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Architecture and style of compressive Neogene deformation in the eastern-southeastern border of the Salar de Atacama Basin (22°30'-24°15'S): A structural setting for the active volcanic arc of the Central Andes

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Introduction

Detailed field and structural mapping integrated with digital elevation models (DEM), analyses of satellite images and previous works carried in and around the Salar de Atacama basin are used here to assess the nature of intra-arc and inner forearc deformation of the Central Andes (between 23° and 24°S, Northern Chile), during the development of the Andean orogen. Special emphasis was given to the Neogene tectonic evolution between the Precordillera and the Western Cordillera (Figure 1) at the time of arc formation.

The deformation of the inner-forearc and arc of the Central Andes

The main structural style of the study area is given by first-order kilometric scale ~NS and east-vergent thrust faults. These faults have a listric section, with detachments levels located approximately 8 km below the surface (Muñoz *et al.*, 2002; Arriagada *et al.*, 2006 and own work). Subsidiary to these main faults, there is a second-order thin-skinned system (Kuhn, 2002) with similar orientation to the first-order structures. This system has detachments levels located approximately 2-3 km below the surface (Figure 2).

Field observations and previous published works (Ramírez & Gardeweg, 1982; Charrier & Reutter, 1994; Wilkes & Görler, 1994) indicate that the structures deform the Oligocene-Miocene San Pedro Formation, Tambores Formation and Quepe beds, and the 3.2 My Tucúcaro-Patao Ignimbrite

The topographic expression of both first- and second-order faults corresponds to a set of subparallel fault-propagation-folds and fault-bend-folds, which can be seen in the field as prominent NS trending ridges with heights between 50 and 400 m. The fold and thrust belt architecture controls the landscape of the Precordillera and the Salar de Atacama Basin. Furthermore, we found evidence of an 80 km long structure along the active magmatic arc (Figure 1, 2), so-called Miscanti Fault. This fault represents the easternmost expression of the fold-and-thrust belt. The ca. 400 meters high structural relief of the Miscanti Fault controls the development of intra-arc lakes (Miscanti and Miñiques lakes) and the local and spatial extension of andesitic-basaltic lavas erupted from nearby volcanic centers. The geometry and evolution of the folding due to this structure, was modeled with the *TRISHEAR 4.5*^{TM} software which is based on algorithms presented in Allmendinger (1998). Such modeling indicates that the Miscanti Fault belongs to the first-order system, having a detachment level buried ca. 8 km below the surface.

The pattern of deformation exhibits an eastward migration during the last 28 My, but a nearly steady EW orientation of the maximum compressional axis for the same time window (Jolley *et al.*, 1990; Charrier & Reutter, 1994; Wilkes & Görler, 1994; Jordan *et al.*, 2002; Reutter *et al.*, 2006 and our own work).

Evidence of active tectonics (Niemeyer *et al.*, 1984, Jordan *et al.*, 2002; Reutter *et al.*, 2006, and González *et al.*, this symposium) indicates a similar deformation regime at least from the Pleistocene to the Holocene.

