CLOCKWISE BLOCK ROTATIONS ALONG THE EASTERN BORDER OF THE CORDILLERA de DOMEYKO, BETWEEN 22°45' and 23°30' (CHILE).

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INTRODUCTION

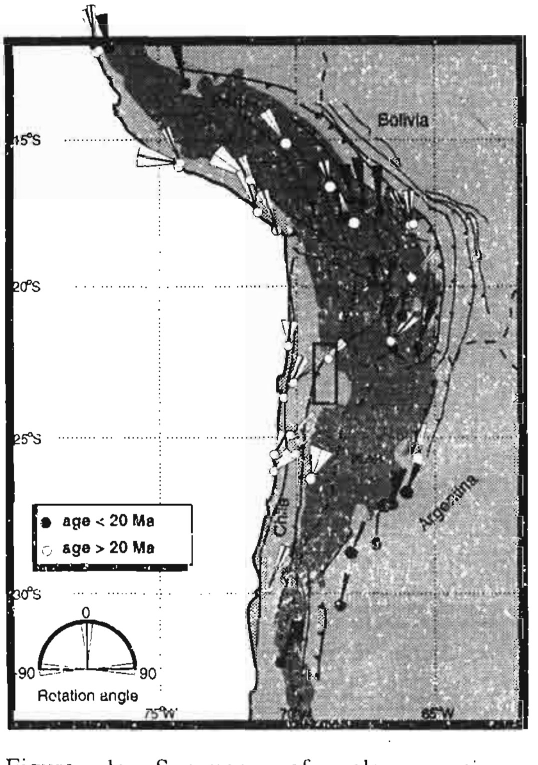

Figure 1: Summary of paleomagnetic rotations in the Central Andes. The box indicates our study area to the west of the Salar de Atacama.

Several paleomagnetic studies demonstrates that the occurrence of tectonic rotations is one of the major characteristic of the structural evolution of the Central Andes (Figure 1). These rotations are clockwise along the Chilean margin while counterclockwise rotations are found north of Arica.

The origin of these rotations is however still a matter of debate. In most of the published studies, the lack of a structural control and geographically restricted paleomagnetic sampling (few sites) impede a clear understanding of the age of the rotation and the size of the rotating blocks. Up to now, rotations within the Chilean forearc have been attributed either to early Cretaceous deformation along the Atacama Fault System (Forsythe and Chilsholm, 1994; Randall et al. 1996), oroclinal bending of the whole Andes or in situ block rotations in response to oblique convergence (Beck et al., 1986).

Preliminary results from the Northern Salar de Atacama (Hartley et al. 1992) indicate the presence of rotations, possibly associated to relative motions between thrust sheets. In this study, we report detailed results from 38 sites collected along the western border of the Salar de Atacama (El Bordo Escarpment, Figure 2). This area corresponds to a segment of the Cordillera de Domeyko where in situ clockwise block rotations have been suggested to interpret the complex structural pattern (Mpodozis et al., 1993). Although compressive deformation seems to play a role in shaping the oriental border of the Cordillera de Domeyko, multiple episodes of Tertiary strike-slip displacements, either in dextral or sinistral sense have been reported (Reutter et al., 1991; Tomlinson and Blanco, 1997).

GEOLOGY OF THE STUDY AREA

Thick continental red beds, conglomerates and intercalated volcanic rocks constitute most of the rocks outcropping along the El Bordo ("Purilactis Group", Ramírez and Gardeweg 1982; Hartley et al., 1992; Charrier and Reutter 1994, Figure 2) with ages ranging from Cretaceous at the bottom to Oligocene at the top. (See Mpodozis et al., this volume, for a new revision of the stratigraphy of the area).

MAGNETIC PROPERTIES

Relatively fine-grained sediments belonging to the base of the Purilactis Group, especially favourable to paleomagnetic studies, have lower magnetic susceptibility than intermediate and upper levels consisting of volcanodetrital material. Thirty-eight sites, with a total of 420 samples were drilled in the sedimentary sequences, interbedded volcanic rocks and associated intrusions (Fig. 2). Detailed progressive thermal demagnetization provided well-defined characteristic magnetizations for most sites.

