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Outstanding pleistocenic megafauna in southernmost Brazil

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The origin of Rio Grande do Sul coastal plain, at the southernmost portion of Brazil, dates back to Pleistocene. Its geomorphological features are the result of four great sea level transgression-regression events, each one originating extensive barrier-island/lagoonal environments. Fossils of extinct mammals belonging to Lujanian age megafauna (about 120.000 years B.P.) are found in lagoonal deposits of the Lagoon-Barrier III System, which corresponds to the penultimate transgression-regression event of the Quaternary. Nowadays, these deposits are well-known in outcrops along Chuí creek´s banks. The study of these deposits and fossils has provided valuable information regarding palaeoecologic and palaeoclimatic aspects in southern Brazil, as well as has improved our understanding of coastal physical proccesses that led to the Rio Grande do Sul coastal plain development.
Keywords: *Pleistocene, megafauna, taphonomy, biostratigraphy, palaeoecology, barrier-island/lagoonal systems.*

INTRODUCTION

The fossiliferous banks of the Arroio Chuí Creek (Fig.1), are located on the Rio Grande do Sul Coastal Province The origin of this province is linked to tectonic events dating back to Jurassic Period that led to the breakup of Gondwana supercontinent and resulted in the opening of the Atlantic Ocean (Villwock & Tomazelli, 1995). These events produced two major geomorphological units that integrate the Coastal Province (Fig. 2): (a) the Highlands, which comprise Sul-riograndense Shield, composed mainly by Precambrian igneous and metamorphic rocks, and the Central Depression and Araucárias Plateau, formed by Paleozoic-Mesozoic sedimentary and volcanic rocks of Paraná Basin; and (b) the Lowlands, constituted by Mesozoic and Cenozoic sedimentary deposits of the upper portion of the Pelotas Basin, which constitute the coastal plain.

The Pelotas Basin is a marginal, open and stable sedimentary basin (Weeks, 1952) deposited between the Lower Cretaceous (Albian-Aptian) and the Miocene (Fontana, 1990), and which is more than 10 thousand meter thick. It is constituted by terrigenous clastic sediments originated by erosion of the Sul-riograndense Shield and the Paraná Basin rocks. Re-working of sediments of the upper portion of the Pelotas Basin by sea level oscillations between Miocene and Holocene times, originated a wide range of transitional and marine depositional environments. These environments are constituted by sedimentary facies accumulated in two main siliciclastic depositional systems (Tomazelli *et al.*, 2000), as follows.

- **Alluvial Fans System**, adjacent to the Sul-riograndense shield, fans were deposited between Miocene and Pliocene times, and their distal portions were subject to re-working in lacustrine and marine environments.

- **Lagoon-Barrier Systems,** constituted by four systems parallell to the coastline, developed seawards from the alluvial fans. This unit results from four major glacio-eustatic sea level oscillations during the Pleistocene and the Holocene, between 450.000 and 6.000 years B.P.

Each lagoon-barrier system is constituted by long and relatively narrow sandy barrier-islands that isolate large lacustrine bodies landwards, such as the Patos lagoon, and the Mangueira and Mirim lakes. In the coastal plain area southward of the Patos lagoon estuary, Lagoon-Barrier systems II, III and IV are well-preserved. The development of System II originated the Mirim lake. According to oxygen isotopic curves (Schackleton & Opdyke, 1973; Imbrie *et al.*, 1984), the third sea-level transgressive maximum occurred about 120.000 years B.P., originating the Patos lagoon and other lacustrine environments in which fossils of terrestrial mammals (pleistocenic megafauna) were accumulated. Nowadays, these fossiliferous deposits are exposed along the banks of the Chuí creek, close to the of Santa Vitória do Palmar town. Lagoon-Barrier System IV, correlated to the last transgressive maximum of 6.000 years B.P., constitutes the coastline and several coastal lakes.

