

STRUCTURE OF THE ARGENTINE ANDEAN CORDILLERA BETWEEN 30° 30' AND 31° 00' S

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Introduction

In the Argentine Andean Cordillera between latitude 30° 30' and 31° 00' (fig.1), two main tectonostratigraphic groups can be defined : a Paleozoic (Gondwanic) basement with a characteristic thin skinned tectonic structure and the Andean cover with remarkable extensional structures inverted by Tertiary compressional tectonic event.

The Gondwanic basement is constituted by Silurian?, Devonian and Permo-Carboniferous marine sedimentary units, generally deposited in carbonate or siliciclastic sedimentary platforms, intruded by Upper Paleozoic granitoid rocks (Tocota pluton). The most important structures related with Gondwanic Orogenic Cycle are thrust and related folds, with transport direction to the East and remarkable shortening.

The Andean cover discordant over the Gondwanic basement has a volcanic and volcanoclastic origin with some interbedded continental sedimentary rocks. Two tectonostratigraphic groups can be also defined: a preorogenic sequence linked with an extensional tectonic event, and a synorogenic sequence linked with a compressional tectonic event producing the inversion of the previous extensional features. The lower units (Choiyoi Group and Vizcachas Fm. of Permian and Triassic age) are affected by normal faults with downthrow of the Western blocks and are intruded by Triassic granodioritic rocks. These faults involve the Gondwanic basement in a typical thick skinned tectonic style and are grouped in bands with a N-S direction. The uppermost units (Melchor and Olivares groups of Tertiary and Plio-Quaternary ages) are also discordant over the last ones. The normal faults were inverted in the Upper Miocene by an elevation of the West blocks, deforming the lower and upper units in a compressional context during the Andean Orogenic Cycle.

The Gondwanic Orogenic Cycle

The Gondwanic Orogenic Cycle goes from the upper Devonian to the lower Permian. The preserved structures linked to this Orogenic Cycle in this area were generated during San Rafaelic phase at lower Permian (Ramos, 1988). The deformation characteristics are of thin-skinned type: almost complete absence of metamorphism and schistosity, and the presence of numerous thrust levels, with folds related to thrust surface geometry.

Usually, the thrust surfaces are placed on favorable levels —as the Silur-Devonian limestones situated on the bottom of the Paleozoic succession. The main geometric structures at different scales (m to km) are imbricate fans or duplexes. The observation of different kinematic criteria shows an East tectonic transport direction for all Gondwanic thrusts.

Some folds at different scales appear to be related to the Gondwanic thrusts. The folds have different geometric features. Asymmetric folds are the most common type depicting interlimb angles lower than 70° and the axial plane dipping 20° to 40° W. The folds are facing towards the E or the SE. Generally, they are cylindrical folds, but sometimes we can find folds with non cylindrical shapes.

