EVOLUTION OF THE CORDILLERA DE LA SAL, NORTHERN CHILE

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Resumen

En la depresión del Salar de Atacama, la sedimentaciòn es de abanicos aluviales y playas con intercalaciones piroclásticas dacíticas y riodacíticas desde el Oligoceno. El orìgen de la cuenca y la deformación sinsedimentaria presente en la Cordillera de la Sal se deben a una tectónica de deplazamiento sinistral en fallas paralelas al rumbo del orógeno.

Key Words: Andes, Salar de Atacama depression, Cordillera de la Sal, continental red beds, transpression.

Geographical and geological setting

The narrow Cordillera de la Sal (CDS) fold belt is situated in Northern Chile (II. region) within the endorheic "Salar de Atacama depression", which is part of the Preandean depression, a morphological low between the Chilean Precordillera and the Western Cordillera of the Andes (fig. 1). At the present time the Western Cordillera represents the western part of the modern magmatic arc; the position of the Preandean depression is therefore an unusual one between the magmatic arc and the forearc region. Nevertheless it is considered an intraarc basin. Its actual marginal position with respect to the modern magmatic arc is probably due to the effect of the eastwards shifting of the position of the magmatic arc in time (REUTTER et al. 1988).

Stratigraphy

The CDS is mainly built up by red beds and evaporites of the Oligo-/Miocene **San Pedro Formation** (SPF) with an exposed thickness of >3,000 m.

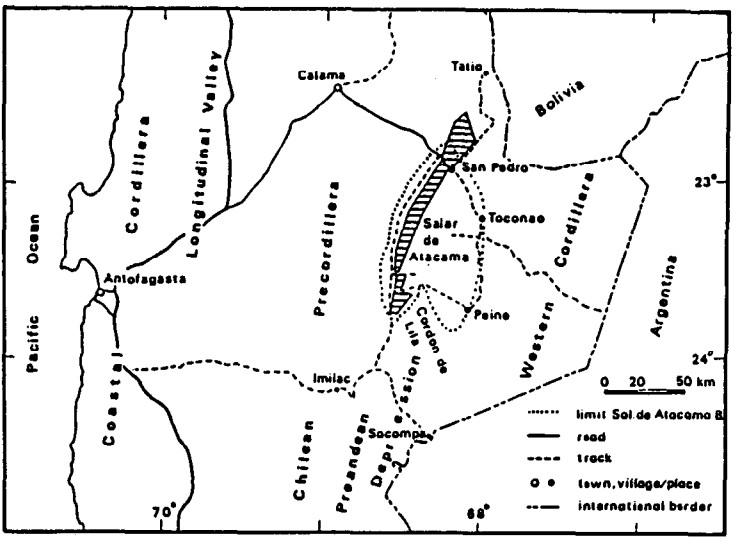

Fig. 1 Location map and main structural units; working area hatched.

