RECENT VERTICAL MOTION AND QUATERNARY MARINE TERRACES IN THE CALDERA AREA, NORTHERN CHILE (27°S)

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KEY WORDS: Neotectonics, forearc, marine terraces, uplift, Quaternary, Chile.

INTRODUCTION

The main sequence of marine abrasion terraces along the coastal belt of northern Chile, between 27°-28°S, was carved during the last million year or so. Detailed mapping and a morphostratigraphic study of these marine terraces provide new data for assessing the style and rates of Quaternary deformation. In a second contribution within this symposium Marquardt and Lavenu (1999) discuss the recent brittle deformation registered by the area, and emphasize its extensional character.

THE COASTAL BELT IN THE CONTEXT OF THE CENTRAL ANDES

In the Caldera area (27°-28°S), the coastal belt is a narrow portion of land, 1 to 3 km wide, located between the coastline and the Coastal Cordillera (figure 1). It represents the westernmost emerged forearc morphostucture of the Central Andes and includes a sequence of marine terraces preserved up to an altitude of about 300 m a.s.l.

With respect to the morphostructure of the Norte Grande, fully developede at the latitud of Antofagasta (23°S), the Norte Chico shows some differences (figure 1): (a) the coastal belt reaches a much larger width (up to 15 km) than to the north; (b) the Coastal Scarp (which limits the coastal belt from the Coastal Cordillera north of 30°S) of the Norte Grande is replaced by a gently sloping surface covered by aluvial and eolian sedimentary deposits; (c) a transitional zone between the northern intermediate depression and the transversal valleys develops towards the east; and (d) the mesozoic backarc basin rocks and the Puna plateau disappear southward. At the latitude of the study area there is a

transitional zone between the inclined subduction segment to the north and the subhorizontal subduction segment to the south, without active volcanism betwen 28° and 33°S.

ELEVATION, INFERRED AGE AND LATERAL CORRELATION OF THE MARINE TERRACES

The best preserved marine terraces are located up to an altitude of ~250 m a.s.l. The terraces with associated Pleistocene marine deposits are preserved at ~200 m a.s.l. and they are identified mainly by *Argopecten purpuratus* and *Concholepas concholepas*. Over 200 m a.s.l. and up to ~350 m., coastal marine deposits, assigned to Pliocene because of the presence of *Chamys* spp., *Ostreas* spp. and other extinct species, do not correspond to marine terraces deposits s.s. but rather to basin margin sediment (Herm, 1969).