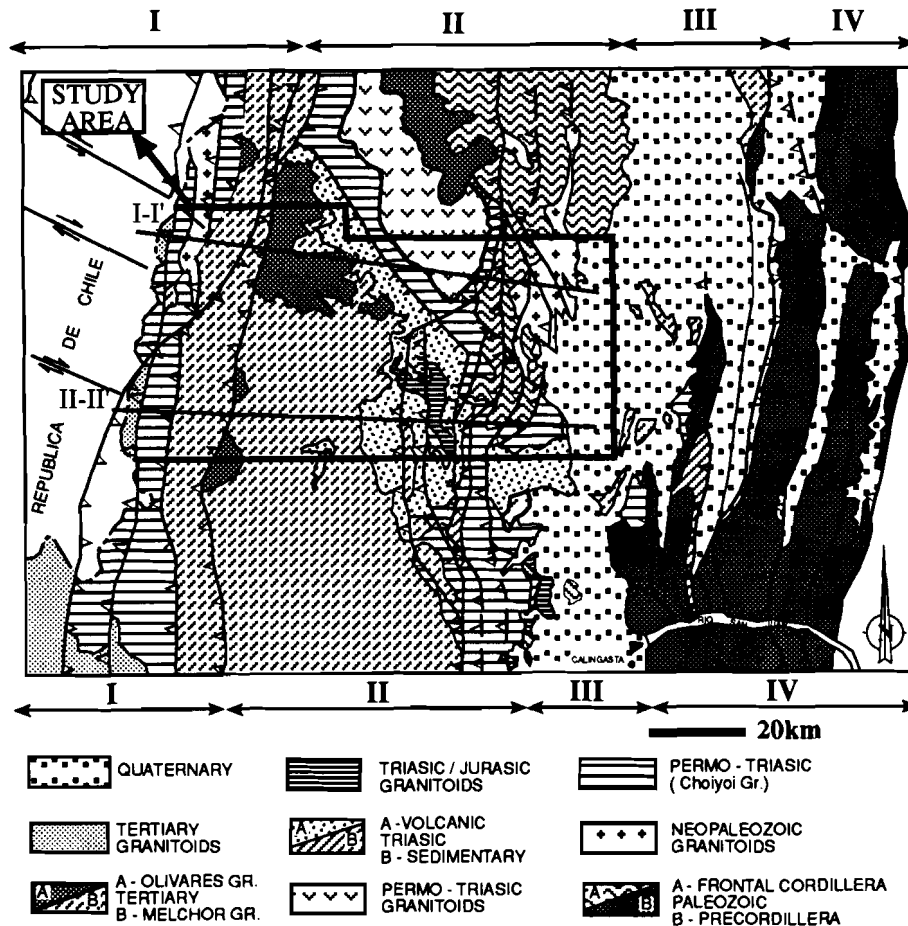


Fig.1.- Geological sketch map with location of study area.
I-Principal Cordillera. II- Frontal Cordillera. III- Rodeo-Calingasta Basin.
IV- Precordillera

Although it was not possible to restore the Gondwanic deformation, we were able to estimate the shortening of some minor structures. The calculated shortening is up to 70% in some duplex structures in the Atutia river area using a bed-length balance method. The calculated shortening must not be too different from the regional shortening generated by the Gondwanic deformation.

The Andean Orogenic Cycle

The Andean Orogenic Cycle (Ramos, 1988) is the ultimate responsible of the tectonic construction of the Andean Cordillera. In this cycle we can distinguish two main stages: the first one is an extensional tectonic episode, starting in upper Permian and concluding in the lower Cretaceous; the second one is a compressional tectonic episode, which goes from the upper Cretaceous to the Quaternary.

The extensional stage

In the upper Permian starts an important extensional stage, which generates a significant volcanism (Choiyoi volcanic episode). From the Triassic to the lower Jurassic, this process accelerates, but it slows down in the rest of the Jurassic and the lower Cretacic, and the first marine deposits appear. The deposition area and the Mesozoic sedimentation depocenters migrate to the W, conditioned by the extensional deformation migration in the same direction.

The structures related to the Andean extensional tectonic process are normal faults grouped in bands with a N-S direction (fig. 1). Sometimes we can find normal faults with a NO-SE direction, which represent transfer zones.

The normal faults are listric, merge in a common detachment level dipping to the W. In the cross section I-I' and II-II' (fig.2) we can observe the Andean extensional prism geometry, with the

Gondwanic basement dipping to the W, and at the same time, each fault-block dipping to the E. This geometrical configuration defines a half-graben model and determines the existence of an important Gondwanic basement outcrop in the E of the studied area (Tocota Horst). We must remark the presence of Jurassic sediments in the W side of the Cortadera Fault (fig. 2). This fact shows that the Cortadera Fault represents the limit between the two main paleogeographical and structural domains of the Andean Cordillera in this area: the Cordillera Frontal and the Cordillera Principal.

