Sedimentary Geology 296 (2013) 21–35

Contents lists available at ScienceDirect

Sedimentary Geology

journal homepage: www.elsevier.com/locate/sedgeo

# High-resolution sequence stratigraphy and continental environmental evolution: An example from east-central Argentina

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ARTICLE INFO

*Article history:*
Received 30 April 2013
Received in revised form 7 August 2013
Accepted 8 August 2013
Available online 17 August 2013

Editor: J. Knight

*Keywords:*
Allogenic controls
Sequence stratigraphy
Plio-Pleistocene
Argentina
Fluvial systems

ABSTRACT

The aims of this contribution is to establish a high-resolution sequence stratigraphic scheme for the continental deposits that constitute the Punta San Andrés Alloformation (Plio-Pleistocene) in east-central Argentina, to analyze the basin fill evolution and to identify and assess the role that extrinsic factors such as climate and sea-level oscillations played during evolution of the unit.

For the high-resolution sequence stratigraphical study of the Punta San Andrés Alloformation, high- and low-accommodation system tracts were defined mainly on the basis of the architectural elements present in the succession, also taking into account the relative degree of channel and floodplain deposits. Discontinuities and the nature of depositional systems generated during variations in accommodation helped identify two fourth-order high-accommodation system tracts and two fourth-order low-accommodation system tracts. At a third-order scale, the Punta San Andrés Alloformation may be interpreted as the progradation of continental depositional systems, characterized by a braided system in the proximal areas, and a low-sinuosity, single-channel system in the distal areas, defined by a high rate of sediment supply and discharge peaks which periodically flooded the plains and generated high aggradation rates during the late Pliocene and lower Pleistocene.



## 1. Introduction

Many studies of late Cenozoic climate and sea level change emphasize their extreme glacial or interglacial character. However, oxygen isotope curves (Imbrie et al., 1984; Chappell and Shackleton, 1986; Williams et al., 1988; Waelbroeck et al., 2002) show that approximately 80% of the glacial cycles during the middle and late Pleistocene shows intermediate characteristics, with minimum temperatures below those of interglacial periods, but not as cold as those of full glacials. Likewise, the decrease in glaci-eustatic sea-level, estimated between 100 and 140 m for a full glacial event (Clapperton, 1993; Rabassa et al., 2005; Rabassa and Coronato, 2009), may have been between 40 and 85 m for these intermediate situations. These multiple late Cenozoic climate variations triggered cycles of glaciation/interglaciation in Patagonia that led to sudden changes in sediment supply, fluvial discharge and sea level (Cavallotto and Violante, 2005).

The Punta San Andrés Alloformation (PSAA) comprises a classical Plio-Pleistocene continental sedimentary succession of the Argentinian Pampean Plain (Fig. 1) that accumulated contemporaneously with Patagonian glaciations. The Punta San Andrés Alloformation has been studied since the early 1900s because of its rich vertebrate fauna. It comprises up to 18 m of very well-exposed sedimentary rocks that display several palaeosols stacked among alluvial and fluvial deposits.

The PSAA provides a unique opportunity for high-resolution analysis of the role that climate and glacio-eustasy played in the evolution of continental depositional systems. This work aims at: a) building a general sequence stratigraphic framework for this unit on the basis of lateral and vertical variations of sedimentary facies and palaeosols, system tract stratigraphic bounding surfaces, and b) identifying and assessing the role that extrinsic factors such as climate and glacio-eustatic sea-level oscillations played during evolution of the unit.

## 2. Geological setting

The late Cenozoic Pampean basins (Fig. 1a) are part of the extra-Andean foreland region of central Argentina and are bounded to the east by the Atlantic passive margin and to the west by the Andean deformational front. The accumulation of post-Miocene deposits in the Pampean region (Fig. 1a), near the passive margin, was favored by high sediment availability, associated with the rise of the Andean Cordillera (Turic et al., 1996; Parker et al., 2008). On the Argentinian coastline, tectonic or neotectonic activity has been scarce and the development of marine cliffs is related to uplift by lithostatic rebound (Folguera and Zárate, 2011; Pedoja et al., 2011). On the Bonaerenian coast (Fig. 1a), the estimated uplift rate for the last 100 kyr is of 0.01 to 0.03 mm/year (Pedoja et al., 2011). This rate could explain the 12 to 18 m-high marine cliffs in the study area but cannot be extrapolated to the rest of the Pleistocene or be taken into account as a driving factor in the Punta San Andrés Alloformation deposition.

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0037-0738/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.sedgeo.2013.08.008