Figure 1 – Panoramic view of Chuí creek banks (Photo: Lopes, 2000)

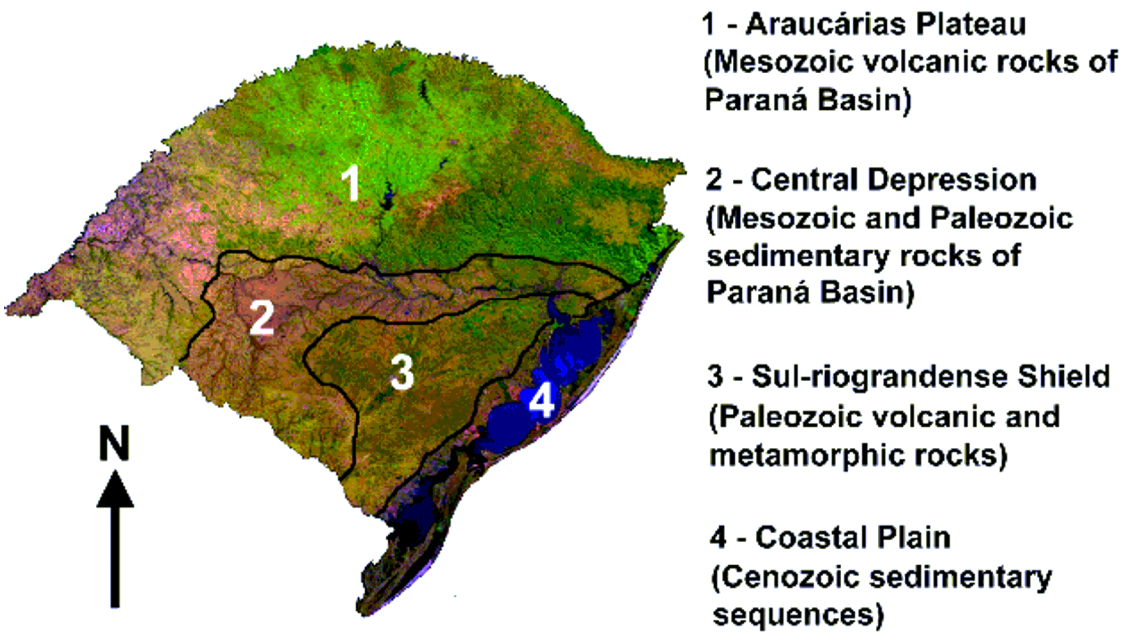

Figure 2 – Major geomorphological units of Rio Grande do Sul state (Satellite mosaic: EMBRAPA, 2000)

LOCATION

Lagoon-Barrier System III is well-preserved along the coastal plain of Rio Grande do Sul and its associated lacustrine deposits are remarkable due to the presence of ichnofossils of marine organisms, such as molluscs and galleries of *Callichirus* sp. (crustacea), and fossils of terrestrial mammals (Pleistocene megafauna). In the southern portion of the coastal plain, the presence of these fossils is well-known in sedimentary layers exposed along the banks of the Chuí creek, as well as in deposits along the continantal shelf. Although personal communication from inhabitants of Santa Vitória do Palmar suggest the existence of other possible fossiliferous sites, until now only those exposed along the Chuí creek have been surveyed.

The Chuí creek (Fig. 3), about 25 km long, originates in the wetlands at southern of Banhado do Taim and flows from NE to SW to the Chuí town, where turns to SE following the Chuí lineament direction down to the Atlantic Ocean. Northward the bridge on the road that connects Santa Vitória do Palmar and Hermenegildo beach, the originally meandering course of the creek was artificially straightened in the 1960´s and 1970´s, then exposing the fossiliferous layers along the banks. The type-section of the outcrop is located about 1 km northward the bridge, on the coordinates 33º35'26" S and 53º20'22" W. Southward the bridge, the creek´s course is meandering and the fossiliferous layer is covered by vegetation and aluvionar sediments, so avoiding the clear view of the fossiliferous layer.

SITE DESCRIPTION

Lithological and stratigraphical data of the deposits exposed along the banks of the Chuí creek (Fig. 4) were obtained through excavation and manual sounding (Lopes *et al.*, 2001). At the base of the banks, about 4 m beneath the surface, there is a layer of indeterminate thickness, composed by fine to medium-grained yellow-reddish sands, exhibiting parallell and crossed stratification. This layer also contains ichnofossils of molluscks and galleries of *Callichirus* sp. These characteristics suggest that this layer was deposited on a beach environment, more specifically in the intertidal zone. On the top of this layer there are a few thin lenses of dark-brown sand, suggesting higher concentration of organic matter.

