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Paleogeographic, structural and magmatic evidences for the existence of different lithospheric blocks in the Central Andes: Samples from southern Peru and northern Chile

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INTRODUCTION

The Andes are classically considered to represent the type of orogenic chains resulting from the subduction of an oceanic plate beneath a continental plate. In spite of a considerable literature involving stratigraphic, paleogeographic, structural, magmatic and geophysical data, any model that convincingly explains the modality of the Andean surrection has been emerged. All the current models focused on the importance of the subducting plate and very few considerations on the heterogeneity of continental plate. Paleogeographic reconstructions, structural evidences and magmatic and metallogenic evolution of Southern Peruvian Western Cordillera and Northern Chilean Domeyko Cordillera are used to identify a structure that delineates two different lithospheric blocks.

PALEOGEOGRAPHIC DATA

In Western Cordillera of Southern Peru, two distinct domains, separated by the Cusco-Lagunillas-Mañazo fault system are recognized: the Arequipa basin and the Cusco-Puno high (Fig. 1). The both domains have specific Mesozoic and Cenozoic evolutions. The Arequipa basin is characterized by a thick, marine, Mesozoic sequence (Vicente, 1989). The Cusco-Puno high only displays a thin Mesozoic, mainly marine sequence (Audebaud et al., 1976, Jaillard & Sempere, 1989; Carlotto, 1992-2002). Its main characteristic is the occurrence of a thick Cenozoic, continental red bed sequence (the San Jeronimo Group; Carlotto, 1998; Perelló et al., 2003).

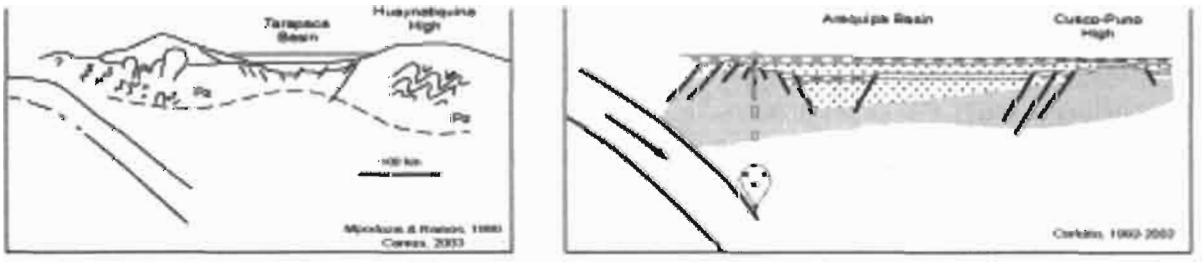

Fig. 1. Jurassic-Early Cretaceous backarc in Northern Chile and Southern Peru

In Domeyko Cordillera of Northern Chile, Two domains, separated by the Bordo Escarpment, are recognized: the Tarapacá basin and the Huaynatiquina high (Fig 1). The Tarapaca basin infill is marked by a thick sequence

of Jurassic and Cretaceous marine carbonates and siliciclastic sediments (Mpodozis & Ramos, 1989). Late Cretaceous and Cenozoic deposits infilling the Huaynatiquina high (Atacama basin: Purilactis Group; Mpodosis et al., 1999, Arriagada, 2003)

STRUCTURAL DATA

The Cusco-Lagunillas-Mañazo fault system and the El Bordo Escarpment system, during the Mesozoic acted as normal fault systems and as reverse transpressive faults during the Cenozoic (Audebaud et al., 1976, Jaillard & Sempere, 1989; Carlotto, 1992-2002, Mpodosis et al., 1999, Arriagada, 2003).