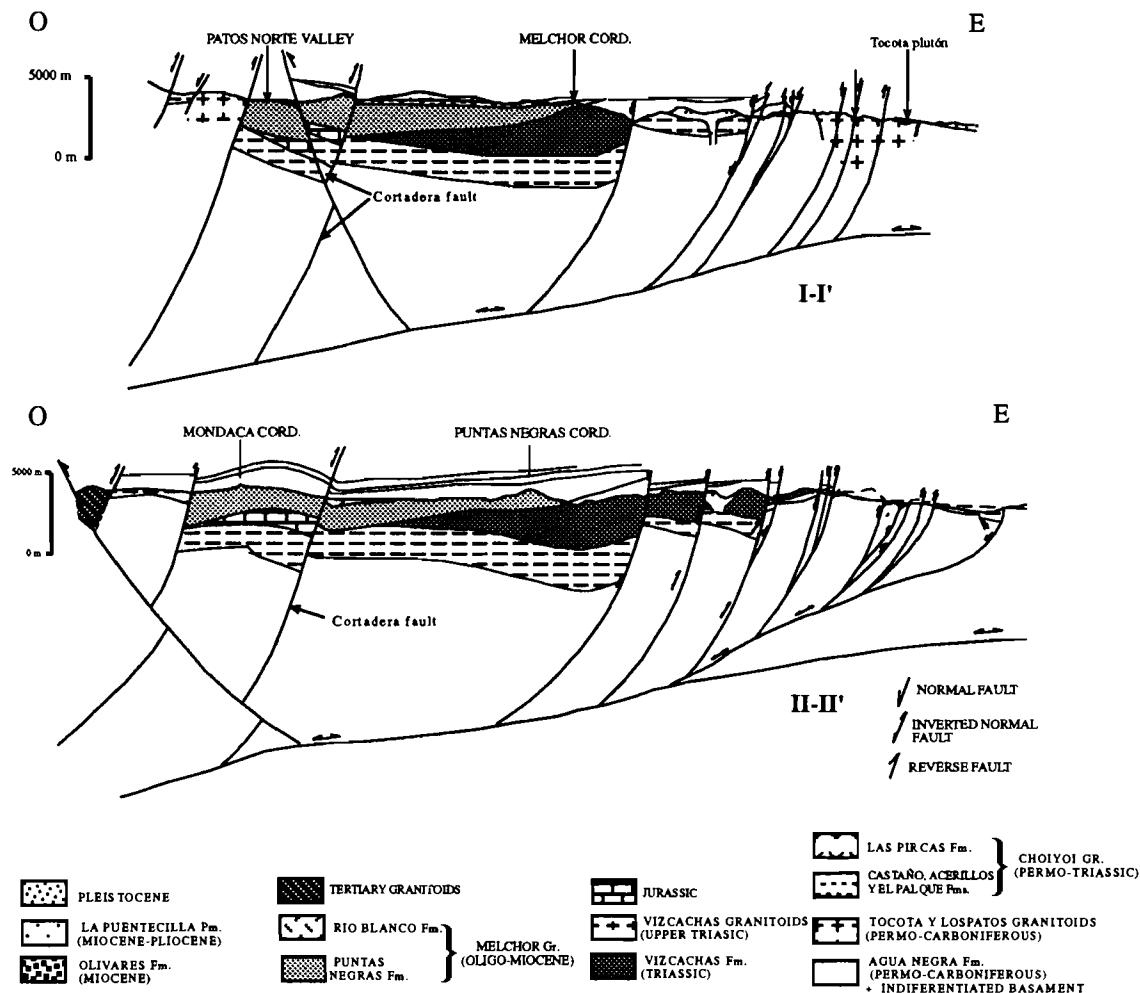


Fig. 2.- Geological cross sections. For location see Fig. 1.

The compressional stage

The Andean compressional stage starts in the upper Cretaceous in the same latitude in Chile (Legarreta and Uliana, 1991). However, in the studied area, it probably starts in the Oligocene, which is the age of the first synorogenic sediments (Melchor Group). The Melchor Group lays unconformably over the preorogenic successions and the Gondwanic basement (fig. 2), and its depocenters migrate from the W to the E, opposite to the extensional stage depocenters. The geometrical configuration of the Melchor Group is determined by the extensional structure and the erosion surfaces developed over the different fault-blocks from the Jurassic to the Oligocene. In the upper edge of the fault blocks the Melchor Group rests on the lower Andean units (cross sections I-I' and II-II', fig. 2); and in the E of the studied area, it even rests on the Gondwanic basement.

The most important compressional structures are reverse faults and thrusts, and scarce related folds. Most of the faults are generated by the inversion of the extensional faults during compressional tectonics process. However, some faults formed later cut the pre-existing faults (fig. 1 and 2). The observation of different kinematic markers shows an East tectonic transport direction for the Andean compressional structures.

The inversion ratio of the reverse fault measured in the Tertiary sinorogenic rocks is usually less than 1 km. The crustal shortening calculated in the cross section I-I' and II-II' (fig. 2) is of about 8%. This fact contrasts with the more than 50% calculated shortening of the Precordillera unit (Gosen, 1992). All this shows that most of the crustal shortening of the Andean Cordillera at the compressional stage has been transferred to the Precordillera unit through the lower detachment fault. This facts also show that the Cordillera Frontal unit is an uplift block in which the estensional structures have been preserved, and that the Rodeo-Calingasta basin is of piggy back type.

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