Tectonophysics 668–669 (2016) 15–34

Contents lists available at ScienceDirect

Tectonophysics

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

Late Cretaceous–early Eocene counterclockwise rotation of the Fueguian Andes and evolution of the Patagonia–Antarctic Peninsula system

F. Poblete [a,b,c,*], P. Roperch [b,c], C. Arriagada [a], G. Ruffet [b,c], C. Ramírez de Arellano [d], F. Hervé [a,d], M. Poujol [b,c]

[a] Departamento de Geología, Universidad de Chile, Santiago, Chile
[b] CNRS (CNRS/INSU) UMR 6118, Géosciences Rennes, 35042 Rennes Cedex, France
[c] Université de Rennes I, Géosciences Rennes, 35042 Rennes Cedex, France
[d] Carrera de Geología, Universidad Andres Bello, Salvador Sanfuentes, 2375 Santiago, Chile

A R T I C L E I N F O

Article history:
Received 30 May 2015
Received in revised form 23 November 2015
Accepted 24 November 2015
Available online 12 December 2015

Keywords:
Patagonian Orocline
Fuegian Andes
Antarctic Peninsula
Paleomagnetism
Tectonics
Plate tectonics

A B S T R A C T

The southernmost Andes of Patagonia and Tierra del Fuego present a prominent arc-shaped structure: the Patagonian Bend. Whether the bending is a primary curvature or an orocline is still matter of controversy. New paleomagnetic data have been obtained south of the Beagle Channel in 39 out of 61 sites. They have been drilled in Late Jurassic and Early Cretaceous sediments and interbedded volcanics and in mid-Cretaceous to Eocene intrusives of the Fuegian Batholith. The anisotropy of magnetic susceptibility was measured at each site and the influence of magnetic fabric on the characteristic remanent magnetizations (ChRM) in plutonic rocks was corrected using inverse tensors of anisotropy of remanent magnetizations. Normal polarity secondary magnetizations with west-directed declination were obtained in the sediments and they did not pass the fold test. These characteristic directions are similar to those recorded by mid Cretaceous intrusives suggesting a remagnetization event during the normal Cretaceous superchron and describe a large (>90°) counterclockwise rotation. Late Cretaceous to Eocene rocks of the Fueguian Batholith, record decreasing counterclockwise rotations of 45° to 30°. These paleomagnetic results are interpreted as evidence of a large counterclockwise rotation of the Fueguian Andes related to the closure of the Rocas Verdes Basin and the formation of the Darwin Cordillera during the Late Cretaceous and Paleocene.
The tectonic evolution of the Patagonian Bend can thus be described as the formation of a progressive arc from an oroclinal stage during the closure of the Rocas Verdes basin to a mainly primary arc during the final stages of deformation of the Magallanes fold and thrust belt. Plate reconstructions show that the Antarctic Peninsula would have formed a continuous margin with Patagonia between the Early Cretaceous and the Eocene, and acted as a non-rotational rigid block facilitating the development of the Patagonian Bend.
© 2015 Elsevier B.V. All rights reserved.

1. Introduction

An impressive feature of the Patagonia–Antarctic Peninsula system is the striking opposite curved shape between the Patagonian Bend (Fig. 1), where the main structures and physiographic features change from a N–S trend in southern Patagonia to a ESE–WNW orientation in Tierra del Fuego, and the northern tip of the Antarctic Peninsula with an inversed shape (Fig. 1). Wegener (1929) first described this major structure and proposed that South America and the Antarctic Peninsula were joined at their tip and that the orogenic curvature of Patagonia resulted from westward drift of South America. Although nearly a century has passed since his insightful work, the tectonic evolution of the two regions during Gondwana breakup and the possible oroclinal bending of the southernmost South America (Carey, 1958) are still a matter of controversy (Fig. 2).

