

## A REVIEW OF THE ACCUMULATIONS OF FOSSIL MARINE MOLLUSKS IN CONTINENTAL AREAS OF THE SOUTHERNMOST BRAZILIAN COAST, RIO GRANDE DO SUL STATE

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The Coastal Plain of Rio Grande do Sul state (CPRS; Figure 1A), in southern Brazil, is a geomorphologic unit that was formed between the Late Cretaceous and Holocene, and during the Late Neogene and Quaternary it has been affected by several glacioeustatic oscillations that originated four major barrier-lagoon systems (Tomazelli *et al.*, 2000). In the southern portion of the coastal plain, between the Patos Lagoon estuary and the Brazilian-Uruguayan border, several fossiliferous deposits containing remains of both terrestrial and marine organisms can be found associated to these systems. The largest concentrations of marine fossils are found on the continental shelf, from depths between 0 and 40 meters at least (Figueiredo Jr., 1975); during autumn and winter, bioclasts from these concentrations are removed by storm waves and transported to the beach, forming large *konzentrat-lagerstätte* known as “concheiros” that extends for some 40 kilometers along the coastline.

Besides the continental shelf other fossil accumulations are found in continental areas, currently far from the coastline, in the southernmost western margin of Mangueira Lake, Chuí Creek and another location probably associated to the Pleistocene Barrier II (Closs & Forti, 1971). Regarding the marine mollusks from Chuí Creek and Mangueira Lake, their exact stratigraphic provenance is still controversial and needs a revision because of its importance for correlations with sea-level highstands and the geologic evolution of the CPRS. Here is presented a discussion about the fossil molluscan accumulations found in the southernmost portion of CPRS, including new data regarding its stratigraphic position, faunal content and correlation with other accumulations found in Argentina and Uruguay. Although some concentrations have been recorded in other areas of the southern CPRS, the discussion here is focused on those found in the Santa Vitória do Palmar County and presumably associated to the “Chuí Formation”.

### SHELLS FROM THE “CHUÍ FORMATION”

Closs & Forti (1971) described several molluscan taxa from what they considered five distinct fossil accumulations from four distinct localities (Figure 1B): two in Chuí Creek, near

the town of Chuí (samples E1 and E2), at the bridge of the road between the town of Santa Vitória do Palmar and Hermenegildo Beach (sample E3), another in the same road (sample E4), and one some 50 kilometers to the north of the town of Santa Vitória do Palmar (sample E5). Although they did not provide detailed stratigraphic data, the authors correlated all these localities to the “Chuí Formation”, which they proposed was Holocene instead of Pleistocene in age, based on faunal similarities between these accumulations and those from the “Querandinense Formation” of Uruguay. However, under the light of new models regarding the origin and geologic evolution of CPRS, the “Chuí Formation” was re-interpreted as including four distinct chronostratigraphic units, each one formed by a major sea-level transgressive event between the Late Pleistocene and Holocene, that formed four barrier-lagoon depositional system. Thus the samples represent spatially and temporally distinct accumulations.

### **Samples E1 and E2**

These samples were obtained by Closs & Forti (1971) in an outcrop exposed in the left bank in the lower course of Chuí Creek; E1 was collected in the lower portion of the outcrop and E2 in the upper portion. This outcrop was re-studied by Caron (2007), who described its stratigraphy and obtained a  $^{14}\text{C}$  age of  $5750 \pm 40$  years (cal. 6260-6080 cal yr BP) for an articulated bivalve (*Tagelus plebeius*). He demonstrated that this accumulation represents an estuarine environment developed during the Holocene transgression around 6 cal ka BP. The ages and stratigraphic position of this shell accumulation indicates that the maximum sea-level highstand was reached between 2 and 3 meters above present sea-level. The taxa identified in this outcrop include estuarine organisms such as *Erodona mactroides*, *Tagelus plebeius* and *Heleobia australis* mixed with marine taxa such as *Corbula caribaea* and *Macra* sp.