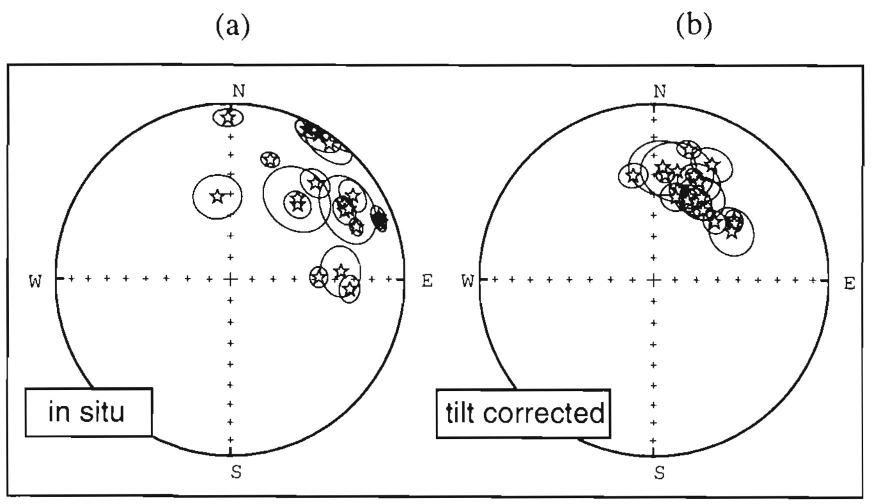

Figure 3: Equal -are projection of mean site paleomagnetic directions from the lower units of the Purilactis group.

In in situ coordinates, characteristic magnetizations are dispersed and away from the present day field direction, a feature that demonstrates that secondary overprint was well removed during demagnetization. (Fig. 3 a). All sites corresponding to the lower Purilactis Group, have normal polarity (Fig. 3 b). The fact that only the normal magnetic polarity is suggests deposition during the long normal

Cretaceous Chron (119-84 Ma). On the other hand, normal and reverse polarities are observed in the overlying volcanic rocks and cross cutting dikes. K-Ar ages (Mpodozis et al. this volume; Arriagada [in preparation]) indicate an emplacement for these volcanic rocks at the Cretaceous-Tertiary boundary (67-64 Ma).

The observed inclinations are in good agreement with the expected for stable South America during the Cretaceous. However, the magnetic declinations are very different from the expected directions, demonstrating the importance of clockwise rotations as a mechanism of the deformation. Upon grouping the samples according to their geographical location, distinct clusters are observed showing a well-defined gradient in the magnitude of the rotation increasing from north to south (Fig. 2). The largest rotation (~70°) is found South of Cerro Quimal, while to the north, the Barros Arana Syncline does not show evidence of rotations. The large rotation reported by Hartley et al. (1992) at one locality corresponds to a disrupted small block on the northern edge of the syncline. Dikes with ages of ~66 Ma, that intrude sediments from the lower Purilactis Group record the same amount of rotation, indicating that tectonic rotations are younger than Paleocene. Further work is needed to constrain the upper limit for the age of the rotation. However, rotations are likely related to a significant deformation phase that affected the Cordillera de Domeyko during the Eocene (Mpodozis et al., 1993).

CONCLUSIONS

The lack of the reverse polarity in the basal members of the Purilactis Group, suggests deposition during the long normal polarity period of the Cretaceous (119-84 Ma). Large clockwise rotations found in this study tend to support the tectonic model previously proposed by Mpodozis et al. (1993) for the Cordillera de Domeyko. However, paleomagnetic data are yet limited to the eastern border of this segment of the range where variations in the amount of shortening may enhance local tectonic rotations. Differences in the magnitude of Eocene (Oligocene?) rotations are strongly controlled by major heterogeneities of the Paleozoic basement and the presence of the partially inverted Purilactis basin. However, the reason why the sense of the rotations is systematically clockwise in most areas of the northern Chilean Andes is still poorly understood.