Similar geologic features between southernmost America and the Antarctic Peninsula (Dalziel et al., 1975; Hathway, 2000; Hervé et al., 2005; Katz and Watters, 1966) suggest that they have been connected. However, the initial geometrical arrangement of these two units has been intensely debated: while some paleogeographic reconstructions suggest that the Antarctic Peninsula was a straight prolongation of Patagonia, forming a rectilinear margin during the Gondwana breakup (Fig. 2a) (Dalziel et al., 1973; Storey, 1991; Suárez and Pettigrew, 1976), others place the Antarctic Peninsula at the western edge of Patagonia (Fig. 2b) (Dalziel et al., 2013; Ghidella et al., 2002; Harrison et al., 1979; König and Jokat, 2006; Miller, 1983). The possible oroclinal bending of the southern margin of the Andes has also been debated. Counterclockwise (CCW) tectonic rotations recorded in the Fueguian Andes were interpreted as evidence for an oroclinal bending of the Patagonian Bend related to the closure of the Rocas Verdes Basin (Fig. 2a,b) (Burns et al., 1980; Cunningham et al., 1991; Dalziel et al., 1973). But, recent studies have suggested that the curved margin of southernmost South America is a primary feature (Diraison et al., 2000; Ghiglione and Cristallini, 2007; Ramos and Aleman, 2000).

* Corresponding author at: Géosciences Rennes, Campus de Beaulieu, 35042 Rennes, France.
E-mail address: ferpoble2@gmail.com (F. Poblete).

http://dx.doi.org/10.1016/j.tecto.2015.11.025
0040-1951/© 2015 Elsevier B.V. All rights reserved.

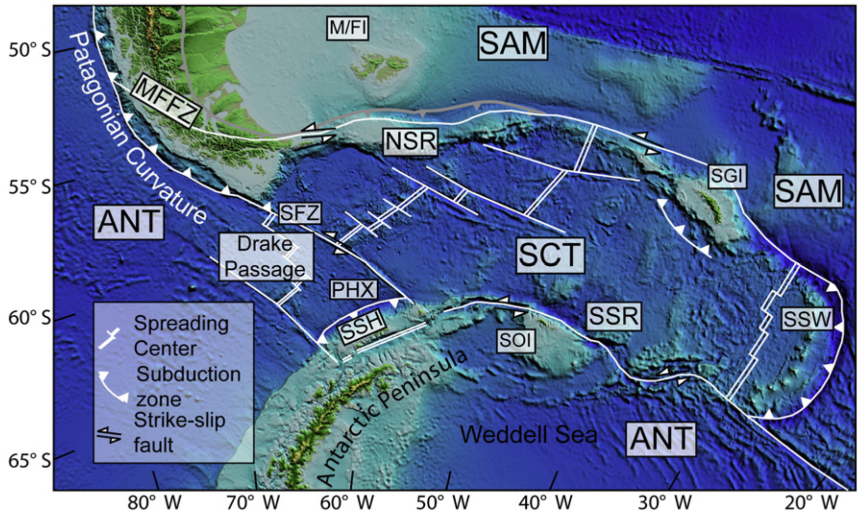

Fig. 1. Physiography of the region showing the principal tectonic plates and structures. The Scotia (SCT) plate is surrounded by the Antarctic (ANT) plate and the South American (SAM) plate. The South Shetland (SSH) and the South Sandwich (SSW) microplates are also depicted. PHX is for the former Phoenix plate. Main structures: MFFZ, Magallanes–Fagnano fault zone; NSR, North Scotia Ridge; SSR, South Scotia Ridge; SFZ, Shackleton Fracture Zone. SGI and SOI are for South Georgia Island and South Orkney Island microcontinents. M/FI is for Malvinas/Falkland Island. Modified from (Barker, 2001; Dalziel et al., 2013; Klepeis and Lawver, 1996; Lagabrielle et al., 2009; Smalley et al., 2007).