### **Samples E3 and E4**

Sample E3 was collected by Closs & Forti (1971) at the bridge over Chuí Creek, but the authors did not provide any stratigraphic data, so that it probably represents specimens found scattered at the creek bed, as can be seen today. The creek was further deepened during the late 1960s, and during the excavations marine and continental Pleistocene sedimentary layers were exposed. Thus the sample E3 may represent fossils that were removed during these activities. Sample E4 was collected in sediments dredged from a channel near the road, and possibly represents the same original accumulation of sample E3. However, it is possible that this may also represent fossils from accumulations located even deeper, because according to local workers marine shells can be found at depths below the creek bed.

### **Sample E5**

This sample comes from a farm located some 50 km to the north of the town of Santa Vitória do Palmar. Although Closs & Forti (1971) did not provide much information

regarding the origin of the fossils, personal communication by people living in the area revealed that the specimens were obtained by drill holes, but the exact depth of their location is unknown. However, given the location of the drill hole, directly in Barrier II, this sample may represent a different accumulation from that exposed in the banks of Chuí Creek.

## Discussion

Although Closs & Forti (1971) considered all fossil shells from Santa Vitória do Palmar County to be Holocene in age and correlated to the “Chuí Formation”, the new data indicate that they actually represent distinct units. Recently, an in situ shell accumulation exposed in the shallow marine facies at the base of the banks of the creek, was identified between 1 and 2 km to the north of the bridge (Figure 1C). This accumulation is less than 10 centimeters in thickness, it is positioned nearly 9 meters a.s.l., and presumably represents the main source for the shells found near the bridge. The stratigraphic position of this accumulation indicates a Pleistocene age, given that fossil mammals from the overlying fluvial facies were dated by ESR between 33 and 42 ka BP (Lopes *et al.*, 2010). The taxa identified in this accumulation (Table 1) include only marine, intertidal to infralittoral species such as *Amiantis purpurata* and *Pitar rostrata*. The good preservation of most of the specimens, including small-sized juvenile individuals and even an articulated *Corbula caribaea*, indicate that this accumulation represents a shallow marine community, deposited by a storm event. Although Chuí Creek flows along the plain that corresponds to the Lagoon System III, located between Pleistocene Barrier Systems II and III, the marine facies exposed along the banks of the creek seems to be correlated to Barrier System II, that extends in subsurface beneath the continental deposits of Lagoon System III. Precise ages for this barrier are not available yet, but it may represent either the 325 ka marine transgression (Tomazelli *et al.*, 2000) or the 200 ka one.

Although samples E1, E2, E3 and possibly E4 are associated to the same geomorphologic unit (Lagoon System III), they in fact represent temporally and geographically distinct environments. While samples E1-E2 indicate a Holocene estuarine environment, E3-E4 correspond to a shallow marine environment that seems to represent the sea-level highstand correlated to Barrier System II; sample E5 was located far from the other samples, and in order to understand its exact stratigraphic position new drillings are needed.

The conclusions of Closs & Forti (1971) were followed by other researchers (e.g. Sprechmann, 1978), who accepted the correlation of these accumulations to the Holocene “Querandinense” of Uruguay, now correlated to the Villa Soriano Formation (Martínez *et al.*, 2006) and the “Belgranense” of Argentina, now part of the Las Escobas Formation (Aguirre, 1993). However, the stratigraphic revisions of the Brazilian accumulations show that this correlation is valid only for the samples E1 and E2, while the other samples represent Pleistocene transgressions, that can be correlated to the Pascua Formation of Argentina (Nabel & Vargas, 1998). The understanding of the stratigraphic position and faunal content of such accumulations may provide relevant information on paleoenvironments and past sea

level oscillations that affected southern Brazil and correlate these transgressions with similar features found in the Uruguayan and Argentinean coastal areas.

