SEDIMENTARY REGISTER OF THE CENOZOIC DEFORMATION OF THE WESTERN BORDER OF THE ALTIPLANO IN THE NORTHERN CHILE (REGION OF TARAPACÁ, 19°00' - 19°30')

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INTRODUCTION

Along the west side of the 3.500 - 4.500 m high Altiplano plateau, in northern Chile between 15° and 27° South latitude, there are thick Early to Late Miocene sedimentary series that register the tectonic evolution of the plateau. In this paper we describe: a) the substratum of the sedimentary series, b) a regional flexure (Moquella Flexure), which is part of the west-vergent thrust system (Muñoz and Sepúlveda, 1992; Muñoz and Charrier, 1996; García et al., 1996) and is well exposed in the Moquella region (19°08'-19°27'S / 69°20'-69°50' W), c) the geometry, composition and fabric of the associated syntectonic deposits, and intend to establish the chronology of the described events, and to reconstruct the tectonic evolution of this region and its implications for the uplift of the Altiplano.

THE DEFORMED SERIES

a) *The substratum.* The substratum consists of folded mesozoic continental sedimentary deposits with some andesitic intercalations intruded by rhyolitic and granodioritic stocks, correlated with the Cretaceous Cerro Empexa Formation (Camus and Fam, 1971) and the late Oligocene ? - early Miocene Altos de Pica Formation an equivalent of the Oxaya Formation (Montecinos, 1963), which unconformably covers the Mesozoic rocks.

The Altos de Pica Formation (Galli and Dingman, 1962) forms in the study region an approximately 400 thick series composed of ash tuffs with polymictic volcanic intercalations of conglomerates and sandstones. K/Ar age determinations on biotite from two tuffs in the upper levels of the unit gave 21.7 ± 0.6 Ma (Naranjo and Paskoff, 1985) and 19.3 ± 0.8 Ma (Pinto, in publication). North of the study region an ignimbrite in the lower levels of the Altos de Pica Formation gave a 25 Ma age (García and Hérail, this symposium).

b) *Moquella Flexure* (or monoclinal: see Muñoz and Sepúlveda, 1992; Muñoz and Charrier, 1996). Deformation in the Altos de Pica Formation and older units in this region corresponds to the west-verging and N20°W trending Moquella Flexure (Fig. 1). This structure, exposed along 13 km between Suca (in the North) to Retamilla (in the South) valleys, deforms a regional gently west dipping slope formed by the top the Altos de Pica Formation. The throw along this flexure of ca. 300 m generated a depressed area to its west side that was filled by the products of the erosion developed on the east side of the flexure. The lowermost layers of the Altos de Pica Formation exposed in the core of the flexure form a chevron fold, suggesting the existence of an east-dipping thrust fault in the underlying Mesozoic substratum. The northward prolongation along strike coincides with the Ausipar Fault (Muñoz and Charrier, 1996; García and Hérail, this symposium), indicating its close association to the west-vergent thrust system exposed along the west border of the Altiplano.

c) *The syntectonic deposits.* In the zone we differenciated on the basis of their distribution, composition and grain-size three westward fining units associated to activity of the Moquella Flexure. These units were deposited on the front west side of this structure.

The basal unit or **Lataguálla Formation** (Pinto, in publication) is composed in the lower levels by matrix supported, polymictic volcanic conglomerates, and sandstones, whereas in the well stratified upper levels it is composed by rhyodacitic volcanic sandstones. Abundant pumice matrix is present throughout the sequence. Acidic components in this unit were originated by erosion of the Altos de Pica Formation. To the West, the Lataguálla Formation forms an approximately 300 m thick sedimentary series. The thickness decreases to the East, where it overlies the flexured Altos de Pica Formation (Fig. 1). An ignimbritic deposit intercalated in the upper levels of the Lataguálla Formation gave a 16.2 ± 0.7 Ma age (Muñoz and Sepúlveda, 1992).

The second unit, overlying the Lataguálla Formation, is the **Transition Sequence** (Pinto, in publication) composed by a lower volcanic member that interfingers with an upper sedimentary member. The volcanic member, exposed to the east of the Moquella Flexure (Fig. 1), corresponds to a 200 m thick and 16.3 ± 0.6 Ma old (Muñoz and Sepúlveda, 1992) rhyodacitic ignimbrite. The ca. 80 m thick sedimentary member, located to the west of the Moquella Flexure (Fig. 1), is composed by very fine conglomerates and sandstones composed by pumice and andesite fragments.

The third unit or **El Diablo Formation** (Tobar et al., 1968) overlies the Transition Sequence and corresponds to a sequence of predominantly very coarse andesitic gravels and scarce gravelly sands. This deposits forms a wedge: the thickness of which decreases from West to East from ca. 300 m to 0 m next to the flexure (Fig. 1); in addition, from North to South its thickness increase from 50 m to 300 m. Before deposition of the El Diablo Formation strong erosion affected the Lataguálla Formation in the south part of the study region. The lower layers of the El Diablo Formation form successive systems of westward prograding alluvial fans. The upper layers of the El Diablo Formation, that fill-up the depressed area west of the Moquella Flexure, are in onlap the west-dipping slope of the flexure and cover the East side of this structure (Fig. 1). K-Ar age determinations on an andesitic lava that overlies the El Diablo Formation (Fig. 1) gave 9.0 ± 1.0 Ma (Naranjo and Paskoff, 1985) and 8.2 ± 0.5 Ma (Muñoz and Sepúlveda, 1992). This lava is slightly eroded to the East of the Moquella Flexure, suggesting a slight activity of the flexure after 9 Ma.

CONCLUSION: SEQUENCE OF THE DEFORMATION

The deformation in the western border of the Altiplano at 19°15' S is represented by the Moquella Flexure which was active between 19 Ma and 9 Ma. Its activity is represented by the following syntectonic deposits: Lataguaila Formation, Transition Sequence and El Diablo Formation. The compositional differences in these units indicate different source rocks for the sediments.

The first phase of deformation (ca. 19 Ma) flexured the Altos de Pica Formation, generating an uplifted relief to the East that represented the source of the sediments accumulated in the depressed area developed to the west of the flexure. The Lataguaila Formation was generated during this phase (ca. 19-16 Ma). The second phase (ca. 16 Ma) is represented by a rhyodacitic and andesitic volcanic activity that generated the volcanic deposits covering the relief formed in the first phase that since then has been eroded. The erosion of these volcanic deposits provided the components of the Transition Sequence. Finally, deposition of the El Diablo Formation (ca. 16-9 Ma) was characterized by a great supply of andesitic component coming from andesitic volcanic centers located to the East. The higher volume of materials represented by the El Diablo Formation relative to the Lataguaila Formation (Fig. 1), that indicates a higher storage capacity of the depressed area to the west of the flexure, and the high energy environment represented by the lower levels of El Diablo Formation suggest the existence of a higher period of activity along the Moquella Flexure, shortly after 16 Ma, while the onlap geometry of the upper levels suggests a later slowing of the deformation near 9 Ma.

The Moquella Flexure like was produced by the activity of a blind west-vergent thrust fault affecting to the Mesozoic substratum.

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