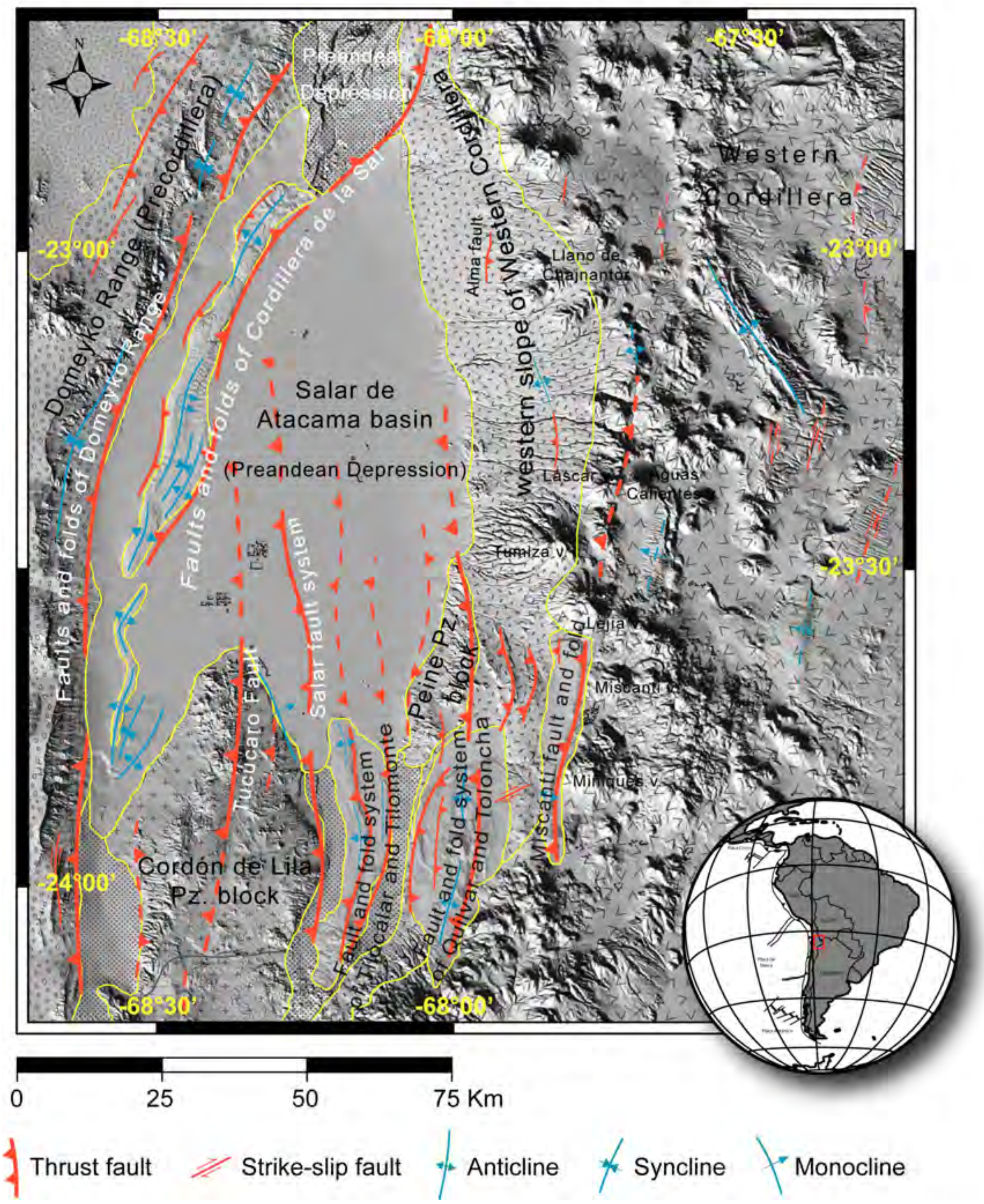

Figure 1: Simplified structural map of the study area compiled after Niemeyer (1984), Jolley *et al.* (1990), Charrier & Reutter (1994), Wilkes & Görler (1994), Jordan *et al.* (2002), Muñoz *et al.* (2002), Arriagada *et al.* (2006), Reutter *et al.* (2006), and our own work. Yellow lines are boundaries of main morpho-structural units. Topographic base: SRTM GTOPO90.

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Discussion

Preliminary data of vertical offsets obtained from the observed main structures, indicates a decreasing rates of uplift and shortening since the Early-Neogene up to Present. Using available data published by Niemeyer (1984) and Jordan *et al.* (2002) we estimate an uplift rate of ca. 0.4 mm/yr for the time period between the Late-Miocene and the Early-Pliocene (Quechua Tectonic Phase). In contrast and by using our own field observations, we estimate an uplift rate of ~0.05 mm/yr for the time window between the Early-Pliocene up to the Present; hence, decreasing one order of magnitude between the two identified phases of deformation.

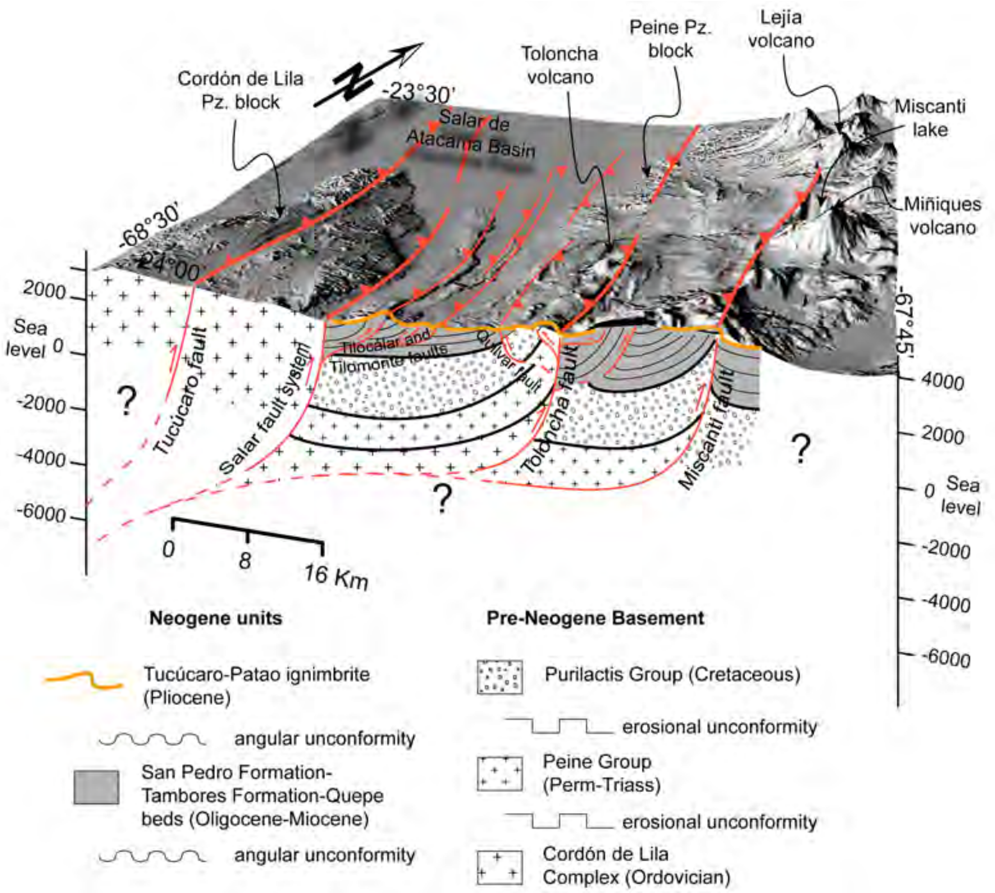

Figure 2: Schematic 3D block model showing the proposed architecture and style of deformation for the study area. Geology units compiled after Ramírez & Gardeweg (1982), Niemeyer (1984), Charrier & Reutter (1994), Wilkes & Görler (1994), Breitkreuz (1995), Mpodozis *et al.* (2005) and field observations. Vertical exaggeration: 3X.

The nature of the link between the kinematics and timing of deformation in this portion of the volcanic arc of the Central Andes is currently under study, with the aim of assessing a better understanding of the precise feedbacks between deformation and volcanism in convergent tectonic settings.

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