There is an erosional unconformity between this layer and the overlapped layer, which is composed by beige-coloured clayey sand. It is about 1,5-meter thick and contains *in situ* fossils of terrestrial Pleistocene mammals. Above, there is a layer with higher concentration of fine sediment and vegetal remains. At certain points along the banks this layer is capped by a carbonatic layer ("caliche"), which origin was attributed to precipitation of carbonates under warmer and dry semi-arid climate regime (Delaney, 1965; Bombin & Klamt, 1975). The surface layer is about 0,5 and 0,6-meter thick and consists of modern soil and sand with high concentration of organic matter, grass covered.

The granulometric variation on the layers from the bottom to the top indicates a transition from a high-energy beach environment to a low-energy

lacustrine environment. This transition may be explained by the growth of a sand spit that isolated a coastal lagoon. Subsequently, when the free communication between the lagoon and sea has been closed, it became a wet continental environment where remains of Pleistocene mammals were accumulated. The process that led to the closing of the lagoon was probably similar to the process that had closed the connection between Mirim palaeolagoon and Atlantic Ocean and originated the Banhado do Taim and Mangueira lake (Buchmann, 1997).

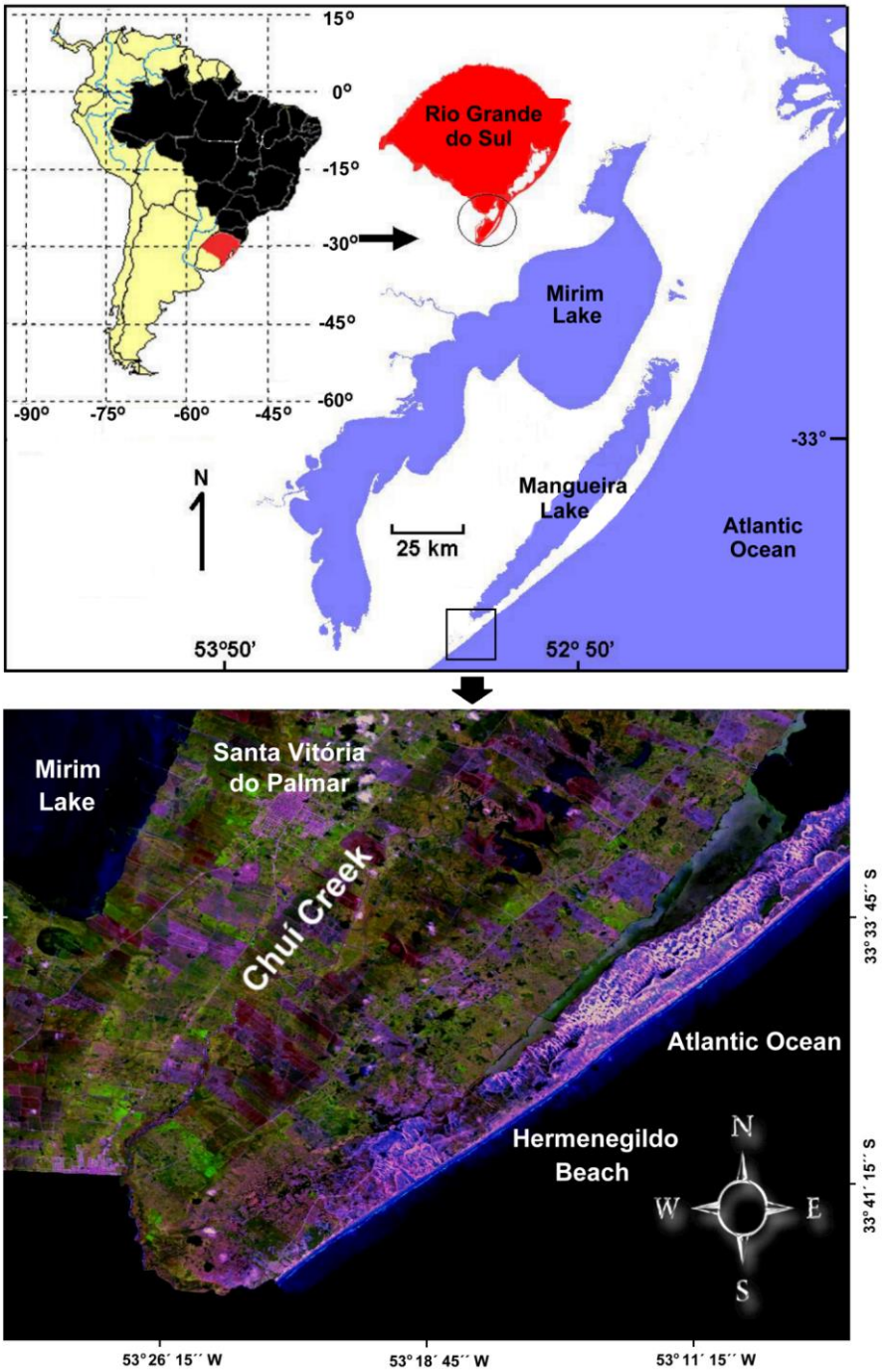

Figure 3 - Map of the southernmost portion of Rio Grande do Sul coastal plain, where Chuí creek is located (Satellite mosaic by EMBRAPA, 2000)

Stratigraphic revisions of these outcrops by Buchmann *et al.* (2001) and Lopes *et al.* (2001), based on geologic studies of Villwock & Tomazelli (1995) and Tomazelli *et al.* (2000), led to the re-evaluation of the stratigraphic description of the area carried out by Soliani Jr. (1973). The sediments of the Santa Vitória Formation, identified by Soliani Jr. (1973) as deposited in lacustrine environments are, actually, those beach sediments containing ichnofossils of *Callichirus* sp and molluscs. The sediments that the author interpreted as paleosoils are the lacustrine sediments containing Pleistocene megafauna fossils of the Barrier-Lagoon System III.

