NEW PALAEOMAGNETIC RESULTS FROM THE COASTAL CORDILLERA/PRECORDILLERA BOUNDARY NORTHERN CHILE: IMPLICATIONS FOR PLATE MARGIN DEFORMATION.

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INTRODUCTION

Crustal rotation is an important part of Andean deformation in the Central Andes. Numerous palaeomagnetic results from the Coastal Cordillera of northern Chile (see Randall, 1998 and Beck, 1998 for reviews) indicate substantial rotations have affected the Jurassic-Cretaceous rocks of the then magmatic/volcanic arc and which now forms part of the present-day forearc. The area is transected by a number of major margin parallel, sinistrally transtensive to transpressive, fault systems (the Atacama Fault Zone - AFZ, the Coastal Cordillera-Precordillera Boundary Fault system - CC-PC, and the Sierra Castilla / Agua Amarga / La Ternara fault zones which all form part of the larger Domeyko Fault System - DFS). Any or all of these fault systems may have contributed to the recorded rotations. Furthermore it has long been suggested that larger scale processes, associated with the development of the Andes as a whole, have contributed to the observed crustal rotations. It has however proved difficult to elucidate the timing of the actual rotations and to relate these to their causative deformational event or events. During the past five years we have conducted integrated palaeomagnetic, geochronological and structural studies of various geologic units along a 200 km length of the boundary between the Coastal Cordillera and the Precordillera zone (CC-PC) in order to better constrain the timing of rotation in relation to deformation (Grocott & Taylor, 2002). The boundary between these two areas/morphotectonic units is recognised as a sinistrally transpressive fault system exemplified in the Copiapó region by a narrow fold and thrust system whose outcrop pattern and kinematics imply that they are part of a more steeply inclined sinistral transpressive fault zone (the CC-PC FZ, Arévalo et al., in prep.). We present new palaeomagnetic data from units of Cretaceous to Paleogene age from Inc de Oro in the north (26.8°S) to Vallenar in the south (28.8°S) along this boundary and evaluate them in relation to this deformation.

GEOLOGICAL SETTING AND PALAEOMAGNETIC DATA

The area has been the locus for a number of previous palaeomagnetic studies (Forsythe et al., 1987, Riley et al., 1993, Dupont-Nivet et al., 1996, Randall et al., 1996, Randall et al., 2001) and these data plus those of Table 1 are represented on Figure 1. In addition Fernández et al. (2000) have studied two profiles from Inca de Oro to east of the Domeyko Fault System. The new data of Table 1 include results from Tertiary plutonic complexes (Inca de Oro, Cabeza de Vaca and of the Vallenar area - results 1, 3, 7). To the north and south of Vallenar itself field studies indicate that the emplacement of these complexes was syn-tectonic to the transpressive deformation and displacement on the boundary system. This is evidenced by granitic components of the complex having high-temperature fabrics parallel to the deformational fabric and ductile shear zones, which show a range of pre, syn and post tectonic relationships to the granite margins themselves. Here this deformation has been dated, based on Ar-Ar geochronology of hornblende and biotite separates from the granites, to be between 66 and 62 Ma. This age for deformation is consistent with our own and others (Matthews et al. 2001) results from the syntectonic Inca de Oro granite situated in the north of the belt and is consistent with K-Ar ages for plutons and minor intrusions (e.g. Cabeza de Vaca) in the central part of the belt (Arévalo 1994, 1995). Palaeomagnetic results from sediments and volcanics of the Punte del Cobre Fm, the Chańarcillo Gp. and Cerillos Fm. (results 2, 4, 6, 8), both east and west of the boundary itself, all fail fold tests indicating that they were remagnetised and rotated post deformation. In total the palaeomagnetic data from the entire area show no significant differences in rotation across the major fault systems but appear to diminish rapidly east of the DFZ.

The vast majority of samples were collectedwoth portable drills and orientated using both sun and magnetic compasses. Most sites/samples, with the exception of dykes from the Cachiyuyo complex, yielded a characteristic remanence component during standard stepwise AF and thermal demagnetisation. Mean site directions were computed giving unit weighting to samples and unit means from mean site directions. The data as a whole straddle the CC-PC boundary zone and indicate a statistically significant clockwise rotation in all units varying between 28-56°, mean 40". These results are not significantly different from those of the Coastal Cordillera (e.g. Randall et al. 1996 and unpublished data from the Vallenar region, Figure 1) nor from the area immediately east of the DFS (Randall et al. 2001). While we would argue that at least 15° of rotation is related to observed faulting (Grocott & Taylor 2002), the data implies a large-scale process is responsible for the bulk of rotation seen throughout the area. At a more local scale, and particularly highlighted by the study of Fernández et al. (2001), is that between site variation is a function of local small scale block rotations which may be more closely related to the fault systems.

