Structural setting of the Cordillera Oriental of the Central Andes at 25°S: Tectonic and magmatic implications

V. Acocella [1], L. Vezzoli [2], R. Omarini [3], M. Matteini [3], & R. Mazzuoli [4]

[1] Dip. Scienze Geologiche, Università Roma Tre, Italy,
[2] Dip. Scienze Chimiche e Ambientali, Univ. degli Studi dell'Insubria, Como, Italy
[3] Facultad de Ciencias naturales, Universidad Nacional de Salta, Argentina.
[4] Dip. Scienze della Terra, Univ. degli Studi di Pisa, Italy

Introduction

The N-S trending Cordillera Oriental of the Central Andes, at a latitude of 25°S, marks the transition between the Puna-Altiplano plateau, to the west, and the Brazilian shield, to the east. Most of the tectonic evolution of the Cordillera Oriental is related to the Mio-Pliocene compressional phase which affected, migrating eastwards, the eastern portion of the Andes (Marrett and Allmendinger, 1994; Strecker and Marrett, 1999; Riller et al., 2001). The Cordillera Oriental also constitutes the outcropping area of the easternmost volcanic products associated with the convergence of the Nazca-South American plates. In fact, volcanic activity in the Central Andes is mostly focused, at this latitude, along the N-S trending volcanic arc and, to the east, along major NW-SE trending structures. One of these, the Calama-Olocapato-El Toro (COT) can be traced for more than 300 km to the east of the arc, until the border of the subandean zone in the Cordillera Oriental. Its presence is marked by the NW-SE alignment of Miocene magmatic centres (Matteini et al., 2002a; Matteini et al., 2002b).

Defining the structure of this portion of the Andes is crucial to understand the tectonic style of deformation and how tectonic and magmatic processes are related with each other at significant distances to the back of volcanic arcs in continental collision settings.

This study therefore aims at defining the structural setting of the Cordillera Oriental, in order to better understand the following issues: (1) the tectonic style affecting the Cordillera Oriental; (2) the nature of the easternmost part of the COT; (3) the relationships of the structures in the Cordillera Oriental with volcanic activity.

For this purpose, field work (geological survey and structural analysis) has been carried out in the area of the Cordillera Oriental. This is supported by petro-chemical analyses and age determination of the volcanic rocks outcropping in the area.

Results

The collected data show that the Miocene-Quaternary evolution of the area has been affected by 2 main types of structures, with a N-S and NW-SE orientation. The N-S structures are focused in narrow zones of intense deformation and mark the borders of the main structural blocks in the Cordillera Oriental. To the east, these structures are associated with a larger reverse component of displacement, forming important thrust systems which border the main structural blocks. To the west, the reverse component decreases, being replaced by an

increasing dextral component; therefore, the main N-S systems in the Cordillera Oriental are transpressive dextral. Evidence of extension locally superimpose over previous transpression.

The NW-SE structures are more widespread and spaced with regard to the N-S systems. These structures show a clear left-lateral component, even though a clear extensional reactivation has been observed.

Magmatic activity was associated with both N-S and NW-SE structures between 13 Ma and 6 Ma. The major magmatic complex (e.g. Negra Muerta and Las Burras) are located, along the COT, in correspondence with the N-S structures, where these exhibit a significant strike-slip component of movement.

Discussion and Conclusions

The collected data suggest the following points.

1) The recognized compressional and strike-slip motions can be interpreted in the frame of a westward constant progression from compressional to dextral motions across the Cordillera Oriental; this can be related to the slightly oblique convergence (about 20°) between the Andean crust and the strong Brazilian shield. The obliquity of this convergence can account for such a partitioning of the deformation, into compression and strike-slip motions at the back of the Andes.
2) This partitioning founds its counterpart to the west of the volcanic arc, where compression and dextral shear are partitioned, as a consequence of oblique convergence, at the front of the Andes. Therefore, the Andean chain seems to be affected, at this latitude, by a symmetric structural style, resulting from the compressional structures at the front and the back, shifting into dextral motions in an innermost position.
3) The easternmost location for volcanic activity, along the COT, is found in correspondence of the eastward limit of the strike slip structures. This coincides with the Las Burras monzogranite, emplaced along a releasing bend formed by N-S trending dextral structures. More to the east, where the strike-slip component fades and pure compression is found, no volcanic activity is observed.

References

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