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PALEOMAGNETIC RESULTS FROM SOUTHERN PERU AND BOLIVIA: OROCLINAL BENDING AND BLOCK ROTATIONS IN THE CENTRAL ANDES

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The paleomagnetic studies undertaken in the Central Andes are inconclusive in demonstrating the occurrence of allochtonous terranes during the Andean evolution (i.e. since Late Permian) [*Palmer et al.*, 1980a,b; *Heki et al.*, 1984; *May and Butler*, 1985]. However, these studies have shown relative rotations between Peru and Chile that led *Heki et al.* [1983] and *Kono et al.* [1985] to propose a large oroclinal bending of the Andes. A differential amount of shortening with a maximum of 250 to 425 km in the central Andes also implies counterclockwise fore-arc rotation of 15° to 20° in southern Peru and and clockwise rotation in northern Chile [*Isacks*, 1988]. Another interpretation of paleomagnetic rotations in Peru and Chile has been proposed by *Beck* [1988] who suggested that *in-situ* block rotations result from oblique directions of convergence between the oceanic plate and the overriding continental crust. In this model, rotations are mostly confined to the fore-arc system. In order to constrain the hypothesis of rotations related to a strong shortening in the Central Andes and the bending of the orocline, we have undertaken a paleomagnetic study (50 sites) of Jurassic volcanism and Cretaceous batholith that outcropp along the coast of southern Peru. We also conducted a paleomagnetic study in Bolivia (30 sites) to better constrain the extent of rotations near the hinge of the Bolivian deflection.

In coastal southern Peru, most sites from the Jurassic volcanic rocks have been partially or totally remagnetized during a tectono-magmatic event that may be related to the emplacement of the Peruvian coastal batholith and/or to the first Andean phase of compressional deformation during the Late Cretaceous. This secondary magnetization was observed at 21 sites (mean virtual geomagnetic pole: 59.5N, 190.1E, k=111, a95=3.0). If we assume that the remagnetization is of Late Cretaceous age, a counterclockwise rotation of about 20° was recorded by the forearc of southern Peru. Primary remanent magnetizations recorded by the volcanic

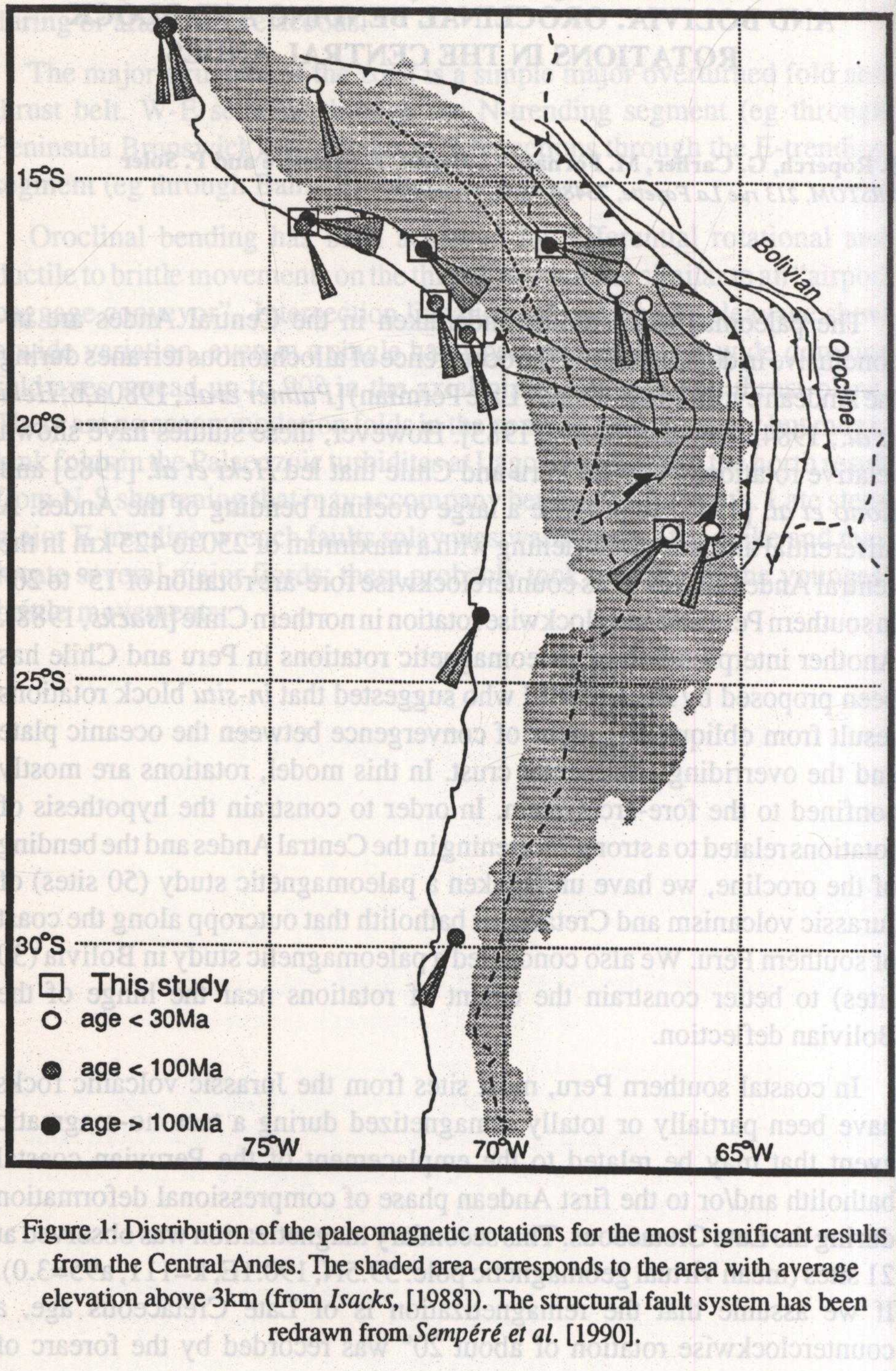

Figure 1: Distribution of the paleomagnetic rotations for the most significant results from the Central Andes. The shaded area corresponds to the area with average elevation above 3km (from *Isacks*, [1988]). The structural fault system has been redrawn from *Sempéré et al.* [1990].

rocks and the batholith reveal a more complex tectonic history, and large counterclockwise rotations are documented near the localities of Chala and Arequipa. The observed differences between the primary and the secondary magnetization indicate that a tectonic event occurred prior to the acquisition of the secondary magnetization.

In Bolivia, Permian sediments near the lake Titicaca and middle Tertiary red bed sediments in northern Bolivia also recorded counterclokwise rotations but the amount of rotation recorded by the Permian units is larger than that recorded by rocks of Tertiary age. In southern Bolivia, various amount of rotations from none to about 40° clockwise rotations are recorded in Tertiary volcanic units and red bed sediments.

The homogeneous anticlockwise rotations of about 15 to 20° recorded by the secondary magnetizations in southern coastal Peru from 16°S to 18°S are in agreement with an oroclinal bending induced by strong shortenings in the eastern Cordillera (Figure 1). In Bolivia however, our new results and those of *McFadden* [1990] suggest that the pattern of rotations is closely related to the tectonics of various structural blocks (Figure 1). Additional paleomagnetic data and structural geology are still needed to better define the spatial distribution and the temporal evolution of the different structural blocks.

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