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Structure of the southern Cordillera Oriental (Argentinean Andes)

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Introduction

This communication is aimed to describe and discuss the general structure and the tectonic evolution of the southern edge of the Cordillera Oriental, next to the Puna. The structure of the study area consists of a system of N-S trending Andean thrust and fold structures, which are superimposed on a Cretaceous rift system (Salta rift). Inversion of the Salta Basin has been documented from surface data in the Cordillera Oriental (Grier at al., 1991) as well as from seismic data east of the studied area in the Santa Bárbara system (Cristallini et al., 1997). In most of the studied area there are not seismic data. This work has taken advantage of the excellent outcrops presents in the area, thus this is a field based work. Satellite image interpretation has also been incorporated. Detailed mapping of new areas as well as re-interpretation of previously described areas brings new insights into the tectonic evolution of the southern Cordillera Oriental.

Stratigraphy

The southern edge of the Cordillera Oriental is characterized by the presence of extensive outcrops of Precambrian basement rocks, the absence of Paleozoic series and the irregular distribution of very thick Mesozoic and Tertiary continental clastic sequences (3-12km) (Figure 1). The basement mainly consists of a monotonous succession of thin bedded sandstones and shales, Precambrian –Lower Cambrian in age (Puncoviscana Formation). These rocks have been deformed, metamorphosed and intruded by granites during the Early Paleozoic. Apart from few isolated Ordovician outcrops, the oldest rocks unconformably overlaying the Puncoviscana basement belong to the Creatceous- Eocene Salta Group. This Group comprises three units, which from bottom to top are: Pirgua Subgroup, Balbuena Subgroup and Santa Bárbara Subgroup.

The Cretaceous Pirgua Subgroup consists of alluvial and fluvial deposits formed by breccias, conglomerates, sandstones and shales that imbed alkaline volcanic rocks (Galliski and Viramonte, 1988). The thickness and lithology is strongly controlled by the distribution and motion of the Cretaceous extensional faults of the Salta Basin. This basin has been described as a part of a rift system, which extended obliquely to the Andean Range from the central Andes of Peru and Bolivia to the Chaco-Paranense basin in the Andean foreland (Uliana et al., 1989) and has a complex overall shape with sub-basins of different trends.

The Maastrichtian-Paleocene Balbuena and Santa Bárbara Subgroups correspond to the postrift sequence. Balbuena materials are characterized by the stromatolitic limestones and greenish shales of the Yacoraite Formation. This is an extensive unit and a good cartographic reference level in the Mesozoic-Cenozoic red bed succession. Above, the fluvial sediments of the Santa Bárbara Subgroup have a Paleocene-Eocene age.

The Oran Group consists of a very thick (up to 6km) Neogene synorogenic sequence of fluvial and aeolian sediments that unconformably overlay all the previously described units.

Structure

The structure of this area is characterized by a fold and thrust system involving all the previously described tectonostratigraphyc units. The predominant vergence to the west of the Andean structures and its different orientations should be emphasized (Figure 1). N-S, NW-SE and NNE-SSW trending structures are present in the area. N-S trending structures are perpendicular to the inferred E-W Andean shortening direction and predominate in the central part of the area. NNE-SSW trending structures predominate in the eastern part of the area whereas in the west NW-SE trending structures are present. Tectonic style is dominated by tight asymmetric folds related to high angle thrusts showing thinned inverted limbs in the hanginwall anticlines. Synclines are often observed in the footwall next to the thrusts. Interference fold patterns are present in several areas at different scales. Among them, the fold pattern affecting the synorogenic Oran Group around Angastaco and the folds of the syn and postrift sediments in the Las Conchas River are prominent at cartographic scale. Several structures have been observed at cartographic and at outcrop scales which demonstrate reactivation of the previous Cretaceous extensional faults. First, inversion is evidenced by thickness and facies variations of Cretaceous sequences across some thrusts. Along of some of these thrusts, basement short-cuts and their related extensional faults are observed. The extensional fault system of the Salta Rift Basin showed both E and W dipping faults. E dipping faults have been reactivated whereas some of the W dipping faults have been preserved although they have been folded.

Timing of Andean deformation

Detailed mapping has revealed the existence of unconformities and growth geometries in the Tertiary and Quaternary of the studied area that allow dating the onset and timing of the Andean deformation. An angular unconformity has been observed between the Oran Group and the Santa Bárbara Subgroup in the Angastaco area. It suggests the onset of the Andean deformation in the area at Late Paleogene- Early Miocene times. In the lower part of the Oran Group, the Angastaco Fm shows growth geometries (progressive unconformities) in the western part of the studied area. They are especially visible around the basement involved anticlines in San Lucas area and in the thrust front of Pucarilla and Peñas Blancas. In these last localities the upper growth sediments unconformably overlay the hangingwall. In the Pucarilla area, a lahar deposit interbedded in these upper sediments has yield an age of 12.11+/- 0.11Ma (Marret et al. 1994). In the upper part of the Oran Group a Pliocene formation presents a basal high angle angular unconformity in the western area whereas in the east it is involved in the structures but resting parallel to the lower Oran Group. Growth geometries are observed in the Quaternary sediments evidencing deformation until nowadays.

