TRANSPRESSIONAL MOTIONS ALONG THE CORDILLERA OCCIDENTAL – COASTAL BELT BOUNDARY SINCE THE LATE CRETACEOUS (SOUTHERN PERU, 16° S)

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INTRODUCTION

The study area is located in southern Peru NW of the city of Arequipa (16° S) at the boundary between the Cordillera Occidental and coastal belt. Previous studies sustain that exists in the area a large overthrust, named the Cincha-Lluta overthrust (Vicente et al., 1979). Recent studies realized in the Huambo (32-r) (Romero & Ticona, 2002; Cruz, 2002) and Aplao (33-r) sheets permit to observe NE-vergent thrusts (areas of Andamayo and Ayo). To the SW, however, in the Majes valley (areas of Aplao and Santa Elena), SW-vergent thrusts are observed. In the central areas of Andamayo and Aplao, faults are subvertical and display evidence of senestral motions, affecting rocks of the Coastal. This work presents the results of an integrated regional study that permits to better understand which tectonic, sedimentary and magmatic processes occurred in the area. We interpret the mentioned fault system as a large flower-structure, which resulted from transpressional motions.

STRATIGRAPHY

The study area displays Proterozoic to Quaternary rocks (Fig. 1). The basement consists of gneisses and micaschists, that yielded 1811±39 y 1900 Ma (Cobbing et al., 1977). It is overlain by the Ongoro Fm (Devonian?), composed of schists, slates and sandstones. **The Mesozoic** consists of: the Chocolate Fm (Early Jurassic; conglomerates, volcanic breccias and flows); the Socosani Fm (Toarcian-Bathonian; limestones); the Yura Group (Callovian-Neocomian), with its Puente Fm (sandstone-shale), Cachios Fm (shale), Labra Fm (sandstone-shale), Gramadal Fm (shale-limestone) and Hualhuani Fm (sandstone); the Murco Fm (Barremian-early Albian), composed by mudstones and sandstones; the Arcurquina Fm (middle Albian-Turonian; limestones); the Seraj Fm (Senonian-Maastrichtian?; sandstones, shales, limestones, gypsum, conglomerates). **The Cenozoic** consists of: the Huanca Fm (Middle Eocene – Early Oligocene), which crops out in the NE and

includes the Querque (volcanic-clast conglomerates), Huasamayo (sandstones) and Tarucani (polymictic conglomerates) members; to the SW, the Sotillo Fm (Eocene-Oligocene) is coeval with the latter, and consists of mudstones and sandstones; the Tacaza Group (Miocene) is composed by tuffs, and the Barroso Group (Pliocene-Pleistocene), by volcanic breccias and flows; the Quaternary deposits include the notable Andahua Group (Pleistocene), which consists of andesites and basaltic andesites.

INTRUSIVE ROCKS

The plutons that crop out in the central part of the study area belong to the Coastal Batholith and include granites, granodiorites, tonalites and diorites. Isotopic dates from near the study area (Weibel et al., 1978), range between 97 ± 4.0 and 58.9 ± 2.0 Ma. In the NE area, two plutons (granite-tonalite) are assigned to the Eocene.

STRUCTURAL GEOLOGY

In the study area, folds are mainly observed to the NE, being of kilometric scale with tight to locally recumbent flanks. To the north, the main structure are: the NW-SE, NE-vergent, Jasmin reverse fault, which puts the Arcurquina Fm onto the Huanca Fm; and the NW-SE, NE-vergent, Andamayo reverse fault, which puts Paleozoic-Proterozoic and intrusive rocks against Mesozoic strata; these two faults correspond to the so-called Cincha-Lluta overthrust. In the central part of the area, two faults are noteworthy: the WNW-ESE-trending Santa Rosa fault is a strike-slip fault with a reverse component that uplifted the basement; and the NW-SE-trending Ongoro fault is a senestral strike-slip fault that uplifted Coastal Batholith plutons. To the SW, the NW-SE-striking Cosos and Santa Elena faults are SW-vergent reverse faults that thrust strata of the Yura Group onto Cenozoic rocks.

