

## JURASSIC TO LOWER EOCENE TRANSTENSIONAL TECTONICS IN THE ARC AND BACK-ARC OF THE ATACAMA REGION, CHILE.

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### INTRODUCTION

Studies of the kinematic and chronologic history of the Jurassic-Lower Cretaceous Andean arc between 25° and 27° S, in combination with the recognition that magmatism and deformation were coeval (Brown et al., 1993; Grocott et al., 1994; Dallmeyer et al., 1996), have confirmed that the magmatic arc developed in a wide transtensional setting which involved a change from a ductile dip-slip dominant to ductile strike-slip dominant displacements in the Early Cretaceous (c.130 Ma).

Recently published results on younger rocks farther to the east document the existence of two other events in the Lower Cretaceous back-arc and in the Upper Cretaceous-Lower Eocene arc which were also dominated by dip-slip and by strike slip (Arevalo, 1994; Arevalo, et al., 1994; Arevalo, 1995). These suggest that the extension and/or transtension perhaps intermittently continued within the arc and back-arc until the Lower Eocene. The way that dip-slip and strike-slip were partitioned is matter of current research.

### REGIONAL SETTING

The Copiapó area is located on the west side of the Andes in the central part of the Atacama Region between 27° and 28°S. The area is distinguished by three morpho-geologic elements. From west to east: (1) a coastal range formed by an eastward migrating **Plutonic Arc** of Jurassic-Cretaceous age which intrudes a basement formed by Upper Palaeozoic metasedimentary rocks and Permian intrusions; (2) a central zone with a very thick sequence of Cretaceous volcanic and volcanoclastic rocks and limestones interpreted to have developed in a **Back-Arc Basin** (Coira et al., 1982) and (3) unconformably covering the back-arc association, an eastern zone of Upper Cretaceous-Lower Eocene sedimentary rocks, lava flows and ignimbrites which infilled a system of **Rifts and Calderas** (Arevalo et al., 1994), bounded to the east by the Domeyko-La Terner Fault System.

### THE JURASSIC-CRETACEOUS ARC: A SYNPLUTONIC EXTENSIONAL/TRANSTENSIONAL FAULT SYSTEM

In the plutonic arc many workers (Brown et al., 1993; Grocott et al. 1994 and Dallmeyer et al., 1996) have shown that the emplacement of Lower Jurassic to Lower Cretaceous plutonic complexes was associated with a progressively east-stepping extensional fault system that culminated in the initiation of the Atacama Fault Zone as a mainly strike-slip structure in the Early Cretaceous (c.130 Ma). The construction of the plutonic arc was closely associated with the displacements on syn-plutonic mylonite belts defined by hornblende and biotite schists (Grocott et al., 1994; Dallmeyer et al., 1996) that trend parallel to the north-south elongate pluton margins.

## THE LOWER CRETACEOUS BACK-ARC: A STACK OF EXTENSIONAL ALLOCHTONS

The back-arc is associated with a thick sequence of calcareous and volcanic rocks of Early to Mid-Cretaceous age (Valanginian to Santonian). The basal rocks have been subdivided into five formations: Punta del Cobre, Abundancia, Nantoco, Totalillo, and Pabellón (Chañarcillo Group; Sergerstrom and Parker, 1959) which interfingers with the Bandurrias Formation to the north and south. Both Chañarcillo and Bandurrias units are overlain by the Cerrillos Formation.

The Bandurrias Formation and the Chañarcillo Group constitute tectonic units detached from the Punta del Cobre Formation (parautochthon) by the Punta del Cobre detachment which shows a variety of structures indicative of extension: low angle "young over old" faults and large blocks disposed in extensional domino geometries.

In Sierra de Fraga Region, detachments of unequivocal extensional origin have been described (Mpodozis and Allmendinger, 1993). These have affected the Permian to mid-Cretaceous (Aptian) strata in a broad domain east and southeast of Copiapó, probably during the Late Cretaceous (post Aptian, pre-Campanian), are similar in style to those of the Basin and Range province in the Western United States (Critenden et al., 1980), and have been related to the opening of an aborted marginal basin in Central Chile (Levi and Aguirre, 1981). Deposition of Mid-Cretaceous sedimentary and volcanic sequences (Cerrillos Formation) in the Cerrillos basin immediately inboard (east) of the Lower Cretaceous back-arc basin could reflect subsidence associated with these detachments. The closing of the Cerrillos Basin is associated with an important compressive deformative phase during the Upper Cretaceous indicated by the Cerrillos Thrust and by the Chañarcillo and Lautaro fold and thrust belts, of similar formation age.

## THE UPPER CRETACEOUS-EOCENE ARC: A SYSTEM OF EXTENSIONAL RIFTS AND CALDERAS

The rocks of these periods are mainly related to the evolution of the Hornitos Basin (Arevalo et al., 1994). The basin started as a volcanotectonic depression limited to the west by a system of normal-slip growth faults with a right lateral component of movement where rhyolitic dome complexes were synchronously emplaced. Talus breccias were deposited along the borders of the basin while alluvial conglomerates and lacustrine sandstones and siltstones were deposited toward the centre of the basin. A thick and widespread sequence of high potassium basalts and trachybasalt lava flows infilled the basin. The evolution of the basin finished with a phase of explosive volcanism and lava flows which preserve extraordinarily well most of the primary volcanic superstructure (megacalderas, nested caldera complexes, stratovolcanous).

Synsedimentary structures and geometric features recognized in the basin are compatible with deposition in a dilatational transfer zone between the system of normal growth faults and the southern termination of the Domeyko-La Ternerera Fault System. Both these characteristics, and the bimodal and tholeiitic geochemical behaviour interpreted for volcanic rocks of the same suites in the Salvador region (Cornejo, et al., 1993), imply a regional extensional setting for the Upper Cretaceous-Eocene arc.

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