MAGMATIC DATA

During the Eocene, the Andahuaylas-Yauri Batholith (48-30 Ma) was emplaced along the NE margin of the Arequipa basin, and near the Cusco-Puno high (Carlotto, 2002) ending with porphyritic subvolcanic bodies hosting porphyry-type mineralization,

Including the magmatic and metallogenic evolution of both the Andahuaylas-Yauri region (Western Cordillera of southern Peru) and the Cordillera de Domeyko (northern Chile). The geologic evolution of these two segments from the Late Cretaceous to the Eocene follows the same trend, including the emplacement of world-class Eocene-Oligocene copper porphyries in Chile and also important deposits in Peru.

INTERPRETATION

Arequipa and Tarapaca basins display a near identical evolution during Mesozoic and Cenozoic times. (Fig. 2). Their Mesozoic sequences are typical of extensional back-arc basins (Vicente, 1989; Mpodozis & Ramos, 1989). The structural highs in both areas received a continental sedimentary fill with a thickness exceeding 8 km. within a transpressive and compressive context from the Late Cretaceous into the Eocene.

In addition to paleogeographic evidences, the fact that both the Cusco-Lagunillas-Mañazo fault system and the El Bordo Escarpment act since the early late Cretaceous as east-verging reverse faults strongly suggest that a tectonic inversion process occurred un both areas. We suggest that the Western Cordillera of southern Peru could be the northern extension of the Cordillera de Domeyko of northern Chile.

Location of magmatism of I-type located at the limit between two distinct paleogeographic suggest that the main fault system could represent the surface expression of lithospheric structures separating different lithopspheric blocks as it has been demonstrated in the south Peruvian Altiplano (Carlier et al, 2005). Occurrence of different lithospheric blocks documents the heterogeneity of the western margin of South American plate and represents structures inherited of the Trias fragmentation. Then it is this heterogeneity that mainly canalized the andean deformation, the location of magmatic intrusion and by extension the metalogenic and the basin evolution.

