The Agrio - Aluminé fold and thrust belt: a case of a curved belt in response to interaction with a pre-Andean foreland obstacle?

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Abstract. The Agrio-Aluminé fold and thrust belt on the eastern flank of the Andes between 37º and 40º30'S shows a significant along-strike variation in width which defines a curved geometry. Diferential forelandward propagation of both portions delineates a wider northern portion (Chihuidos salient) and a narrower southern portion that becomes a recess (Laguna Blanca recess). Both sectors exhibit different degrees of exhumation, accompained by notable morphological, topographic, and structural changes.
In the southern segment, the lateral growth of the fold and thrust belt (FTB) was inhibited by the presence of a pre-Andean east-west oriented regional feature known as the Huincul High. The combination of structural data and detrital zircon ages of its exposed portion, demonstrates that the Huincul High was already uplifted by the time of inception of Andean deformation. Therefore, it would have acted as a transverse foreland obstacle that inhibited the lateral growth of the Andean belt, increasing uplift and deformation at its adjacent back zone.
This setting suggest a higher pre-deformational sedimentary sequence involved in the Agrio FTB, and the interaction of the Aluminé FTB with the Huincul High, as first-order variables in originating a curved geometry of the FTB.

Keywords: Huincul high, Neuquén basin, Fold and thrust belt, curved geometry.

1 Introduction

Curved traces are recurrent features of structural map-view patterns on different fold and thrust belts (FTB) of the world (Marshak, 2004). Although curving FTB frequently reflect pre-deformational thickness of the sedimentary basin infill (Macedo and Marshak, 1999), other causes for curve formation are also common. These include interaction of the growing orogenic wedge with foreland obstacles or promontories, and intersection between two non-coaxial belts, among others factors (Marshak, 2004). In such cases, a recess is expected to form against the basement high, or where non-coaxial belts overlap, and a salient away from it. These map-view curvatures are commonly accompanied by significant morphological and structural changes (Marshak, 2004).

2 Along-strike variability of FTB between 37º and 40º30'S

The Agrio - Aluminé fold and thrust belt occurs along the Andean foreland region between 37° and 40°30'S. It involves several thousands of meters of a Mesozoic succession accumulated under variable tectonic and sedimentary conditions in the Neuquén basin (Vergani et al., 1995). Different lines of evidence indicate that both portions of the fold and thrust belt developed in at least two discrete periods of progression of deformation toward the foreland. The first occurred in Late Cretaceous times, and the last between the Middle Miocene and the Lower Pliocene (Cobbold and Rossello, 2003; Zamora Valcarce et al., 2006; García Morabito et al., 2011; García Morabito and Ramos, 2012).

There is a striking difference in how deformation progressed toward the east. Differential forelandward propagation of both portions of the fold and thrust belt delineated a wider northern portion that defines a salient (Chiuhuidos salient), and a narrower southern portion that becomes a recess (Laguna Blanca recess) (Figure 1). Significant morphological, stratigraphic, and structural changes occur around 38°45'S, on the transitional area between both segments.

In the north, the Agrio FTB expanded hundreds of kilometers toward the continent by adding rift systems and post-rift deposits into the orogenic wedge. Deformation resulted in a series of large, axial-extended folds of variable wavelengths developed through a combination of thick and thin-skinned tectonics (Zapata et al., 2002; Cobbold and Rossello, 2003; Zamora Valcarce et al., 2006).

South of 38º30'S, the Aluminé FTB is much narrower. Here, the lateral growth of the belt was inhibited by the presence of the east-west oriented Huincul High (Figure 1). The integration of structural data and detrital zircon ages from its exposed portion document that this system was already uplifted by the time of inception of Andean deformation (Naipauer et al., 2012). The pattern of zircon ages from Late Jurassic outcrops of its western portion show significant inputs from Late Triassic (220-200 Ma) and Late Permian (280-260 Ma) sources, indicating a clear provenance from sources located along the Huincul deformation zone. These data confirm the presence of pre-Andean emerged elements along this east-west oriented feature. Therefore, it may have acted as a foreland obstacle, limiting the progression of deformation towards the east, and confining it to a narrow region at its adjacent back zone. Important basement uplifts took place along this western segment, giving rise to the Southern Neuquén Precordillera, an independent mountain system that grew separately from the main Andean chain. This system exhibits the deepest levels of exposure of the entire fold and thrust belt, providing good exposures of the basement, the synrift, and the early postrift successions. NNW-trending inverted normal faults coexist here with a series of NE and east-west oriented folds and faults with evidences of a persistent Jurassic activity. Northwards, it is replaced by partially inverted depocenters preserved in subsurface along the inner Agrio FTB, documenting a dramatic change in the structural relief as a consequence of differential regional uplift.

The interaction of the Aluminé FTB with normal faults of the early Mesozoic rift phase, and with transverse pre-Andean features of the Huincul system, explain the extremely higher structural complexity of this segment, given by highly scattered structures with abrupt orientation changes.