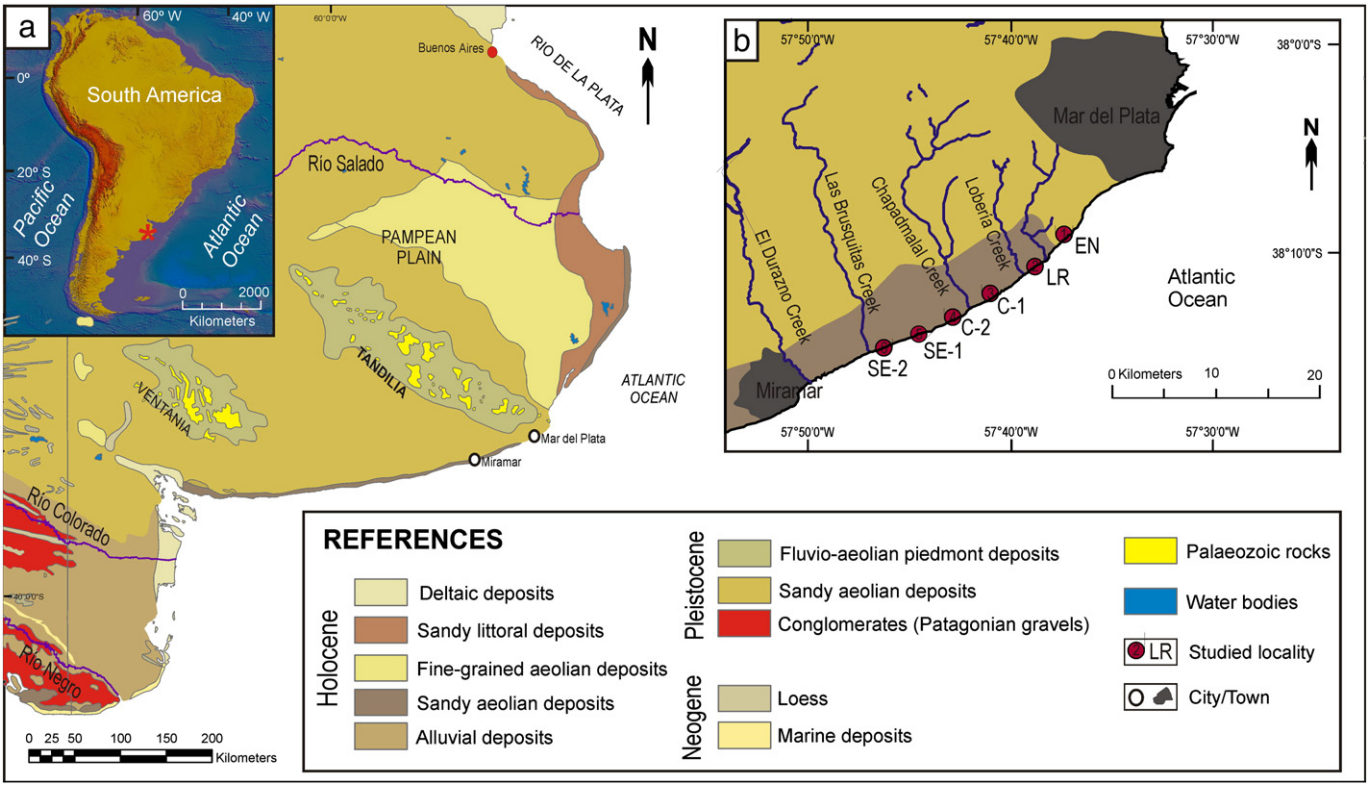


**Fig. 1.** a) Regional setting of the study area and b) location of the main sites.

In the east-central Pampean region, the late Cenozoic succession comprises a series of Plio-Pleistocene continental deposits capped by an extensive plateau of loess and loess-like deposits of late Pleistocene and Holocene age. The study area is located in the south-eastern margin of the Tandilia Range, a succession of hills and mountains with a NW–SE trend spanning 350 km in length and 60 km maximum width (Fig. 1a). The studied unit crops out in the coastal cliffs of east-central Buenos Aires province between the cities of Mar del Plata and Miramar (Fig. 1b).

The Punta San Andrés Alloformation deposits were assigned to the late Pliocene–late Pleistocene and they comprise a continental succession of fluvial, lacustrine and loess-like facies (Zárate, 1989; Beilinson, 2009, 2011). The base of this unit is in sharp contact with Pliocene mudstones of the Punta Martínez de Hoz Alloformation and its top is represented by late Pleistocene–Holocene psammitic deposits of the Arroyo Lobería Alloformation (Fig. 2). The thickness of the Punta San Andrés Alloformation ranges between 12 and 18 m. The unit consists

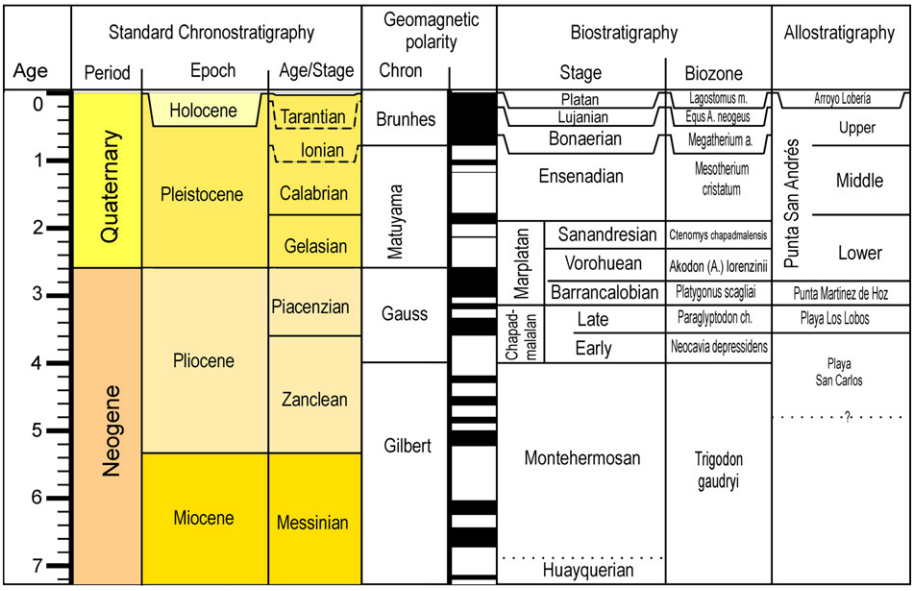


**Fig. 2.** Stratigraphic chart including biostratigraphic units by Cione and Tonni (2005) and allostratigraphic units by Zárate (1989).