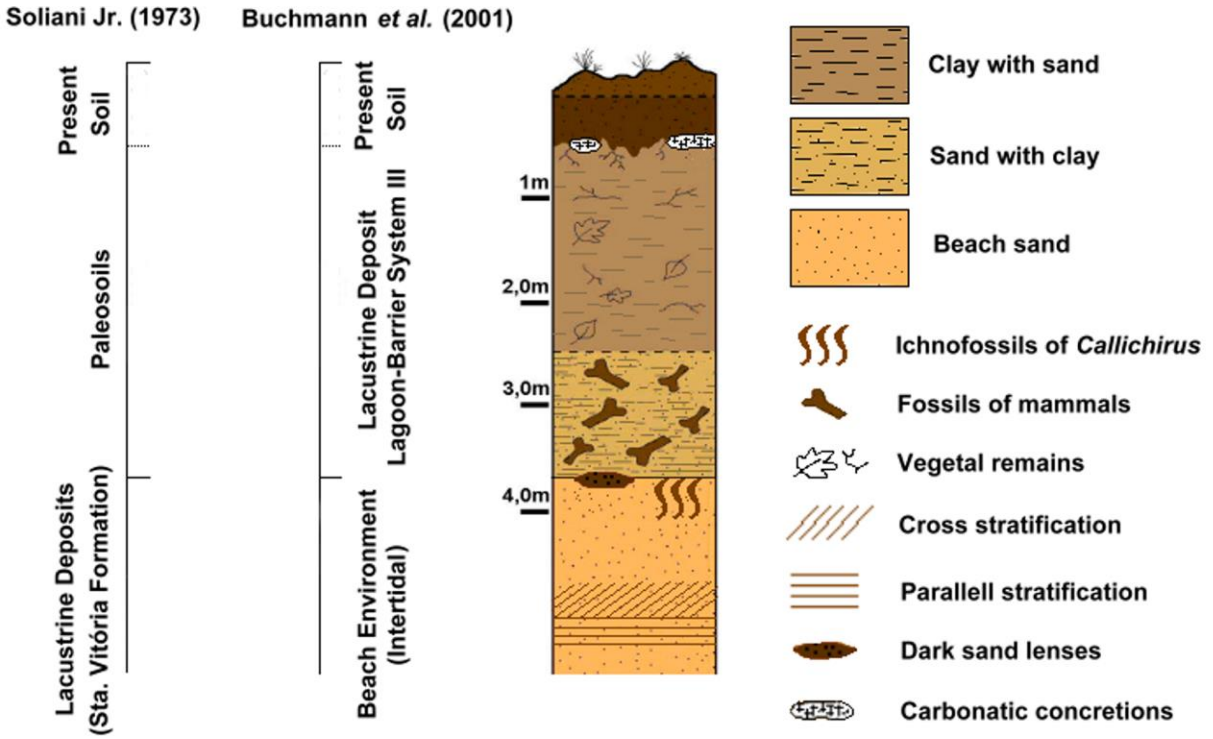

Figure 4 - Stratigraphic column of the depositts exposed along the banks of Chuí creek, with corresponding paleo-environmental interpretations by Soliani Jr. (1973) and Buchmann et al. (2001).
(Modified from Lopes et al., 2001)

Dating of Pleistocene mammals fossils has been done only for remains *in situ* collected on the section of the creek located northward the bridge between Santa Vitória do Palmar and Hermenegildo. Southwards, fossils could be found only on the creek´s bed, so removed from its original position by erosional processes along the banks. During the winter, the water level raises and the fossiliferous layer keeps sunk and consequently under erosional processes. During the summer, the layer becomes exposed again. These fossils have been known and studied for decades (Paula Couto, 1939a,b, 1953, 1975, 1979; Cunha, 1959; Soliani Jr, 1973; Oliveira, 1992). The fossils belong to extinct mammals from several groups (Fig. 5), which allow establishing biostratigraphic correlation with Pleistocene deposits in Uruguay and Argentina (Ubilla, 2004). The presence of *Equus* sp fossils indicates that this fauna is of Lujanian age according to the land-mammal ages of Pascual (1965). According to Rocha de Oliveira (2001), the Pleistocene fossil mammals from the state of Rio Grande do Sul exhibit more relationship with the Pampean fauna in Argentina and northern Uruguay than with Brazilian fauna.

Among the fossils from the Chuí creek there is a predominance of medium- to large-sized herbivores, in comparison with carnivores and small vertebrates. Although the fossil mammals from the Chuí creek are the same from submerged deposits along the Rio Grande do Sul continental shelf, these deposits contain fossils of organisms, such as rodents (Rodrigues, 2003) and birds (Lopes *et al.*, submitted), which have not been found in the Chuí creek banks yet. Their absence might be a result of either the lack of detailed sampling of small fossils, or hydraulic selection of these remains.

The fossils from the Chuí creek are fragile and light-coloured, although they become dark-coloured when exposed to the water. These remains exhibit different preservation patterns, ranging from small, unidentifiable fragments (Fig. 6) to large and complete bones (Fig. 7). The fossils occur in three degrees of articulation: I) Articulated (Fig. 8); II) Disarticulated but associated; and III) Isolated. All these features, plus the presence of different skeletal parts represented by the three Voorhies Groups, suggest that these remains come from several different source areas, located at different distances from the present deposition site. The great amount of unidentifiable fragments exhibiting plain fracture patterns, typical of post-fossilization breakage, indicates that these fossils have suffered considerable degree of re-working, probably due to their removal from the original deposition site and transportation to the present fossil site. The lacking of evidences of scavenging suggests that the carcasses were rapidly covered by water and/or sediment after the death.

The fossil assemblage from the Chuí creek is polyspecific and polytipic, therefore its origin as result of catastrophic mass mortality or predatory action is excluded. Probably, it is an attritional assemblage, constituted by accumulation of fossils from various source areas and different ages (Lopes *et al.*, submitted).

