

## The narrow, shallow, low-accommodation shelf of central Brazil: Sedimentology, evolution, and human uses



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### ARTICLE INFO

#### Article history:

Received 3 April 2012

Received in revised form 25 June 2013

Accepted 5 July 2013

Available online 12 July 2013

#### Keywords:

Foramol  
Rhodoalgal  
Narrow shelf  
Eastern Brazil  
Incised valleys  
Mud depocenters

### ABSTRACT

The continental shelf off the coast of central Brazil, extending from 10 to 16°S, is unusually narrow (~20 km) and rests on the São Francisco craton. The shelf break is located between the 45 and 50 m isobaths and coincides with major hinge-lines of the marginal basins. The shelf was exposed for most of the Quaternary period, particularly during the last 1 my, when the average sea level was –62 m. Submarine geomorphology is strongly influenced by this extended sub-aerial exposure and reduced subsidence, resulting in widespread incisions on the shelf. During the limited episodes of shelf inundation, as is the case today, a few meters of non-framework grain assemblages dominated by coralline algae accumulated on the outer shelf, while quartz sands were restricted to water depths of less than 10–15 m. Mud accumulation on this unusually shallow shelf is aided by additional accommodation space provided by incisions and canyon heads indenting the shelf. Artisanal fisheries, targeting high-value commercial species associated with hard bottoms located on the outer shelf and shelf break, are the most important human use of this shelf. Data used in this study have been compiled from theses and previously conducted surveys and consist of four piston cores, 509 km of chirp subbottom profiles and side scan recordings, and 711 bottom grab samples that have been analyzed for various textural and compositional aspects.

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### 1. Introduction

Narrow, shallow continental shelves are relatively rare in passive margin settings. The continental shelf of central Brazil is extremely narrow and shallow compared to the global average width of 78 km (Shepard, 1963). Other narrow shelves have been recently documented in the literature, such as those of Durban, South Africa (Cawthra et al., 2012) and NW Iberia (Lantzsch et al., 2009), but these shelves are characterized by high-gradients with the shelf break located at depths greater than 100 m. At the narrow shelf of central Brazil, however, the shelf break is located at a depth between 45 and 60 m, which coincides with major hinge lines of offshore sedimentary basins. In these basins, major sediment depocenters are located on the slope and continental rise (Ferreira et al., 2009). The existence of such a narrow shelf has usually been attributed to the fact that it is located entirely on the São Francisco craton (Alkmim et al., 2001) (Fig. 1). Consequently, the shelf has experienced very limited subsidence since the Mesozoic continental break-up. This lack of accommodation space, in conjunction with the fact that during the Quaternary period, particularly during the last

1 million years (my), the average sea-level position was –62 m (Lea et al., 2002; Waelbroeck et al., 2002; Berger, 2008; Blum and Hattier-Womack, 2009) implies that the shelf was exposed sub-aerially almost continuously during this time or that there was no shelf at all during most of the Quaternary period. A major implication of this extended sub-aerial exposure and reduced subsidence is that the submarine geomorphology of the shelf is determined by long-term erosional processes as opposed to sedimentation. Many structural features dating back to the continental break-up period still have a topographic expression on the shelf today and exert control on sedimentation and on the shelf seascape, and thus on human uses and exploitation of its natural resources, particularly fisheries.

These unique characteristics (long exposure, limited subsidence) also provide an opportunity to develop a facies template for tropical narrow-shallow shelves, which has a broad application in deriving distributions of natural resources and predicting the fate of land-derived contaminants.

There is also a substantial lack of information about the tropical shelf of Brazil and its sediments. For example, a recent compilation published by Harris and Baker (2011) on seafloor geomorphology and benthic habitats does not include any contribution from the South Atlantic. In fact, since the REMAC (Brazilian Continental Margin Global Reconnaissance Program) project (Milliman and Summerhayes,