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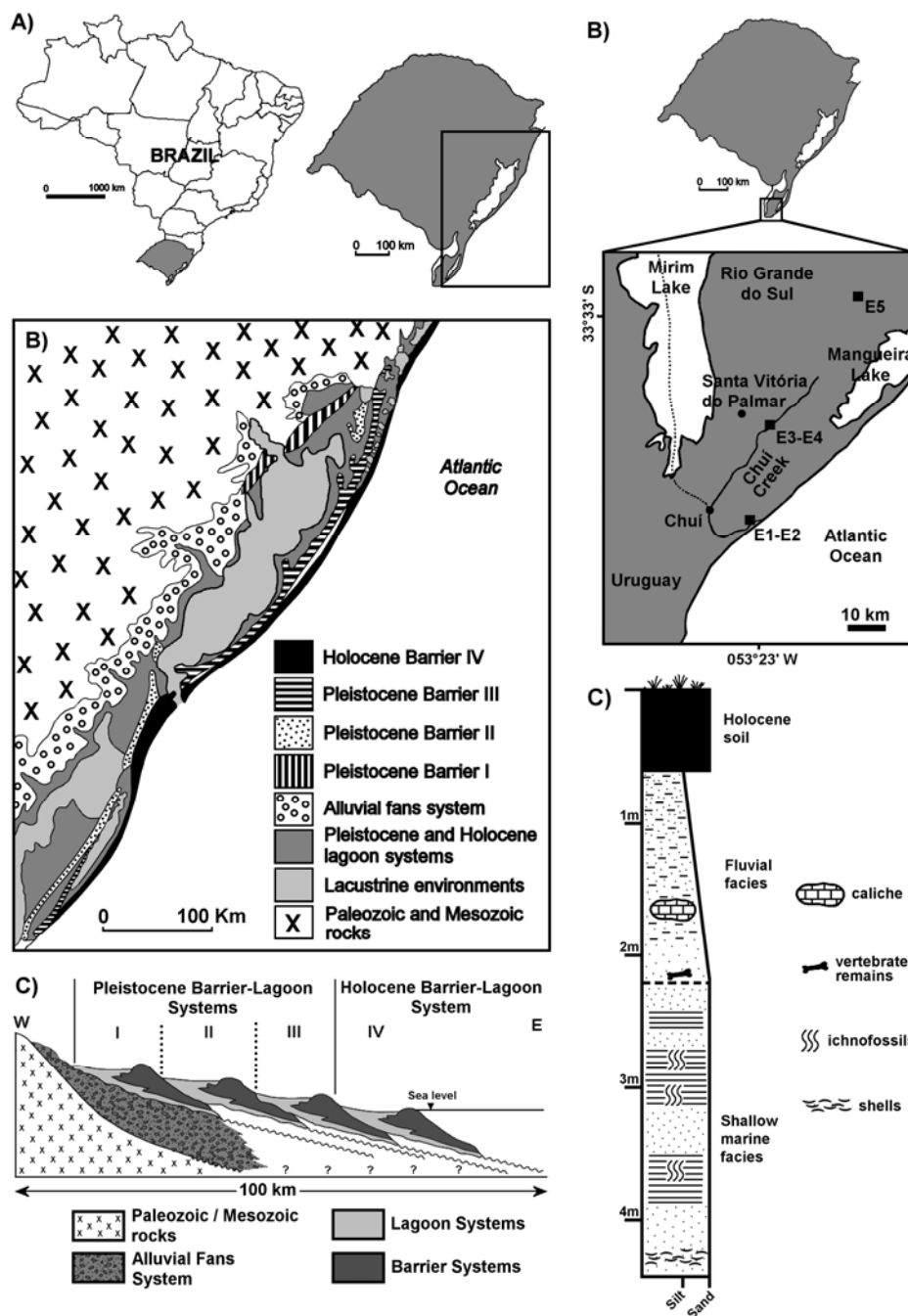


Figure 1 – A) Location and structure of the CPRS (modified from Tomazelli *et al.*, 2000); B) Map of the southernmost portion of CPRS, showing the localities sampled by Closs & Esteves (1971); C) Stratigraphic section of the outcrop in the banks of Chuí Creek where fossil mollusks were found *in situ*.