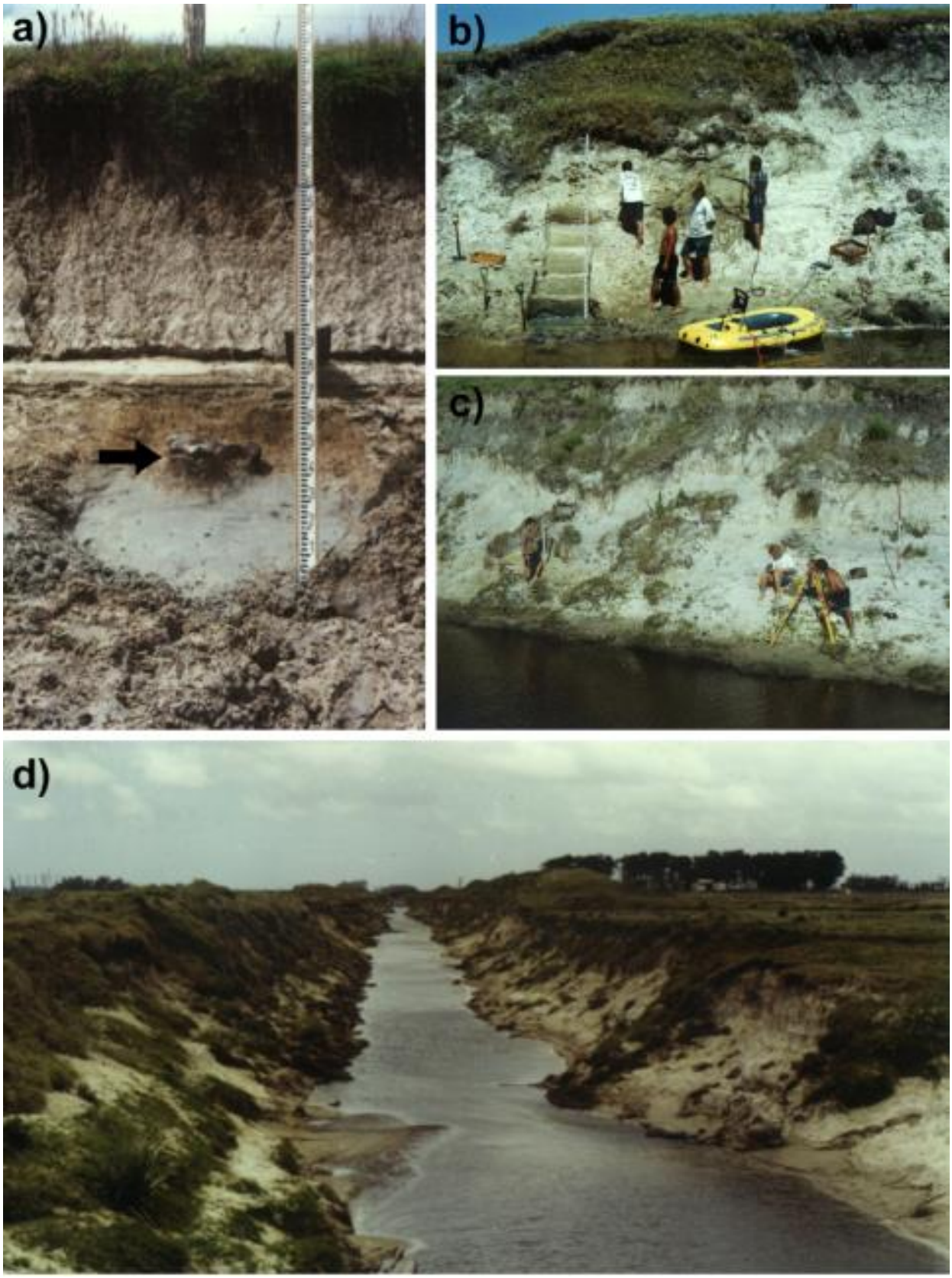

Figure 5 – Banks of Chuí creek: a) Fossil of a ground sloth (indicated by arrow), in the contact between beach (at the base) and lacustrine sediments; b) and c) Research activities; d) Panoramic view of the banks (Photos: Lopes 1999, 2000)

The taphonomic features on these fossils suggest that they have been subject to one cycle of deposition-erosion-transportation-redeposition after death at least. Nowadays, they are being re-exposed and transported due to erosional processes along the banks. Unfortunately, they could not survive to this new cycle because of their physical fragility.

