Journal of Geodynamics 53 (2012) 81–94

Contents lists available at ScienceDirect

Journal of Geodynamics

journal homepage: http://www.elsevier.com/locate/jog

Neogene magmatic expansion and mountain building processes in the southern Central Andes, 36–37°S, Argentina

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ARTICLE INFO

Article history:
Received 30 July 2010
Received in revised form 11 July 2011
Accepted 12 July 2011
Available online 21 July 2011

Keywords:
Southern Andes
Miocene
Arc widening
Volcanism

ABSTRACT

The eastern Andean slope from 34° to 37°S has a unique character when compared to neighboring sectors: Lower Miocene volcanic rocks cover upper Cretaceous to Eocene contractionally deformed deposits in the retroarc area. Remnants of the previous upper Oligocene arc front are found at the present-day western Andean slope, west of the mentioned Miocene arc sequences. These lavas and ignimbrites of the Charilehue Formation, typically described as an arc suite, have ages between 18 and 14.5 Ma and thickness over 1000 m, and are delimited by normal faults. Chemical analyses reveal that they have an anomalous chemistry characterized by poorly evolved mantle-derived rocks, which differ from Eocene and Late Miocene typical arc magmas in the region. Their spatial distribution depicts a NE trend more than 100 km long, whose outcrops were affected by Middle to Late Miocene compressional deformation and subsequent exhumation, as shown by field and fission track data. The Charilehue volcanic sequences represent the westernmost products of an incipient and poorly evolved arc that migrated and expanded to the foreland, initially coexisting with an extensional setting inherited from late Oligocene times. This complex evolution is interpreted as the result of a slab shallowing related to the time when the South American plate started its westward absolute shift after a quasistatic period in the Oligocene. The shift of the magmatism to the foreland probably caused a higher thermal gradient and, therefore, a shallower brittle–ductile transition that triggered thick-skinned basement tectonics in the retroarc region, reactivating Late Cretaceous to Eocene décollements.

1. Introduction

The Andean margin between latitudes 34° and 37° south is considered a key area for constraining the geometry of the subducting Nazca plate, evidenced by the volcanic arc front behavior and its position through time. These variations are closely linked to distinct deformational stages (Fig. 1). Several authors have proposed that changes in the subduction angle in the vicinity of the study area generated foreland migration and retreat of the volcanic arc and deformation during the last 30 My (Kay et al., 2006; Ramos and Kay, 2006). These changes are inferred to strongly affect and control foreland deformation, lithospheric flexure due to orogenic loading and emplacement of anomalously thick accumulations of arc-related magmatic rocks more than 500 km away from the trench (Fig. 2) (Kay et al., 2006; Ramos and Folguera, 2005). In this work we discuss particularly the origin of those Late Oligocene–Miocene (Lower Pliocene) sequences (27–4 Ma) hosted in the eastern slope of the main Andes (Fig. 2), which have a complex array from the Chilean coast to the foreland area. In order to do so, we present new field observations that characterize the westernmost sequences assigned to an 18–14 Ma volcanism. A precise geological map of the region and structural cross-sections, together with new radiometric ages and geochemical analyses of the Miocene volcanic rocks, show new evidence to discuss the behavior of the volcanic arc and recognize the slab shallowing of the Nazca plate, during Neogene times.

2. Geology of the study area

Andean contractional deformation in the area has led to the exposure of a great variety of geological units from late Paleozoic to Neogene in age. Permian rocks constitute the exposed basement at these latitudes. They range in composition from andesites to rhyolites erupted during the first stages of Gondwana breakup (Llambias et al., 1979). Since Early Jurassic to Early Cretaceous, moderately deep and platform marine sediments have interfingered with basaltic and andesitic rocks, accumulated in intra-arc settings along extensional depocenters associated with negative trench roll-back velocities of the overridden plate (Giambiagi et al., 2008). Eventually, important changes in magmatism and

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doi:10.1016/j.jog.2011.07.004

