Coastal Geology of the Central-Northern Coast of the State of Santa Catarina, Brazil


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ABSTRACT


The coastal province of the central-northern coast of the State of Santa Catarina is comprised of two geological sub-provinces: a) basement and b) basin, the submerged portion of which corresponds to continental shelf. The surface sector of this basin represents the coastal plain, delimited by two interdigitated depositional systems: (1) the continental, confined to the highlands of the basement and (2) the transitional or coastal, a product of the successive eustatic oscillations occurring during the Quaternary period. The continental units include colluvium, alluvial fan and alluvial deposits of the undifferentiated Quaternary period. The coastal units include the marine (beach), eolic, lagoonal, fluvial-lagoonal and paludal deposits of late Pleistocene (120ka) and Holocene (5.1ka present) periods.

ADDITIONAL INDEX WORDS: Coastal geology, sedimentology, geomorphology.

INTRODUCTION

The coastal plain includes a series of geomorphological features and depositional facies of various sedimentation environments. They include the marine, eolic, lagoonal, fluvial, estuarine, and paludal domains, among others; all correlated with the transgressive processes and episodes occurring during the Quaternary period.

This article is a consequence of the results of the project “Morphodynamic, geologic and paleogeographic study of the coastal plain of the central-northern coast of Santa Catarina and in particular, of the sub-project “Geological mapping of the coastal plain of the central-northern coast of the State of Santa Catarina, Brazil”, which was developed between 1994 and 1998 by researchers of the University of Vale do Itajaí, with the support of the Fundação Banco do Brasil. It constitutes the basis of forthcoming multidisciplinary studies, owing to the fact that it presents fundamental geological elements of the coastal Quaternary period, as shown in preliminary publications of HORN FILHO and DIEHL (1995a,b), HORN FILHO et al. (1995), DIEHL et al. (1995), DIEHL et al. (1996), DIEHL and HORN FILHO (1996), HORN FILHO et al. (1996a,b; 1997), AMIN JR. (2000), ABREU et al. (2003) e MEIRELES (2003).

The coastal plain of the area studied (1,399 km²) is located in the northern region of the central sector of the State of Santa Catarina, between the 26°30’ and 27°30’ latitude south and 48°25’ and 48°45’ longitude west (Figure 1), adjacent to a 220 km extension of south Atlantic ocean on the southeastern brazilian coast. The plain is crossed, from north to south, by the BR101 highway, which runs parallel to the coastline adjacent to Atlantic ocean. The area delineated forms part of the planimetric maps, on the pages for IBGE, 1974, 1981a, 1981b and Camboriú (IBGE, 1983). It represents a coastal sector with intense tourism activity and human occupation, which has caused significant environmental changes.

On the coastal plain, the main units were studied from a geological, geomorphologic, sedimentological and palaeogeographical perspective, the product of which is represented by the geological map of the coastal Quaternary of the central-northern coast of the State of Santa Catarina, in the south of Brazil, at a scale of 1:120,000.

METHODS

A bibliographic review was initially made of the principal works carried out on the area under consideration, focusing in particular, on studies with a geological basis. Next, a preliminary analysis was carried out of the satellite images, at a scale of 1:100,000, in order to gain an overall view of the region.

Figure 1. Localization map.
The map image of the central-northern coast of Santa Catarina (FACIMAR, 1996) (Figure 1), was very important for the carrying out of this stage of the work. The next phase consisted of an interpretation of the aerial photographs from the 1977/1978 aerial survey, at a scale of 1:25,000, generating preliminary geological maps. This was followed by the fieldwork in the area to be mapped, during which 144 surface samples of rocks and sediments were collected, which were submitted to granulometric analysis. The field data were added to the Geographical Information System - GIS.

RESULTS

Coastal Geology

The coastal province of the central-northern coast of Santa Catarina is comprised of two fundamental geological sub-provinces: the crystaline basement and the Santos basin. The sector of this basin with an outcropping surface represents the coastal plain, demarcated by two interdigitated depositional systems: (1) continental, confined to elevations typical of crystalline basement and, (2) transitional or coastal, the result of successive eustatic fluctuations during the Quaternary period.

The principal deposits of the coastal plain include: eluvial, coluvial and alluvial fan deposits; fluvial deposits of the floodplains; fluvial deposits of the marginal dikes; lagoonal deposits; eolic deposits; marine beach deposits, paludal deposits and beach deposits (Figure 2).

The quaternary outcropping deposits on the coastal plain of the central-northern coast of the State was subdivided according to age of formation, with characteristics of undifferentiated Quaternary, late Pleistocene and Holocene periods.

In the area of the study, the following lithostratigraphic units of the crystalline basement are outcropping (Table 1): Santa Catarina Granulitic Complex; Brusque Metamorphic Complex; Gaspar Formation of the Itajai Group; Valuguna Granite; Migmatic Nucleus of Itapema and granite-gneissic Strip of Porto Belo, both of the Tabuleiro Complex, and the intrusive suites of Guabiruba and Pedras Grandes. These units, of the archean, proterozoic and eo-paleozoic periods, are formed of granites, granitoids, gneisses, quartzites, migmatites, metaultramafics, micaschists, metaacalcarreas, marbles and arenites.

The continental deposits include the eluvial and coluvial deposits, the alluvial fan deposits and the fluvial deposits, accumulated in an undifferentiated way during the entire Quaternary period. They are restricted to the tops of the elevations of the crystalline basement, at altitudes higher than 20m, for the eluvials and coluvials; between 15 and 20m, for the alluvial fans and between 2 and 15m, for the alluvial deposits.