Figure 6 – In situ fossil fragments (Photo: Lopes, 2002)

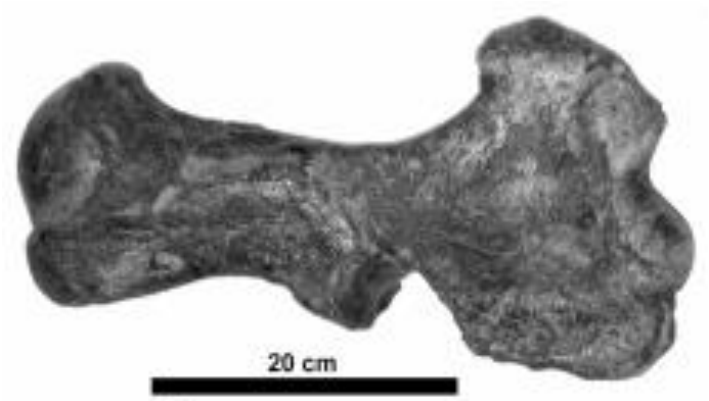

Figure 7 – Complete humerus of a giant sloth (Photo: Lopes, 2003).

Figure 8 – Articulated vertebrae of Lestodon sp., a giant sloth (Photo: Lopes, 2001).

SITE PROTECTION

The Chuí creek flows through several farms along the coastal plain, and its waters are pumped to irrigate rice croppings between the months of november and february.

The fossiliferous deposits of the Chuí creek are under no one kind of legal protection. In spite of this, people who live nearby respect and protect the remains, either by keeping fossils at home or taking them to the local museum of Santa Vitória do Palmar.

REFERENCES

Bombin,M; Klamt,E. 1975. Evidências paleoclimáticas em solos do Rio Grande do Sul. *In*: Comunicações do Museu de Ciências da PUCRS, Porto Alegre. (13): 183-193.

Buchmann,F.S.C. 1997. Banhado do Taim e Lagoa Mangueira: Evolução holocênica da paleoembocadura da Lagoa Mirim, RS, Brasil. Programa de Pós-Graduação em Geociências, Universidade Federal do Rio Grande do Sul (UFRGS). Dissertação de Mestrado, 160p.

Buchmann,F.S.C.; Lopes,R.P.; Rocha de Oliveira,U.; Caron,F.; Lélis,R.J.F; Cecílio,R.O.; Tomazelli,L.J. 2001. Presença de Icnofósseis de *Callichirus* nas Barrancas do Arroio Chuí, RS: Um Novo Afloramento Marinho do Pleistoceno e uma Re-Interpretação da Estratigrafia Local. In: CONGRESSO DA ASSOCIAÇÃO BRASILEIRA DE ESTUDOS DO QUATERNÁRIO (ABEQUA), 8, 2001, Imbé. Anais do VIII Congresso da ABEQUA, Imbé.

Cunha,F.S.L. 1959. Mamíferos fósseis do Pleistoceno do Rio Grande do Sul I - Ungulados. Rio de Janeiro, Divisão de Geologia e Mineralogia, p.1-47 (Boletim 202).

Delaney,P.J.V. 1965. Fisiografia e geologia da superfície da planície costeira do Rio Grande do Sul. Publicação especial da Escola de Geologia, Universidade Federal do Rio Grande do Sul, Porto Alegra, 6: 1-195.

Fontana,R.L. 1990. Desenvolvimento Termomecânico da Bacia de Pelotas e Parte Sul da Plataforma de Florianópolis. In: Raja Gabaglia, G. P. & Milani, E. J. (coords.) Origem e Evolução das Bacias Sedimentares. PETROBRAS, Rio de Janeiro, pp 377-400.

Imbrie,J.; Hays,J.; Martinson,D.; McIntyre,A.; Mix,A.; Morley,J.; Pisias,N.; Prell,W.; Schackleton,N. 1984. The Orbital Theory of Pleistocene Climate: Support from a revised Chronology of the Marine ^{18}O Record. In: Berger, A. *et al.* (eds.). Milankovitch and Climate. Part I. Riedel, pp. 269-305.

Lopes,R.P; Buchmann,F.S.C; Caron,F.; Itusarry,M.E. 2001. Tafonomia dos fósseis de vertebrados (megafauna extinta) encontrados ao longo das barrancas do arroio Chuí e linha de costa, RS, Brasil. Revista Pesquisas em Geociências. Porto Alegre, RS. 28 (2):67-73.

Lopes,R.P.; Brião,C.; Buchmann,F.S.C. (submetido-a) Primeiro registro de fósseis de aves marinhas no estado do Rio Grande do Sul, Brasil.

