TECTONIC INTERPRETATION OF MESOSCOPIC STRUCTURES IN A HIGH STRAIN SHEAR ZONE OF THE ATACAMA FAULT SYSTEM, COASTAL RANGE, NORTHERN CHILE.

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RESUMEN: Se estudia una zona de cizalle ductil pertenciente al Sistema de Falla de Atacama. La zona contiene buenos indicadores cinemáticos mesoscópicos para inferir movimientos transtensionales en el Jurásico-Cretácico inferior. Los desplazamientos son sincinematicos con el emplazamiento de un cuerpo plutónico (Plutón de Cerro Cristales).

KEY WORDS: Kinematic indicators, transtensional strike-slip fault, magmatic arc, Jurassic-Cretaceous boundary.

INTRODUCTION

The Atacama Fault System (AFS) is exposed in the Coastal Range of northern Chile. Its shows fault rocks (mylonites and cataclasites), that are an expression of the paleotectonic movements along of the Coastal Range. The fault rocks are exposed as a N-S trending belt between 22° und 29° S (URIBE & NIEMEYER 1984, SCHEUBER & ANDRIESSEN 1990, BROWN et al. 1991). Radiometric dating of mylonites of the differents segments of the AFS demonstrates that the AFS was active during the Upper Jurasic-early Cretaceous (NARANJO et al. 1984, HERVE 1987, SCHEUBER & ANDRIESSEN 1990). Kinematic reconstructions show that the AFS acted as a zone of sinistral strike-slip faults caused by oblique convergence between the Pacific Aluk Plate and the South American Plate. However, according to preliminary results of structural observations carried out in a ductile shear zone in the AFS between 23°55' and 24°11' S, the AFS displays, in addition, mylonites with kinematic indicators of vertical movements. This shows that the history of the desplacements along the AFS is not yet fully understood.

GEOLOGICAL SETTING

The Coastal Range in the study area is composed mainly of plutonic rocks and andesitic lavas (Formación la Negra, GARCIA 1967). The plutonic rocks consist of gabbros, diorites and granodiorites that have an age range from early Jurassic to early Cretaceous, while the age of the volcanic rocks is confined to the Jurassic. The scarce sedimentary rocks of the area are represented by the Caleta Coloso Formation of early Cretaceous age (GARCIA 1967).

Brittle faults form the boundaries between units corresponding to blocks of differents structural levels. An example is the Caleta Coloso Fault that exhibits, in the western block, plutonics rocks that shows deformational characteristics of a deep level, while lavas and sedimentary rocks are exposed in the eastern block. The rocks of the western blocks are transected by a N-S trendig ductile shear zone, about 400 m wide, that can be followed for 12 km. It forms the western boundary of the Plutón Cerro Cristales (PCC). The rocks on western side of this shear zone are lavas of the La Negra Formation and plutonic rocks of Jurassic age (mainly gabbros and diorites).

The shear zone contains mylonites that were formed and recrystallized under middle to upper amphibolite-facies conditions. The rocks of the PCC of the eastern side of the shear zone display a magmatic flow orientation wich is overprinted by solid-state deformation: The magmatic flow structures are revealed by preferred orientation of plagioclase crystals that have weakly developed core and mantle structures. At the mesoscopic scale, the magmatic flow is expressed by a well developed steeply dipping foliation that is parallel to the mylonitic foliation and the contact between the PCC and the ductile shear zone. This suggests that the emplacement the PCC was synkinematic with the displacement along the shear zone. This means that the AFS in this segment was activity during the development of the magmatic arc of the Jurassic-early Cretaceous.

The mylonitic rocks show granoblastic and lepi-nematoblastic textures suggesting strong recrystallitation that has obliterated the primary tectonic structures. For this reason the sense movement can not be determined using microscopic kinematic indicators. On mesoscopic scale, however, the shear zone contains a variety of kinematic indicators that permit the reconstruction of the displacement history.

MESOSCOPIC KINEMATIC ANALYSIS

The mylonitic rocks show an intense steeply dipping foliation with not only subhorizontal stretching lineations, but also steeply plunging to vertical stretching lineations. The orientation of the lineation changes systematically at a deflection of the shear zone in its southern segment, where the N-S trend of the foliation changes abruptly to an E-W direction. The mylonitic rocks in the northern segment (foliation N-S) have subhorizontal lineations, parallel to the western boundary of the PCC, with a variety of kinematic indicators (asymmetric extensional crenulation cleavage, sigmoidal foliation, asymmetric foliation boudinage) all evidencing sinistral displacement. The mylonites on the southern segments have steeply

plunging lineations toward the PCC, with kinematic indicators (asymmetric extensional crenulation clivage, sheat folds, asymmetric foliation boudinage), which show that the NE-side was displaced downward, correspondingly to the displacement in a normal fault.

In both segments strain markers (chocolate tablet boudinage in basaltic dykes, ptygmatic folds in quarz-feldspar veins) indicate strong shortening perpendicular to the mylonitic foliation. Thus, a deformation in a advanced state with both simple shear and pure shear can be deduced, and a mechanism of sub-simple shear deformation (SIMPSON & DE PAOR in press) is suggested for this shear zone. The asymmetric extensional crenulation cleavage was produced when the principal axes of the strain ellipsoid were almost parallel to the limits of the shear zone.

TECTONIC INTERPRETATION

The shear zone at the western border of the Plutón Cerro Cristales represents a transtensional strike slip fault which was active contemporaneously with the emplacement of the pluton at the Jurassic-Cretaceous boundary (according to radiometric datings by SCHEUBER & ANDRIESSEN 1990). The movements were determined by sinistral slip and additional vertical normal slip in the southern segment, where the shear zone changes its direction. The tectonics which produced the described structures in a deep crustal level caused, at the surface, the opening of a sedimentary basin which gave rise to the clastic sedimentation of the Caleta Coloso Formation (Titonian-Neocomian, GARCIA 1967).

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