SEDIMENTARY AND GEODYNAMIC EVOLUTION

In the study area, the Late Cretaceous – Oligocene interval can be divided into two tectonic periods, during which distinct sedimentary environments were originated, in association with peculiar magmatic processes. **First period (Late Cretaceous - Early Eocene)**. After deposition of the lower part of the Arcurquina Fm, probably in an extensional context (Fig. 2), the accumulation of its middle and upper parts possibly corresponded to the onset of a transcurrent tectonic regime, in relation with the onset of the abundant magmatism recorded by the Coastal Batholith, for which a date of 97 ± 4.0 Ma is registered (Weibel et al., 1978). In the area, mainly dextral displacements on local faults increase after the Senonian, creating space for the emplacement of large plutonic masses. The Seraj Fm is deposited to the NE, while to the SW the thick volcanic Toquepala Group accumulates (Fig. 3), indicating a progressive increase in magmatic activity. This suggests that the volcanic-clast conglomerates of the Seraj Fm (Querque Member) probably reflect a Paleocene paroxysm that occurred in a large part of the study area. Dextral displacements may be related to the convergence of the Nazca and South American plates: between anomalies 30-31 and 21 (≈ 68 and 49 Ma), the mean direction of convergence was NNE-SSW (Pardo & Molnar, 1987). On the other hand, in central Peru Bussell (1983) showed that dextral displacements developed within the Coastal Batholith between 69 and 65 Ma. **Second period (Middle Eocene - Oligocene)**. In the Middle Eocene, the study area underwent a change in tectonic context. Displacements on

faults were now senestral with a reverse component, generating the Huanca basin and the deposition of the Querque Member; these motions would have progressively uplifted the Coastal Batholith plutons. In the Late Eocene, reverse displacements were less important, as suggested by the Huasamayo Member deposits. In the Early Oligocene, the Tarucani Member deposits suggest that displacements on faults in the NE area were principally reverse and NE-vergent, which uplifted Paleozoic-Proterozoic and Coastal Batholith rocks. In the SW area, displacements were reverse and SW-vergent, albeit of a lesser amplitude, as suggested by the Sotillo Fm. These motions can be related to the change in convergence direction between the Nazca and South American plates: between anomalies 21 (≈ 49 Ma) and 13 (≈ 35 Ma) the average convergence direction was N 67° E, and would have generated senestral displacements on NW-SE faults, as well as the Huanca basin, which can be interpreted as a pull-apart (Cruz, 2002). From the Miocene to the Recent, the average convergence direction was N 76° E, and the latter system was maintained. This evolution has resulted in the present configuration, formed by a large positive flower-structure generated by faults with mainly senestral displacements and reverse components (Fig. 3).

CONCLUSIONS

The regional Early Cretaceous tectonic context was probably extensional or transtensional. The Late Cretaceous-Paleocene magmatism (Coastal Batholith - Toquepala Group), at least in the study area, occurred probably in a dextral transcurrent regime; dextral displacements would have produced the necessary spaces for the emplacements of these enormous magma masses. The last motions of this fault system were transpressional, senestral with reverse components, and resulted in the observed large positive flower-structure.

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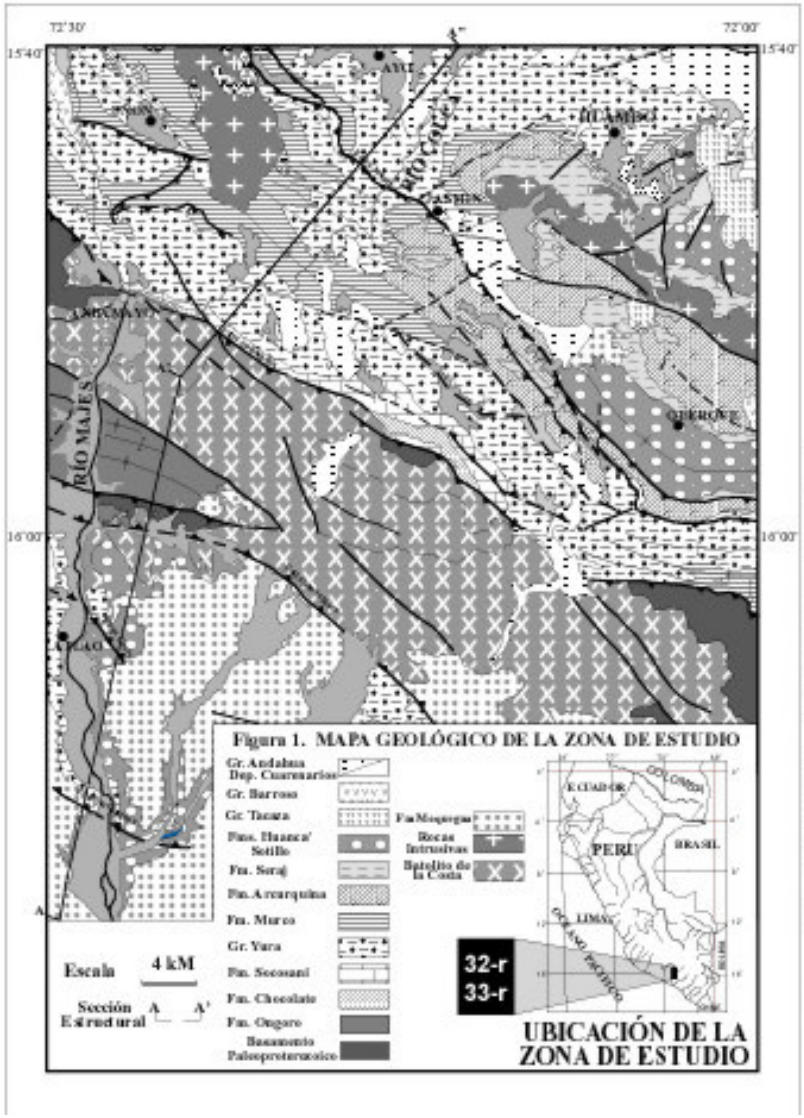