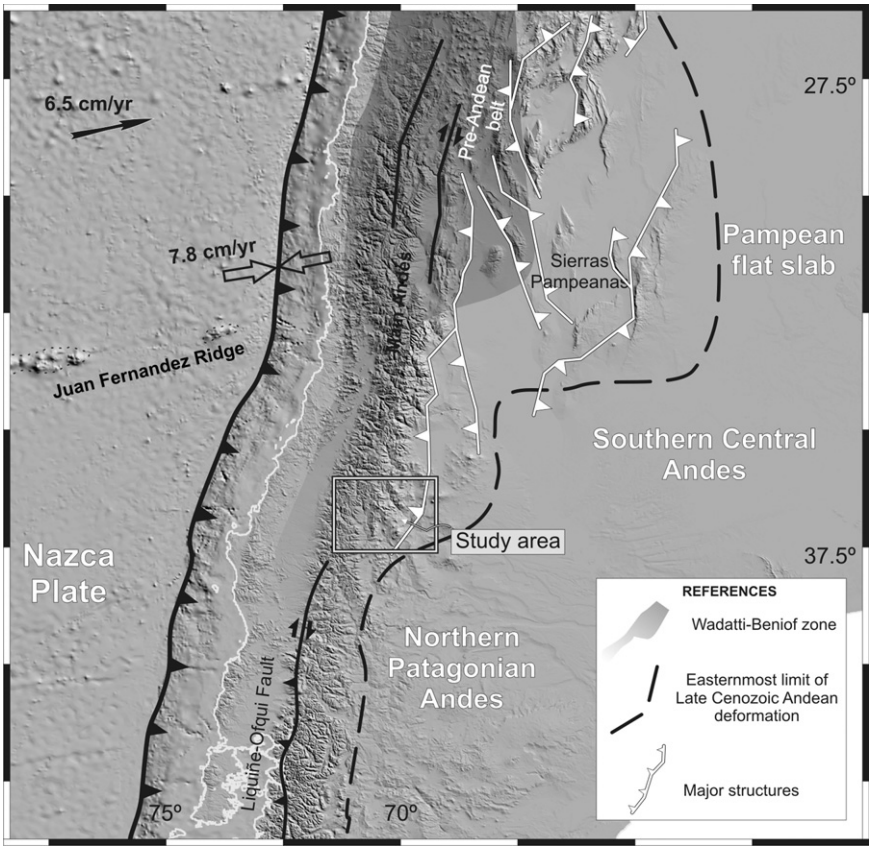

Fig. 1. Present tectonic setting of the study area located in the southern Central Andes segment, south of the Pampean flat slab and north of the Northern Patagonian Andes. The region has a normal subduction angle, and is located west of the Andean orogenic front over the orogenic wedge.

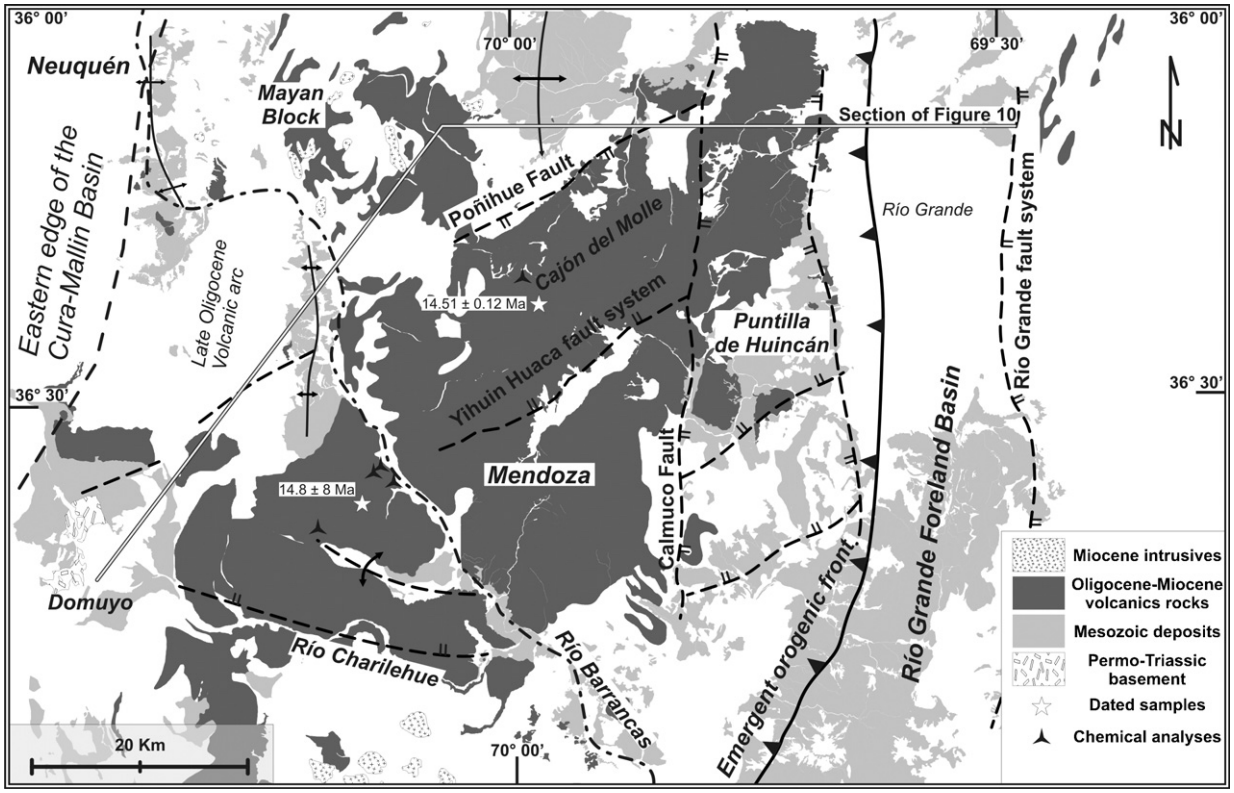

Fig. 2. Andean Miocene Charilehue and Huincan formations and coeval Río Grande foreland basin. A complex array of NE, N, and NW normal faults, namely The Poñihue, Calmuco and Río Charilehue faults control the thickness of sedimentary packages of the Early Miocene volcanic sequences. Westward Late Oligocene position of arc is shown as a reference indicating the position of the volcanic arc previous to its eastward expansion.