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Transgressive deposits and morphological patterns in the equatorial Atlantic shallow shelf (Northeast Brazil)

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ABSTRACT

The aim of this work is to identify and characterize the Late Quaternary morphological patterns of the west coast of the Ceará shelf, Northeast Brazil, based on Landsat 8, sedimentology, and seismic data. The shallow shelf has three regions: the Acaraú high (AH), unconsolidated floor (UF), and Itapagé bank (IB). The AH occurs in the inner shelf (0–5 m water depth) and shows various bedforms and in part a rocky bottom. The UF (>5 m) has many subaqueous dunes with bioclastics, structures for catching lobsters, and an escarpment. The IB is an extensive feature (delimited by the 20-m isobath) with large dunes and a shipwreck. Three seismic boundaries were identified as follows: transgressive surface (TS), subaerial exposure (SE), and miscellaneous surface (MS = TS + SE). Four seismic units were defined as follows: U1 — transparent facies with low amplitude, underlying the SE; U2 — chaotic to parallel facies with moderate to high amplitude, overlying the SE and underlying the TS; U3 — chaotic facies above the SE or TS and below the TS or sea floor, with the largest spatial extension; U4 — periodically occurring chaotic facies above the TS and below the seafloor. U1 is probably related to the falling stage systems tract or previous highstand systems tract. U2 and U3 belong to the transgressive systems tracts and U4 is associated with bedforms of the highstand systems tract. Ancient topography favored the development of transgressive deposits and modern bedforms. The AH, escarpment, and IB are morphostructures influenced by Acaraú sub-basin faults. The inner shelf is characterized by shallow geomorphology strongly influenced by structural inheritance (Precambrian and post-breakup of Pangea), bedrock control, and the Holocene transgressive systems tract (the largest thickness occurs with subaqueous dunes).

1. Introduction

Helland-Hansen et al. (2012) divided the continental shelf into three main groups: sedimentary shelves, combined structural–sedimentary shelves, and structural shelves. The stratigraphy and morphological patterns of shelves are controlled by the relationship between accommodation space and sediment supply (Posamentier and Allen, 1999; Van Wagoner et al., 1990). Autogenic and allogenic factors provide conditions for the development of a systems tract (Catuneanu et al., 2011; Posamentier et al., 1988).

Shelf sediments are represented mainly by carbonates, siliciclastics, mixed, and relicts (Carneiro and Morais, 2016; Emery, 1968; Gomes et al., 2015). Swift (1974) describes the sediments of the shelf as allochthonous (modern sediments supply) and autochthonous (reworking of recent sediments *in situ*) in accordance with the transgression process (type, rate, and sediment supply) during the Holocene.

Older and modern processes (tides, waves, currents, and sea level changes) are continuously reworking the sea floor and create bedforms (Falco et al., 2015; Kenyon, 1970; LoIacono et al., 2010). Beyond the hydrodynamic agent, biogenic features are common, such as coral reefs and the bioherms (Hillis, 1997; Hine et al., 1988; Tucker and Wright, 1990).

Bedform classification ranges according to scale: macrofeatures and microfeatures (Amos et al., 1988; Ashley, 1990; Testa and Bosence, 1999). Many macrofeatures were created during sea level rise, but then subsequently modified by modern processes in the shelf (Dyer and Huntley, 1999).

Many features on shelves are associated with structural control, such as, aligned ridges and valleys, displacement of topographic features, pronounced breaks, and linear scarps (Gomes et al., 2016; Moslow et al., 1989; Stewart and Hancock, 1994). However, the hydrodynamic processes smooth the topographic relief (Harrison et al., 2003) and these features may be recognized only at a regional