Figura 1. MAPA GEOLÓGICO DE LA ZONA DE ESTUDIO

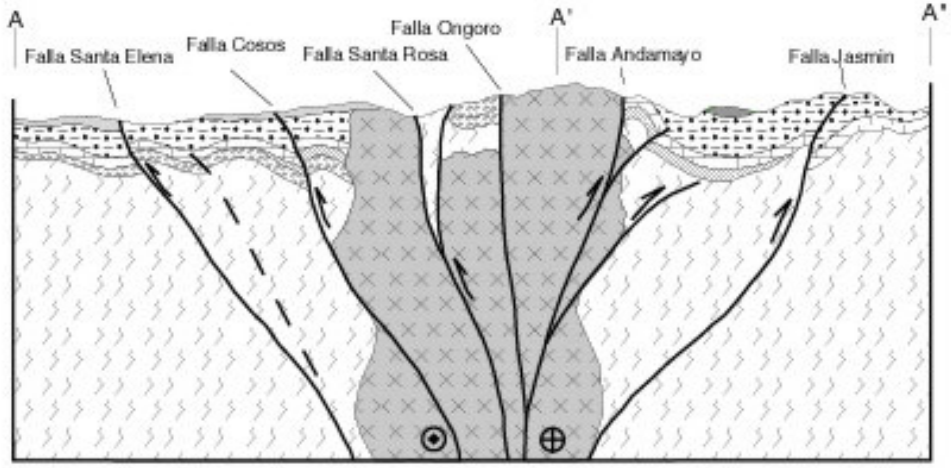

Figura 3. Sección Estructural A-A'-A". En la actualidad

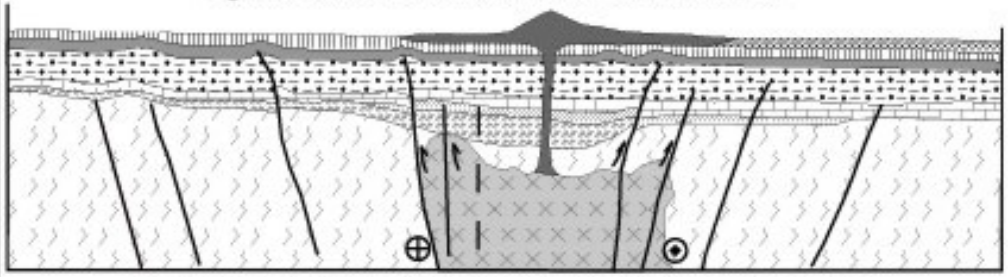

Figura 2. Sección reconstruida para el Cretácico superior - Paleoceno

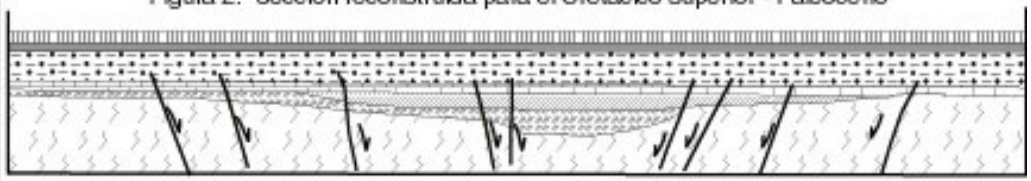

Figura 1. Sección reconstruida para el Albiano medio - superior