Table 1 Palaeomagnetic Data from the Coastal Cordillera-Precordillera Boundary region, 26-29°S

	Unit	Lat	Long	Age	N	Dec	Inc	A95	R
1	Inca de Oro Granite	26.8	290.1	65	11/12	39.3	-43.4	7.0	44.7 ± 9.8
	Cachiyuyo Dyke complex	27.1	289.9	<62	9/9	Unstable			
2	Cerillos Fm., Remag, Qbda. Condores/Paipote	27.3	289.8	< 62	8/9	34.1	-41.7	5	39.6 ± 7.3
3	Cabeza de Vaca Pluton	27.5	289.9	62	9/10	25.8	-42.7	9.3	31.3 ± 11.3
4	Cerillos Fm., Remag, Elisa de Bordo, Copiapo	27.6	289.8	< 62	8/12	50.5	-42.7	8.3	56.0 ± 10.4
5	S. La Dichusa volcs., Hornitos Fm., los Loros.	27.7	289.8	77-62	7/7	29.3	-42.1	8.0	34.8 ± 10.0
6	Cerillos Fm. Remag, Q Totoralillo/Copiapo	27.7	289.9	< 62	5/5	42.2	-44.3	10.2	47.7 ± 12.5
7	Tertiary pluton complex	28.4	289.5	66-62	11/15	27.9	-54.3	8.3	28.6 ± 10.1
8	Quebrada del Cama sequence, Punte del Cobre Fm., S of Vallenar	28.8	289.3	< 65	9/9	31.5	-50.7	4.3	37.1 ± 7.4

4 modified from Riley et al .1993, 5 from Taylor et al. 1996.

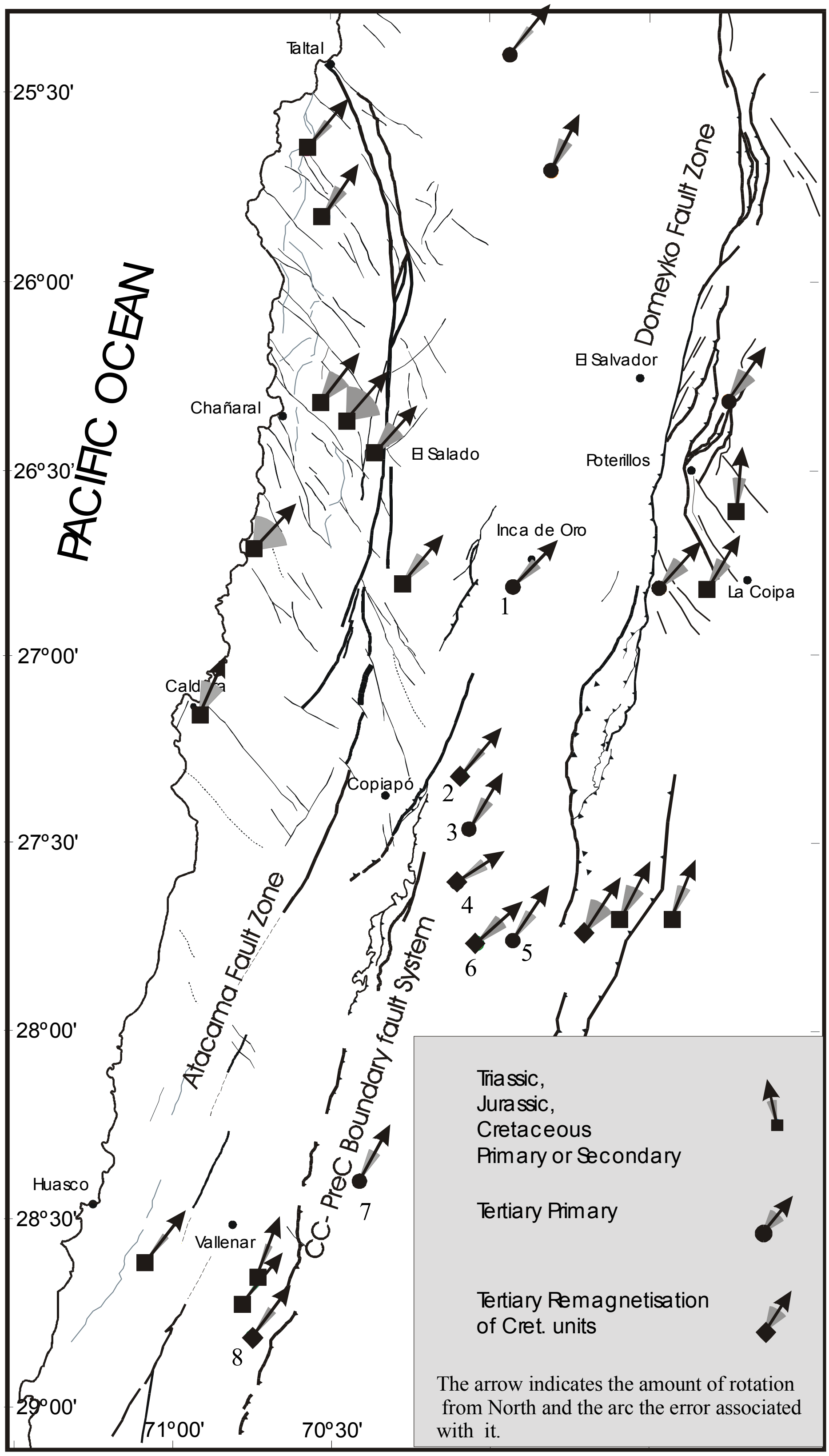

Figure 1 Map of the region showing the palaeomagnetic rotations in Table 1 plus those from Randall et al.1996, Randall et al., 2001, Riley et al. 1993, Forsythe et al. 1987 and unpublished data of the authors.

CONCLUSIONS

The Coastal Cordillera and Precordillera boundary zone of northern Chile between 26 and 29°S is affected by substantial clockwise rotations averaging some 40°. The consistency of these rotations with those to the west from older Jurassic-Cretaceous rocks would suggest a substantial part, if not all, of their rotation is also of Tertiary age. The timing of this rotation would appear to be post 62 Ma as shown by results from both plutonics and remagnetized and rotated Cretaceous units along the boundary zone. The data as a whole suggest a large-scale process has operated and is responsible for the bulk of observed rotations.

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