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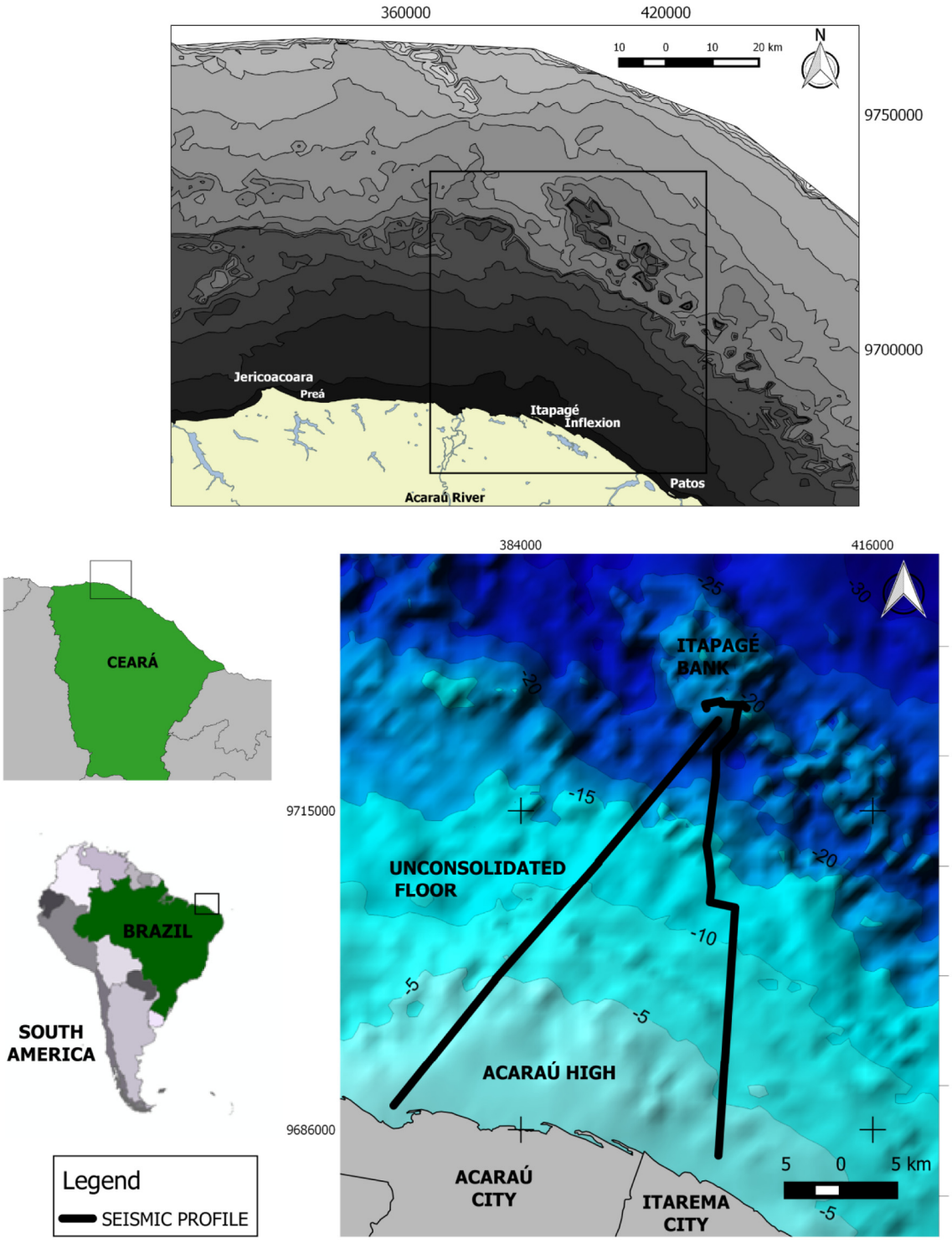

Fig. 1. Study area at the West Coast of Ceará shelf (Itarema and Acaraú) and seismic data survey.
Source: CPRM; DHN; PRONEX; IBGE.

scale (Helland-Hansen et al., 2012). Traces of neotectonic activity may be observed in seismic sections of Quaternary sediments including sedimentary thickening, divergence, and concavity of reflectors (Moslow et al., 1989).

The aims of this study are to identify the Holocene/Late Pleistocene key-surfaces and seismic units (deposits) and characterize the morphological patterns of the shelf offshore to the Itarema and Acaraú/West coast of Ceará (Northeast Brazil). The physiographic limits are the Jericoacoara and Patos headlands (Fig. 1).

In the Ceará basin, there is a lack of research regarding transgressive deposits and their key-surfaces (ravinement, transgressive, marine flooding, and sequence boundary). In other areas, several similar features have been identified as follows: the transgressive large dunes, Adriatic shelf (Correggiari et al., 1996); sand bodies, Gulf of Lion (Rabineau et al., 1998); transgressive sand ridges, South Korea (Park et al., 2003); mixed siliciclastic–carbonate bedforms, Northeast Brazil (Vital et al., 2008); sorted bedforms over transgressive bedform, Sardinia margin (Falco et al., 2015).