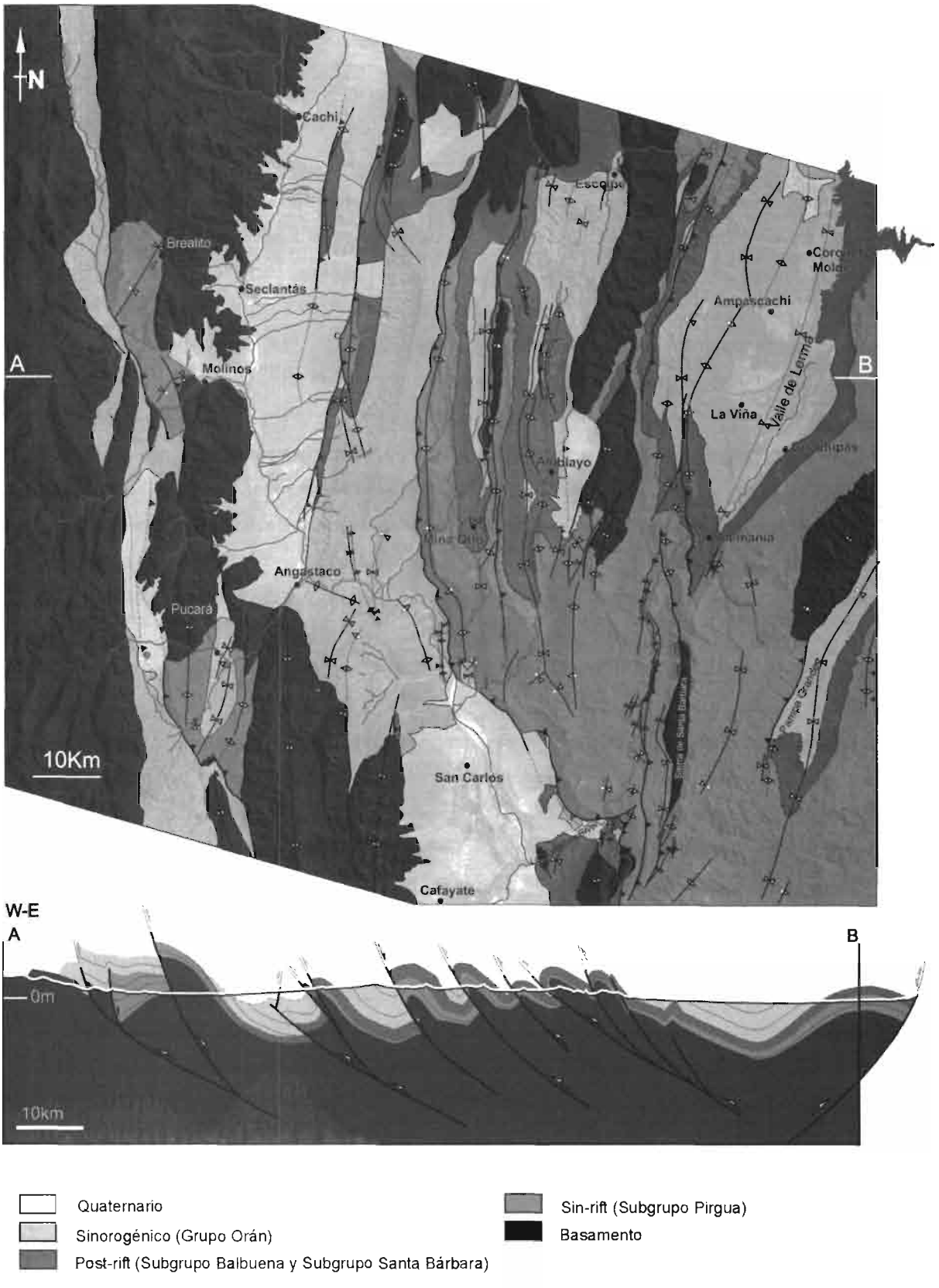

Figura 1: Geological cartography and general cross-section of the studied area.The Cross-section is located on the map.

Discussion and Conclusions

The structural style of the studied area is controlled by the inversion of the extensional fault system of the Cretaceous Salta Basin and the absence of a significant decollement level in the upper crustal levels. The first determine the location and the geometry of some of the contractional Andean structures and the second control the shape of the folds related to the thrust system. The detailed study of the area shows that Cretaceous extensional structures of this part of the Salta Basin present several trends: NW-SE, NNE-SSW and N-S. W-E Andean shortening is superimposed to these previous orientations of extensional structures causing different cartographic patterns depending on its location. Because of the obliquity between the extensional and contractional faults, inversion geometries are only locally significative. They control the development of thrust re-entrants and salients at different scales. Along these oblique structures, inversion geometries are observed such as reactivated faults, basement short-cuts and related folds. Folds interferences of fault-related folds develop in the accommodation zones or in the relay ramps of the previous extensional fault system. Fold interferences also result from the coexistence of different components of shortening due to the inversion of previous extensional faults with different orientations. It is interesting to bring out the obliquity at global scale because sediments of the Cretaceous rift are present in several Andean structural units even in its foreland basin. It makes the limited effect of the inversion tectonics at crustal scale clear.

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