Journal of South American Earth Sciences 64 (2015) 498–510

Contents lists available at ScienceDirect

Journal of South American Earth Sciences

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

Lower Cretaceous provenance in the northern Austral basin of Patagonia from sedimentary petrography

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ARTICLE INFO

Article history:
Received 10 March 2015
Received in revised form
15 August 2015
Accepted 29 August 2015
Available online 2 September 2015

Keywords:
Austral basin
Southern Patagonian Andes
Early Cretaceous
Sandstone provenance
Sedimentary petrography

ABSTRACT

The northern Austral basin from Patagonia is characterized by an Early Cretaceous (Barremian–Albian) coarse-grained regressive sequence. These littoral to continental deposits conform a 150 km long basin cropping out along the Southern Patagonian Andes between 47 and 48°S. The basin fill consist of basal deltaic sandstones with interbedded shales and limestones from the Río Belgrano Formation, topped by up to 350 m of fluvial conglomerates and reworked tuffs of the Río Tarde and Kachaike formations. This continental depocenter represent a major geodynamic and paleoenviromental change from the underling marine Río Mayer Formation. In this study we analyze the tectonic setting and provenance during deposition of the coarse-grained sequence using sedimentary petrography of 37 thin sections in four stratigraphic profiles covering the northern basin. Our dataset indicates mainly a recycled orogenic sandstones provenance, in agreement with potential surrounding basement sources.

1. Introduction

In the northern Austral basin located between 46,5° and 48,5°SL in the southern extreme of South America, an isolated Barremian–Albian coarse-grained depocenter developed on top of the previous deep marine sag sequence. This littoral to continental depocenter is recognized along the Southern Patagonian Andes with outcrops restricted to the area between Lago Posadas to the North and Lago San Martín to the South (Fig. 1; Aguirre-Urreta and Ramos, 1981). The depocenter consist of basal sandstones with interspersed shales and limestones from the Río Belgrano Formation, topped by up to 350 m of conglomerates and tuffs of the Río Tarde and Kachaike formations (Fig. 2; Aguirre-Urreta, 1990; Ramos, 1989). Sedimentological studies from Arbe (1986) determine a shallow marine depositional environment near to shoreline, followed by deltaic to fluvial regressive sequences. The Río Belgrano Formation has Hauterivian–Barremian ammonites (Aguirre-Urreta, 1990, 2002), and yielded a ~122 Ma maximum depositional age from detrital zircons (Ghiglione et al., 2014a, 2015). The Río Tarde Formation is constrained to the Aptian–Cenomanian by a ~121.5 Ma peak of detrital zircons at its base, a U–Pb ~112 ± 2 Ma age for a tuff in its mid section (Ghiglione et al., 2015), and tuffs at the top with K–Ar ages of ~99–97 Ma (Ramos and Drake, 1987).

There are currently two main different hypotheses to explain the geodynamic context of this littoral to continental confined depocenter on top of the marine sag. The coarse-grained sandstones could be a response to basement uplift along the Southern Patagonian Andes (Ramos, 1979, 1989; Aguirre-Urreta and Ramos, 1981), and therefore indicate the beginning of the foreland stage in the northern Austral basin. However, in a recent U–Pb study in detrital zircons Ghiglione et al. (2014a, 2015) detected Paleozoic basement sources mixed with Lower to Middle Jurassic volcanic detritus, characteristic of Central Patagonia. The latter study related the coarse grained sequences, and the onset of littoral to continental conditions, to uplift and exhumation of the Deseado massif during Aptian post-breakup deformation (Giacosa et al., 2010; Dalziel et al., 2013; Heine et al., 2013). Recently, intracontinental deformation in the extra-Andean Patagonia has been related to the development of a broken foreland system in Aptian times (Gianni et al., 2015).

First uplift along the Southern Patagonian Andes took place afterwards, during the Late Cretaceous, with deformation concentrated south of Lago San Martín (Fig. 1; Arbe, 1986, 2002; Kraemer,