Lopes,R.P.; Buchmann,F.S.C.; Caron,F. (submetido-b) Aspectos tafonômicos em fósseis de mamíferos extintos (megafauna pleistocênica) encontrados nas barrancas do arroio Chuí, Rio Grande do Sul, Brasil.

Oliveira,E.V. 1992. Mamíferos fósseis do Pleistoceno superior - Holoceno do Rio Grande do Sul, e seu significado paleoecológico. Programa de Pós-Graduação em Geociências, Universidade Federal do Rio Grande do Sul (UFRGS), Dissertação de Mestrado.

Paula Couto,C. 1939. Paleontologia do Rio Grande do Sul. Revista do Instituto Histórico e Geográfico do Rio Grande do Sul. v. III, IV**,** p.29-90.

Paula Couto,C. 1953. Paleontologia Brasileira (Mamíferos). Rio de Janeiro, Biblioteca Científica Brasileira-Série A. 516 p.

Paula Couto,C. 1975. Mamíferos Fósseis do Quaternário do Sudeste Brasileiro. Paraná, Bol. Paranaense de Geociências, 33.

Paula Couto,C. 1979. Tratado de paleomastozoologia. Rio de Janeiro, Academia Brasileira de Ciências.

Pascual,R.; Ortega Hinojosa,E.R.; Gondar,D.; Tonni,E.P. 1966. Las edades de Cenozóico mamalífero de la Provincia de Buenos Aires. In: Borrello, A.V. (ed.), Paleontografia Bonaerense, Fasciculo IV (Vertebrata). Comisión de Investigaciones Cientificas, La Plata, Argentina.

Rocha de Oliveira,U.; Buchmann,F.S.C.; Itusarry,M.E. 2001. Índice de Similaridade de Fager e Índice de Similaridade Faunística de Simpson Aplicados aos Fósseis de Mamíferos Terrestres do Pleistoceno Superior Coletados na Atual Linha de Costa da Planície Costeira do Rio Grande do Sul, Entre o Farol do Albardão e o Balneário do Hermenegildo. Bacharelado no curso de Geografia, Departamento de Geociências, Fundação Universidade Federal do Rio Grande (FURG), Monografia de conclusão.

Rodrigues,P.H. 2003. Contribuição ao conhecimento dos carnívoros e roedores pleistocênicos proceden tes da porção sul da planície costeira do estado do Rio Grande do Sul, Brasil. Dissertação de Mestrado – Universidade Federal do Rio Grande do Sul, Instituto de Geociências. Programa de Pós-Graduação em Geociências. Porto Alegre, RS. 83p.

Schackleton,N.J.; Opdyke,N.D., 1973. Oxygen Isotope and Paleomagnetic Stratigraphy of Pacific Core V 28-238: Oxygen Isotopic Temperatures and Ice Volumes on a 10^5 and 10^6 Year Scale. Quaternary Research, 3:39-55.

Soliani Júnior,E. 1973. Geologia da Região de Santa Vitória do Palmar, RS, e a Posição Estratigráfica dos Fósseis de Mamíferos Pleistocênicos. Programa de Pós-Graduação em Geociências, Universidade Federal do Rio Grande do Sul (UFRGS), Dissertação de Mestrado, 88p.

Tomazelli,L.J.; Dillenburg,S.R.; Villwock,J.A. 2000. Late Quaternary geological history of Rio Grande do Sul Coastal Plain, southern Brazil. Revista Brasileira de Geociências, 30(3): 474-476.

Ubilla,M. 2004. Mammalian biostratigraphy of Pleistocene fluvial deposits in northern Uruguay, South America. Proceedings of the Geologists' Association, 115: 347-357.

Villwock,J.A.; Tomazelli,L.J. 1995. Geologia Costeira do RS. Porto Alegre. Notas Técnicas, Publicação do CECO-UFRGS N° 08, p. 27-29.

Weeks,L.G. 1952. Factors of Sedimentary Basin Development that Control Oil Occurence. American Association Petroleum Geologists Bulletin, 36:2071-124.

The authors would like to thank the colleagues Renato de Oliveira Cecílio, Renato José F. Lélis and Ulisses Rocha de Oliveira for their collaboration during field works at the Chuí creek.

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