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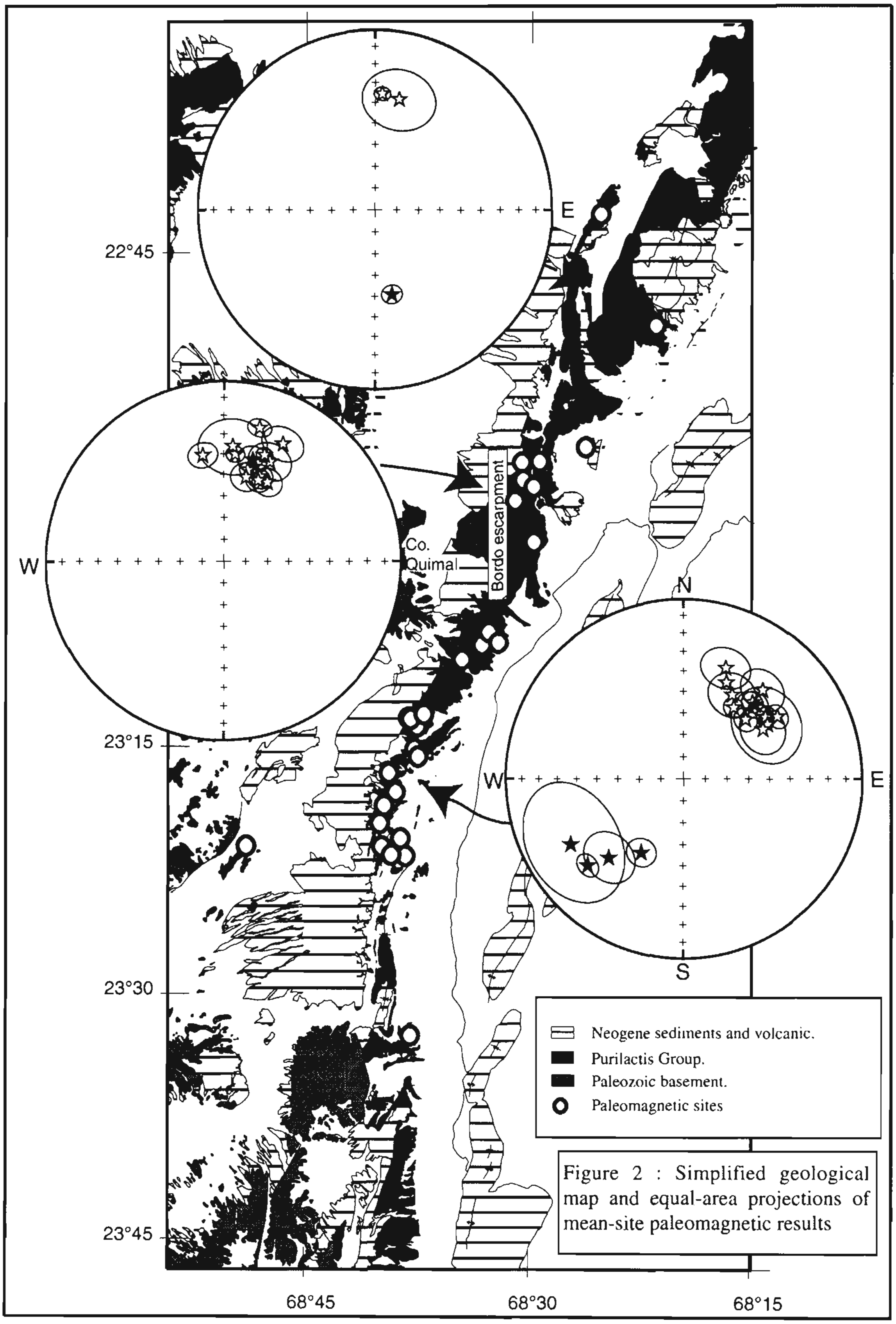

Figure 2 : Simplified geological map and equal-area projections of mean-site paleomagnetic results