Contents lists available at ScienceDirect

Journal of South American Earth Sciences

journal homepage: http://ees.elsevier.com

Spatio-temporal variation of the strain field in the southern Central Andes broken-foreland (27°30′S) during the late cenozoic

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ARTICLE INFO

Keywords
Anisotropy of magnetic susceptibility
Broken foreland
Fiambalá basin
Strain field
NW Sierras Pampeanas
Kinematic analysis

ABSTRACT

We present an integrated structural and Anisotropy of Magnetic Susceptibility (AMS) study focused on the characterization of the spatio-temporal variation of the strain field during the main Neogene deformation, of the Argentine Precordillera and the northern Sierras Pampeanas, immediately to the south of the Puna plateau (27°30′S). The AMS from 43 sites and fault-slip data analysis from mesoscale faults (n = 540) were carried out in Early Miocene to Middle Pliocene sedimentary and volcaniclastic rocks. The AMS results show moderate values of anisotropy degree near to deformation zones, and low and high values of bulk susceptibility. The most predominant magnetic fabric is sedimentary type I and II, with a weak magnetic lineation. In areas where the rocks are deformed, the incipient magnetic lineation are subparallel to the regional structural trend and present a main N–S orientation in the Precordillera and Fiambala basin, while in the Sierras Pampeanas they are mostly NE-oriented. Combining these results with kinematic analysis from fault-slip data, we identify, in the Precordillera and Fiambalá basin areas, a contractional event with E-W main direction, from ~23 Ma to 5 Ma, mostly active from the onset of deposition of Neogene sequences. During this period, in the NW Sierras Pampeanas, the contraction directions follow a NW orientation. The onset of N–S to NNW contraction, mostly recognized in rocks younger than 5 Ma, exposed in the northern areas of Precordillera and Sierra Pampeanas, documents a change of the strain field during the early-to-middle Pliocene, associated with a shift in the contractional direction from E-W to N–S. We relate the change to the rapid uplift of the southern Puna, generating a juxtaposition of an area under N–S extension, affecting the topographically-higher Puna, with the other area under N–S contraction in the adjacent Precordillera and Sierras Pampeanas. We associate these two events as part of the evolution of this segment of the Andes, where the broken foreland setting is active during this time. By combining the AMS and kinematic analysis results, we obtain a timing for the spatio-temporal change of contraction directions, which allows us to compare both the broken-foreland and foreland basins to understand spatio-temporal strain variations.

1. Introduction

In subduction zones, deformation of the continental lithosphere has been interpreted as a response to a regional stress field induced by plate tectonics dynamics (Zoback, 1992; Hu et al., 1996). In this tectonic setting, the cordilleran orogenic system corresponds to a trench-parallel elongated morphostructural belt, which evolution is registered by deformation, magmatism and sedimentation (DeCelles et al., 2009) developed with variable crustal architecture and surface morphology. The Andes, the largest of these non-collisional orogenic systems, have suffered several episodic deformational events through their late Paleozoic to Cenozoic evolution, leading to the construction of a highly-segmented orogen (e.g., Mpodozis and Ramos, 1989; Kley et al., 1999; Horton, 2018). The Altiplano-Puna plateau in the Central Andes, between ~15° and ~27° S, represents a main feature, with an elevated mean topography.

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https://doi.org/10.1016/j.jsames.2020.102981
Received 27 May 2020; Received in revised form 24 September 2020; Accepted 20 October 2020
Available online xxx
0895-9811/