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http://dx.doi.org/10.1016/j.jsames.2015.08.014
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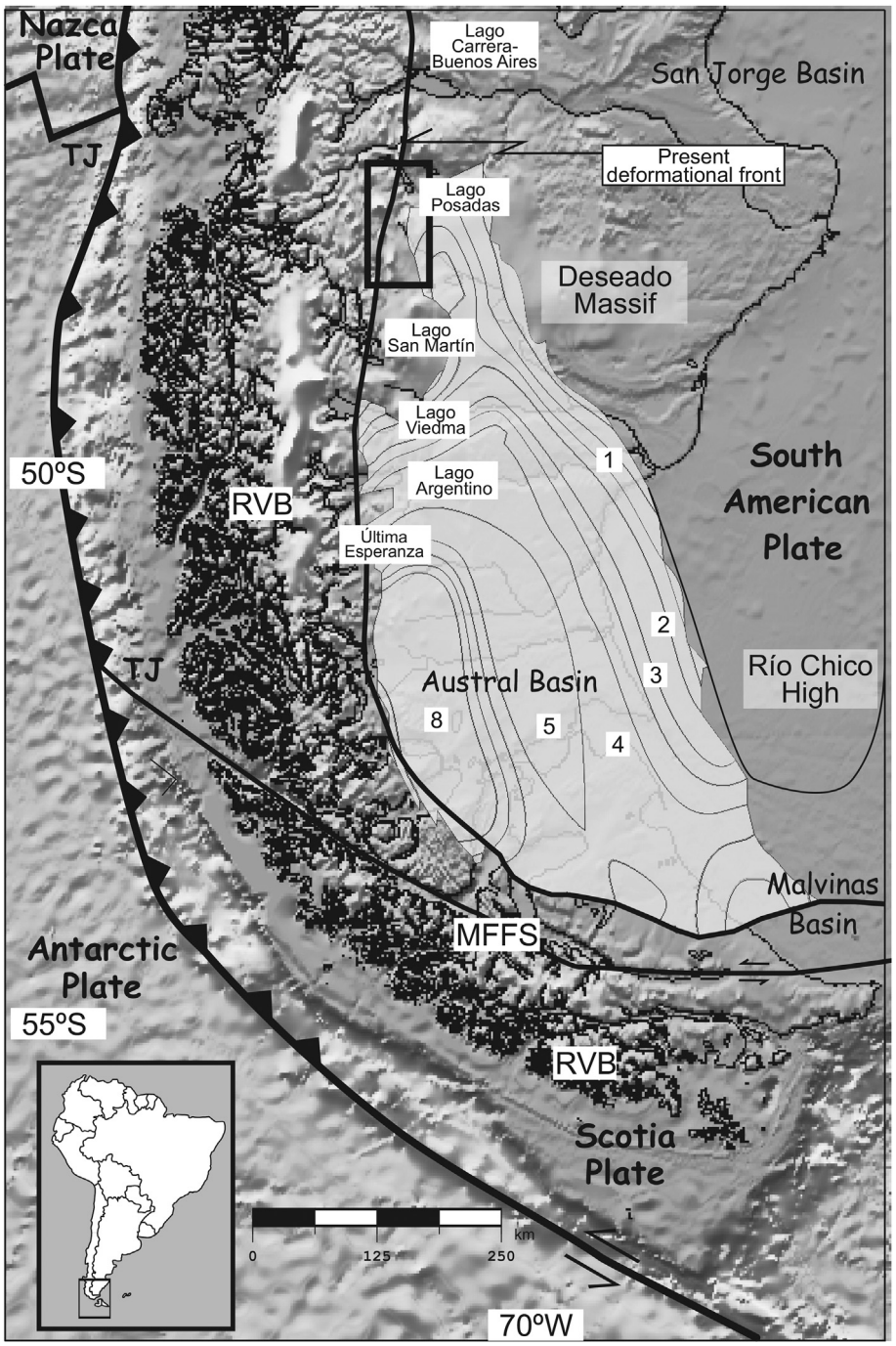

Fig. 1. Location of the study zone (black square) from high-resolution digital elevation model (DEM; Mercator projection, NASA-SRTM) showing sediment distribution from Austral basin. Patagonian basins and site locations mentioned in the text are also shown. Contours indicate foreland sediment thickness within the undeformed depocenters from seismic information in kilometers (from Heine, 2007; www.basinatlas.com). MFFS, Magallanes-Fagnano fault zone; RVB, Rocas Verdes Basin; TJ, Triple Junction.

1998; Ghiglione et al., 2014b). Andean uplift on those sectors produced the onset of the foreland stage in the Austral basin, as is indicated by the appearance of Cenomanian–Turonian coarse sandstones (Fildani et al., 2003; Fosdick et al., 2011; Varela et al., 2012) on top of the sag deposits (Wilson, 1991). Foreland deposits in the Última Esperanza region (Fig. 1; Katz, 1963; Wilson, 1991) contain grains clearly derived from Andean sources, including Paleozoic–Mesozoic metamorphic and ophiolitic complexes, and Upper Jurassic volcanic units (Fildani and Hessler, 2005; Romans et al., 2011). However, between Lagos Viedma and Argentino there are Late Cretaceous sequences with quartzose-recycled sources, most probably from extra-Andean Patagonia origin (Manassero, 1988; Macellari et al., 1989).

We analyzed in this paper the sedimentary petrography of 37 thin sections in four stratigraphic profiles covering the whole Early Cretaceous continental depocenter (see location on Fig. 2), and compare them with the detrital zircons chronological data from Ghiglione et al. (2015). The modal composition of the sandstones is not only useful to classify the sedimentary rocks (Folk et al., 1970), but also to establish the composition of provenance areas (Scasso