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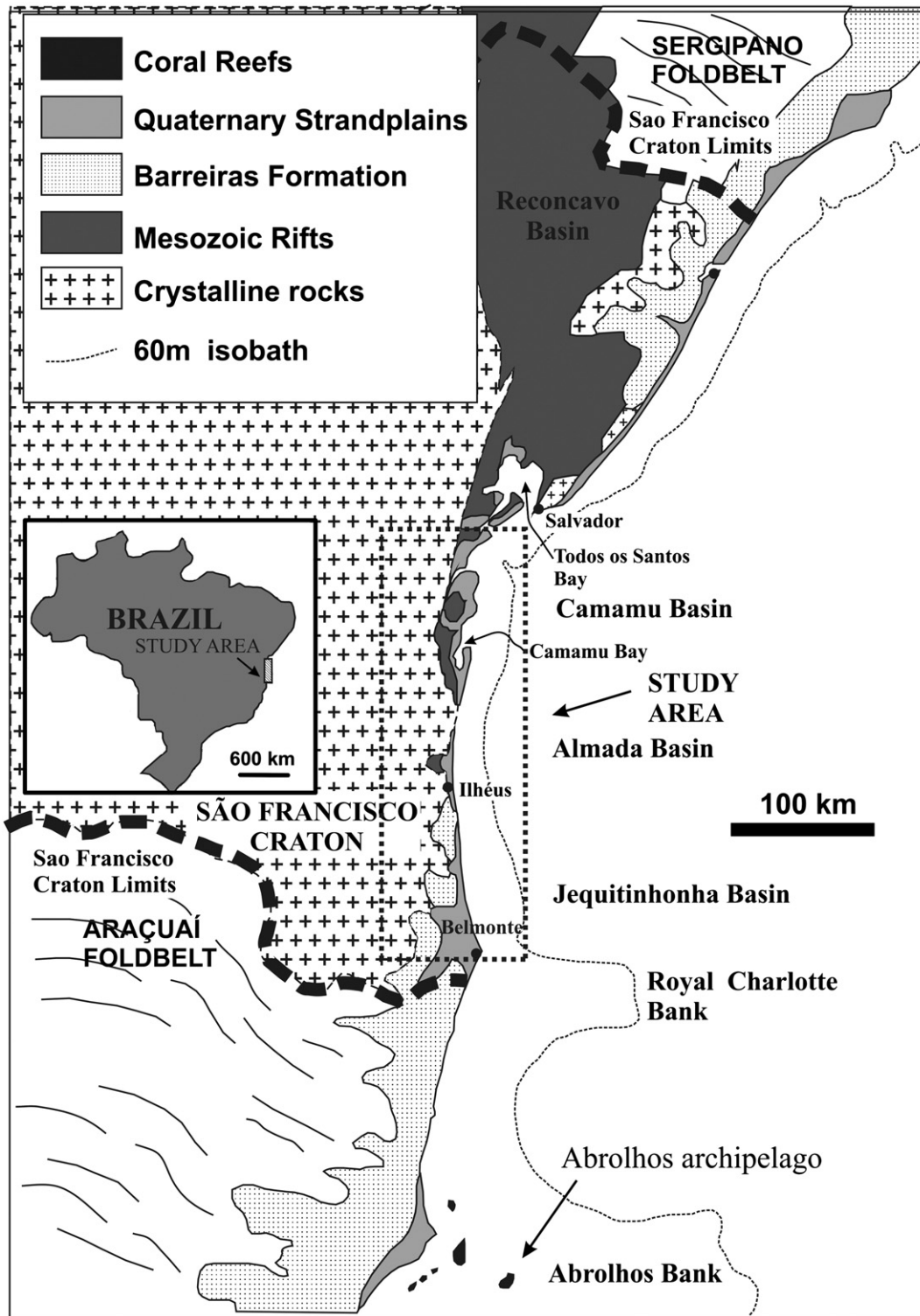


Fig. 1. Location of study area. Also showing simplified geology, and major geotectonic elements discussed in text.

1975), no major synthesis has been published about this area, with the exception of Carannante et al. (1988). However, their paper, although extensively cited in the international literature, presents very limited hard data about the region.

The present paper presents a compilation of the sedimentologic data currently available for the shallow, narrow shelf of central Brazil and discusses how the characteristics mentioned above (long term exposure and limited subsidence) controlled the characteristics of the Holocene sedimentation, the distribution of the seascapes and

the human uses of this area, particularly fisheries. We hope that this compilation will help to bridge the information gap about shelf sedimentation in the Tropical Western South Atlantic area.

## 2. Datasets

The datasets used in the production of this compilation include (Fig. 2): (a) 711 surficial sediment grab samples collected in the shelf area; (b) 509 km of side-scan (EdgeTech model 272-TD – 100 kHz

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