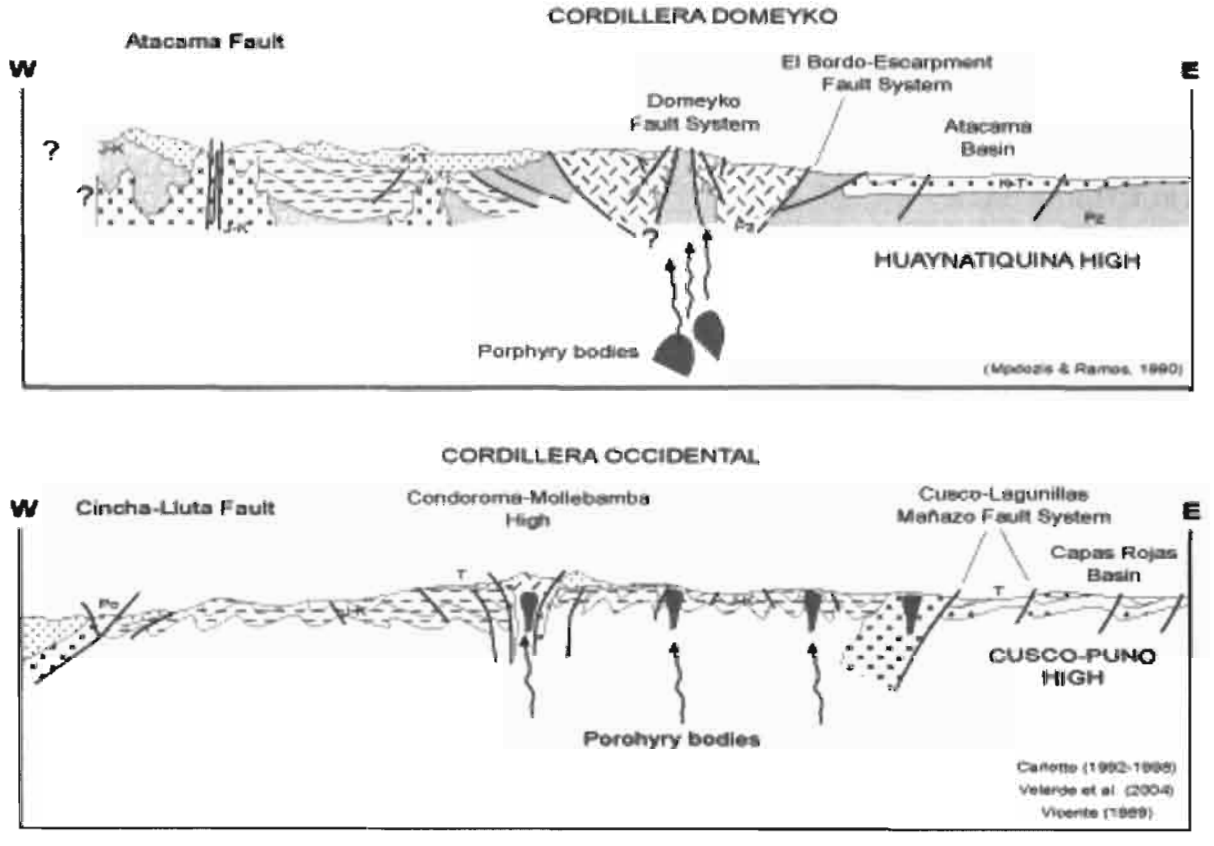

Fig. 2. Cordillera de Domeyko (Northern Chile) and Western Cordillera (Southern Peru)

The emplacement control of giant porphyries in Chile and southern Peru was developed in contractional settings in which the inversion of ancient normal faults played a relevant role in the extraction, transport and accumulation of magmas (Skarmeta & Castelli, 1997). There are the physical models of magmatic intrusion during thrusting that explain this process (Galland et al., 2003). In fact, the structures are geometrically similar to those of the experiments, suggesting that the models indeed are applicable to nature (Cerpa et al., 2004).

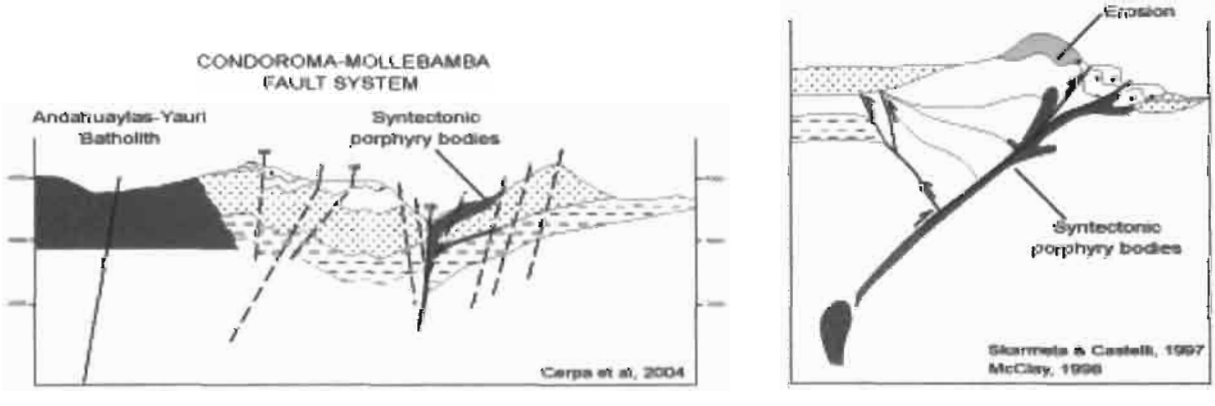

Fig. 3. Magmatic intrusion during thrusting in Cusco-Lagunillas-Mañazo and Domeyko fault system

Syntectonic intrusive porphyrytic bodies were emplaced along the reversed extensional faults and in conjunction with the deformation and construction of the Domeyko (Camus, 2003), Condoroma-Mollebamba and Cusco-

Lagunillas-Mañazo fault system. The emplacement took place during the compressive deformation which began around 44 Ma and which lasted until the Oligocene (~30 Ma).

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