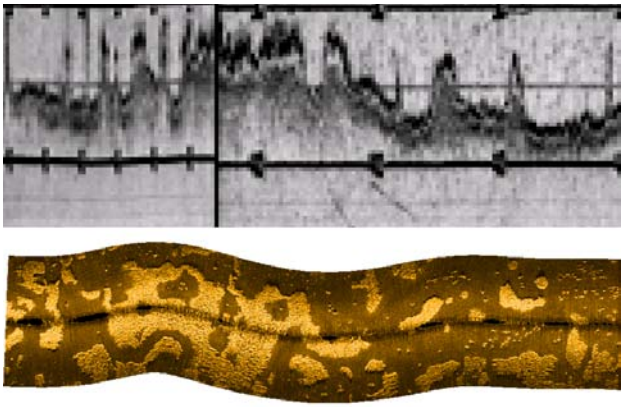


Figure 2c: Sonogram and echo sounder record showing grouped reef structures (P2).

Conclusions

Sidescan sonar and bathymetric survey revealed a great variety substrates. Considering the importance of the region, these new findings have pointed out the importance of mapping the marine habitats over a very sensitive environment. Further analysis and fieldwork will help improving our knowledge of such environment.

Acknowledgments

This work was supported by Conservation International and Gordon and Betty *Moore* Foundation. We thank Ruy K.P. Kikuchi, John Musinsky and Debra Fishman for inputs on the first phase of this study, and to all the team involved during the field surveys.

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