Paleomagnetic studies in Patagonia and the Antarctic Peninsula offer a powerful tool to constrain paleogeographic reconstructions and the origin of the curvatures. As an example, a straight margin of Patagonia would restrict a western position of the Antarctic Peninsula during the early stage of Gondwana breakup while a counterclockwise rotation of Patagonia and a clockwise rotation of the Antarctic Peninsula have been invoked to explain the closure of the Rocas Verdes basin and the development of the Scotia Arc region (Dalziel and Elliot, 1972; Torres Carbonell et al., 2014). Paleomagnetic data have already ruled out the possible clockwise rotation of the Antarctic Peninsula (at least since mid-Cretaceous) (Grunow, 1993; Poblete et al., 2011; Watts et al., 1984), whereas in Patagonia the available paleomagnetic data suggest oroclinal bending of the southermost part of the forearc (Burns et al., 1980; Cunningham et al., 1991; Dalziel et al., 1973) and very minor or no rotations in the Magallanes Fold and Thrust Belt (FTB) (Maffione et al., 2010; Poblete et al., 2014). However, in Patagonia paleomagnetic data remain scarce and sometimes questionable (Poblete et al., 2014; Rapalini, 2007) and, they do not permit to discard the hypothesis that vertical axis rotation could be related to strike–slip tectonics (Cunningham, 1993; Cunningham et al., 1991; Diraison et al., 2000).

We present a paleomagnetic study from 61 sites, sampled in the Early Cretaceous–Eocene Fueguian Batholith and in Early Cretaceous sediments and volcanic rocks from the Fueguian Archipelago (Fig. 3a and b). We used these new data and already published ones to constrain the evolution of the Patagonian Bend and its relation to the Antarctic Peninsula in paleogeographic reconstructions.

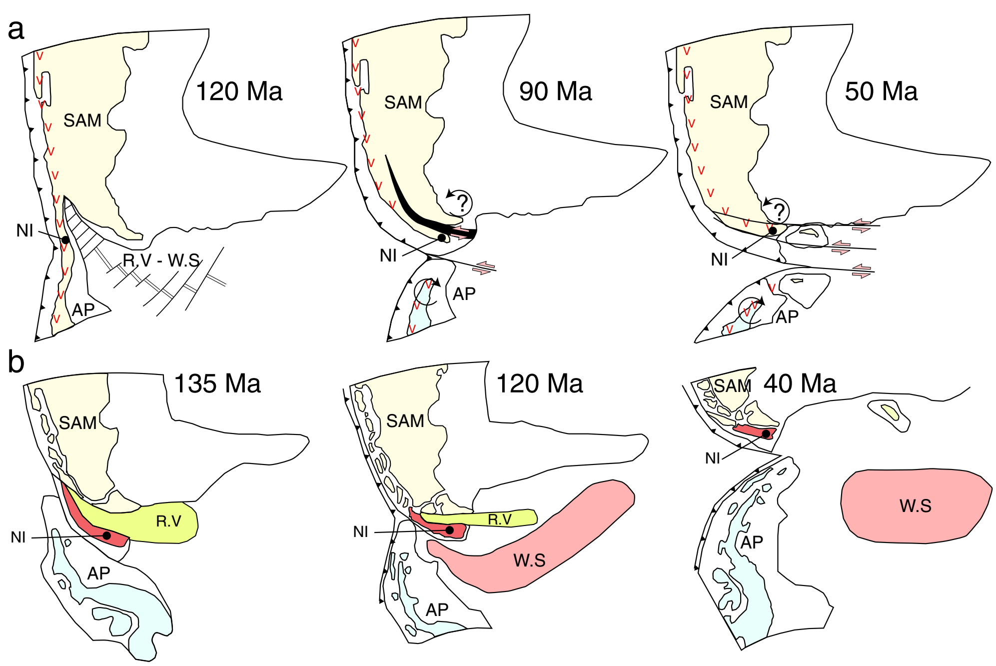

Fig. 2. Paleogeographic reconstructions and tectonic evolution of the Patagonia–Antarctic Peninsula system. Reconstructions are from (a) Diraison et al. (2000) and (b) Dalziel et al. (2013). Abbreviations: SAM, South America; AP, Antarctic Peninsula; R.V., Rocas Verdes basin; W.S., Weddell Sea; NI, Navarino Island.

Download English Version:

https://daneshyari.com/en/article/4691416

Download Persian Version:

https://daneshyari.com/article/4691416

Daneshyari.com