3 Concluding remarks

Differential forelandward propagation of the deformation between 37º and 40º30'S delineated a curving fold and thrust belt geometry. Along-strike variation in width is accompanied by significant latitudinal morphological, topographic, and structural changes. Structural data and detrital zircon ages from the exposed portion of the Huincul High confirm that this E-W feature was already uplifted by the time of inception of the Andean deformation. This structural setting suggests the following two factors as the origin of the curved geometry of the Agrio-Aluminé fold and thrust belt: 1) a higher pre-deformational sedimentary sequence involved in the Agrio FTB generated the Chihuidos salient; and 2) the interaction of the Aluminé FTB with the Huincul High induced the Laguna Blanca recess. Therefore, the Huincul High would have acted as a transverse foreland obstacle that inhibited the lateral growth of the Andean belt, increasing the deformation and uplift in a narrow region where the two systems interacted. Here the Southern Neuquén Precordillera emerged.

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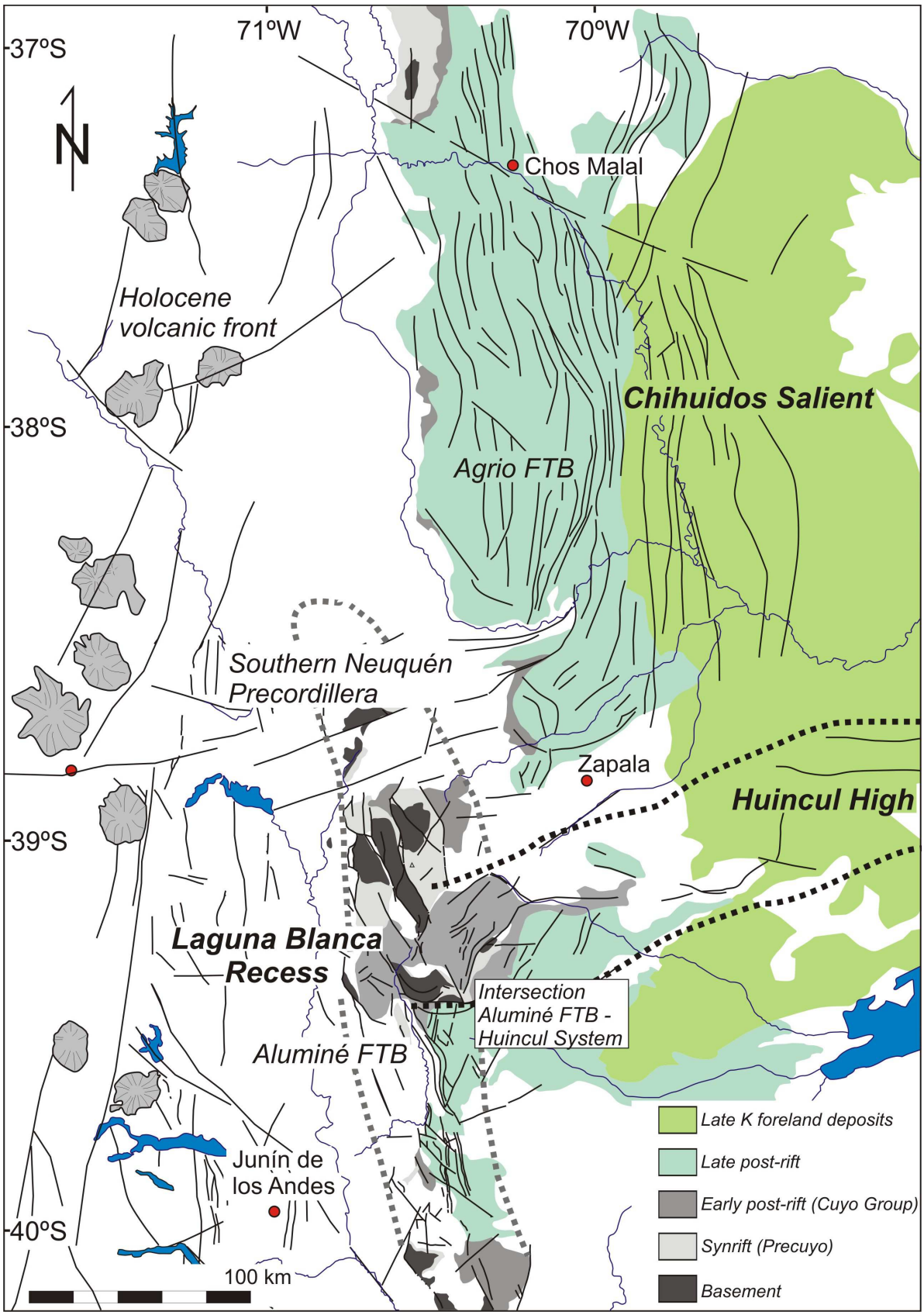

Figure 1. Structural map of the Agrio-Aluminé FTB, illustrating curved geometry and contrast between the Chihuidos salient and the Laguna Blanca recess. In the recess the belt is much narrower, and basement has been brought up defining the Southern Neuquén Precordillera. It reflects the interaction between the eastward propagating Aluminé FTB and the western portion of the Huincul High.