The pleistocenic deposits include the intertidal marine beach deposits, partially or totally covered by eolic sediments and the adjacent lagoonal deposits. The terraces of the flat and slightly undulating surface characterize the predominant form of marine and lagoonal deposits, whose altitudes reach maximum values of 12-17m and 10-12m, respectively. Both deposits are formed of fine and medium sands, well selected and ochre to light brown in color. The overlying eolic sands are fine and red, yellow and brown in color.

The holocenic deposits include the intertidal marine beach deposits covered by eolic sediments, lagoonal deposits or fluvial-lagoonal deposits and the paludal deposits.

The marine beaches are in the form of terraces with flat to lightly undulating surfaces, alternated by depressions, humid and enriched by organic material. These are formed by a succession of long, straight ridges and hollows, which may be continuous and/or discontinuous, lying parallel to the current coastline, and reaching maximum altitudes of 3 to 7m in the elevations, and 1 to 2m, in the depressions. In terms of their sedimentology, they consist of fine, medium and coarse sands, which are selected, mature and quartzose.

The lagoonal deposits, in the form of terraces of up to 4-5m in altitude, appear around the lakes and lagoons, consisting of silt and sand-clay sediments, generally enriched with organic material. These are formed by the processes of flooding and erosion in depressions during higher holocenic sea levels, when the extension of the lagoon reached larger areas than at present.

The fluvial lagoonal deposits, at altitudes of 4-5m, are mainly located in the regions of fluvial courses and consist of fine sediments, originating from fluvial transport of clastic detritus to the interior of coastal lagoonal bodies.

The paludal deposits are associated with tidal plains in protected marine areas, such as tidal channels, inlets and bays. They are comprised of silt-clay sediments, rich in organic material, with vegetation cover typical of mangrove regions (Avicenia schaueriana, Rhizophora mangle, Laguncularia Racemosa) and salt marshes (Spartina).

Paleogeography

The formation of these pleistocenic and holocenic deposits of the coastal plain of the central-northern coast of Santa Catarina is closely linked to the changes in sea level which occurred during the Quaternary period. These changes were controlled by tectonic and climatic factors, and alterations in the level of the oceans, known as tectonic, glacial and geoid eustasies, respectively (MORNER, 1980).

VILLWOCK (1994) defined seven geoevolutional phases for the coastal plains of the southeast and south of Brazil, four of which were selected to describe the geological evolution of the area studied.

Phase I Maximum Yarmoutian transgression/regression, corresponding to the Mindel/Riss interglacial period (±120ka)
Formation of continental deposits (eluvial, coluvial and alluvial fans), undifferentiated, from the beginning of this phase until the present day, in diverse climatic conditions. Formation of the
Itajaí-Açu Porto Belo
maximum of the Yarmoutian transgression/regression
care of the paleogeographical evolution by: phase I, characterizes the
during four geoevolutive phases defined in the
coluvial, alluvial fan, fluvial, fluvial-lagoonal, lagoonal,
marine events associated with paleoclimatic episodes.
were controlled by the sucession of transgressive and regressive
pleistocenic/holocenic epochs, respectively. These deposits
organic sectors, from north to south: (1) the sector; (2) the
characteristics of the surface deposits, the coastal plain of the
and clays for the ceramics and pottery industry.
sediments - sands and pebbles, for civil construction, paving of
coastline, as a soil corrective and for the cement industry; b)
gravel, paving of sidewalks and roads, rocky outcrops of the
and walls in civil construction, decorative stone, material for
migmatites and quartzites, among others, used for foundations
schists, marbles, metacalcareas, quartzites, pyroxenites,
lithological types of crystalline basement and the Quaternary
Mineral Resources
deposits are formed, and continue to form until the present day.
Formation of marine terraces, resulting from the gradual
advance of the coastline, leading to plains of coastal regressive
beach ridges. In low energy environments, the first paludal
deposits are formed, and continue to form until the present day.
CONCLUSIONS
Based on the geomorphological and sedimentological
characteristics of the surface deposits, the coastal plain of the
central-northern coast may be subdivided into five distinct
sectors, from north to south: (1) the Barra Velha sector; (2) the
Itajai-Açu river sector; (3) the Porto Belo peninsula sector; (4)
the Tijucas river sector and (5) the Celso Ramos sector.
The stratigraphy of the immersed coastal plain overlying the
open marginal Santos basin, includes the Quaternary
sedimentary sequence settled on pre-mesozoic lithological
types of the Santa Catarina shield, denominated crystalline
basement. This sedimentary sequence includes continental and
coastal deposits, of the undifferentiated and pleistocenic/holocenic
epochs, respectively. These deposits were controlled by the succession of transgressive and regressive
marine events associated with paleoclimatic episodes.
The geological units of the coastal plain are represented by
coluvial, alluvial fan, fluvial, fluvial-lagoonal, lagoonal,
marine, eolic and paludal deposits. These units were originated
during four geoevolutive phases defined in the paleogeographical evolution by: phase I, characterizes the
maximum of the Yarmoutian transgression/regression
(<120ka); phase II, the maximum of the Sangamonian Wisconsian transgression/regression (120ka - 18ka)
(Cananeia transgression to Brazil); phase III, the maximum of the Flandrian transgression (18ka - 5.1ka) (Santos transgression
to Brazil); and phase IV, the current regression (5.1ka - present).
Continuation of this research, will include subsurface stratigraphy and detailed Quaternary geological comparative
studies.
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