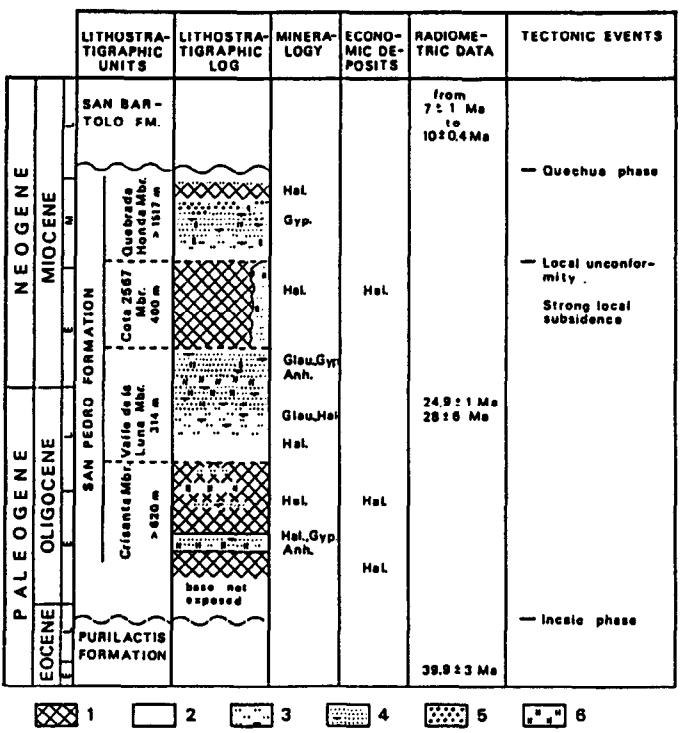

Fig. 2 Stratigraphic data of the San Pedro Fm.; radiometric data according to MARINOVIC & LAHSEN (1984) and RAMIREZ & GARDEWEG (1982). Lithology: 1: halite; 2: mudstone; 3: siltstone; 4: sandstone; 5: conglomerate; 6: tuff.

The stratigraphic section presented in fig. 2 has been measured in the CDS in the Valle de la Luna area at about 23° S. In contrast at 23° 30' S seismic investigation (TOWNSEND, 1988) indicate only 450 m.
The stratigraphic record in the CDS and its surroundings is characterized by rapid lateral changes of thickness and lithology. For this reason and owing to a complicated deformational style a reliable lithostratigraphic correlation between the different portions (see FLINT, 1985) of the about 150 km long outcrop area of the SPF seems to be impossible.
Within the SPF frequent intraformational breccias, slumping horizons, spectacular increases of thickness over short distances and angular unconformities indicate synsedimentary tectonics. At Oligocene time an intensive dacitic to rhyodacitic volcanism starts. Towards the west the evaporites of the SPF are interfingering with conglomerates and sandstones of the Tambores Fm.
The **San Bartolo Group** (0 - >100 m), mostly unconformable, on top of both San Pedro- and Tambores Fm., is built up by a sequence of Upper Miocene ignimbrites with intercalated conglomerates and sandstones.
The **Vilama Fm.** (0 - 80 m) of a Late Miocene - Pleistocene age, mostly concordant on top of the San Bartolo Group, contains conglomerates, sandstones and pyroclastics.

Facies Interpretation

The sediments of the SPF, San Bartolo Group and Vilama Fm. were deposited under similar arid conditions within alluvial fan/playa systems, strongly influenced by volcanic activity. Owing to the very low bromine content in the halites a marine origin of the salts can be excluded.

Tectonics

The most evident tectonic elements are:
- NNE/SSW trending folds with doubly plunging axes. The fold axes display a sinoidal bending, locally evolving towards an "en échelon" grouping. SE-vergency prevails, but there is also a tendency towards divergency, and recumbent folds occur at both margins of the CDS.
- A very complex pattern of near-vertical small-scale faults (normal, reverse and strike slip, mostly sinistral)
- NNE/SSW trending low-angle reverse faults, mostly with an ESE thrust direction, but also the opposite heading is present. Such low-angle reverse faults, sometimes with overthrusts of more than 100 m on top of loose gravels are common outside the CDS near the margins of the Salar de Atacama depression (HOOPER & FLINT, 1986). They evolve over short distances from monoclinal folds.
- Vertical tension fissures, well preserved especially in the conglomeratic Tambores Fm. (N/S) and the Ignimbrites of the San Bartolo Group (NW/SE).

There is good evidence for repeated tectonic syndepositional movements from Oligocene/Miocene time up to the present.

Palaeogeographic and geodynamic interpretation

The Salar de Atacama depression has existed at least since Late Oligocene time as an endorheic evaporative basin. It has been fed mainly by alluvial fans deriving first from W to NW and for the uppermost portions of the SPF from N, whereas a transport from E has not been observed. This trend continues to Plio-/Pleistocene. As a consequence, in this region a very young uplift of the Western Cordillera to its present high seems most probable.
The origin and the observed sedimentary and tectonic pattern of the Salar de Atacama depression fit best with the assumption of sinistral strike slip movements combined with compression (HOOPER & FLINT, 1986; FORSYTHE & TOSKOS, 1988; WILKES & GÖRLER, 1988). The decreasing tendency of total thickness, age and intensity of deformation of sediments from N towards S could be a hint to the development of a pull apart basin. A transpressional regime is documented in the "flower structure" of the CDS.

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