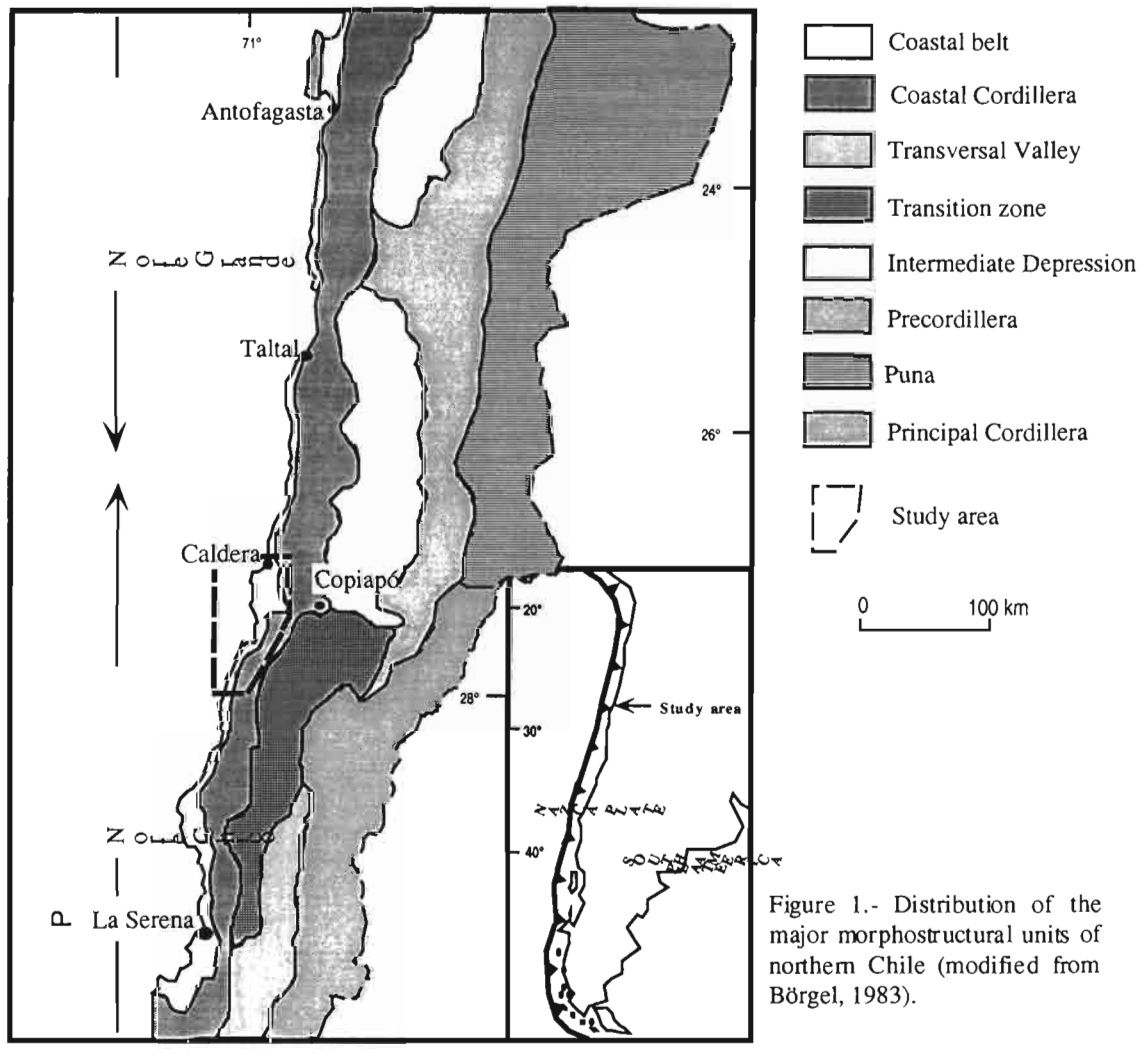

Figure 1.- Distribution of the major morphostructural units of northern Chile (modified from Börgel, 1983).

Based on our morphostratigraphic analisis of the Quaternary marine terraces sequences, we propose the Caldera succession as the type sequence (figure 2). East of Caldera, the altitudes reached by the maximum of the transgression responsible for each marine terrace average +3, +25, +44, +110, +162 and +200 m a.s.l. These altimetric values have an instrumental error of ±5 m and a possible error of about ±10 m in the evaluation of the position of the trace of the transgression maximun.

Age estimation of the terraces is based on : (a) A few geochronological results in the vicinity of Caldera (Radtke, 1987; Leonard, 1994). (b) The hypotesis that warm water mollusc (such as *Donax peruvianus* and *Trachycardium procerum*) may be assigned to a warmer interglacial stage (isotopic stage, i.s., 11) at about 430 kyr (Ortlieb *et al.*,1995; 1996b; 1997). (c) Lateral and vertical correlations between the traces of the successive transgressions corresponding to the Middle and Late Pleistocene sea level variations, as they area known worldwide.

Consequently the age estimations proposed for our type sequence are deduced from that of the last major Quaternary highstands of sea level : ~6 (middle Holocene), ~100 (isotopic substage 5c?), ~125 kyr (i.s. 5e), ~210 (i.s. 7), ~330 (i.s. 9) and ~430 kyr (i.s. 11) (figure 2). By geologycal mapping and lateral correlations, we inferred the chronostratigraphical "age" of the other remnants of the terraces in the southern part of the study area (figure 3).

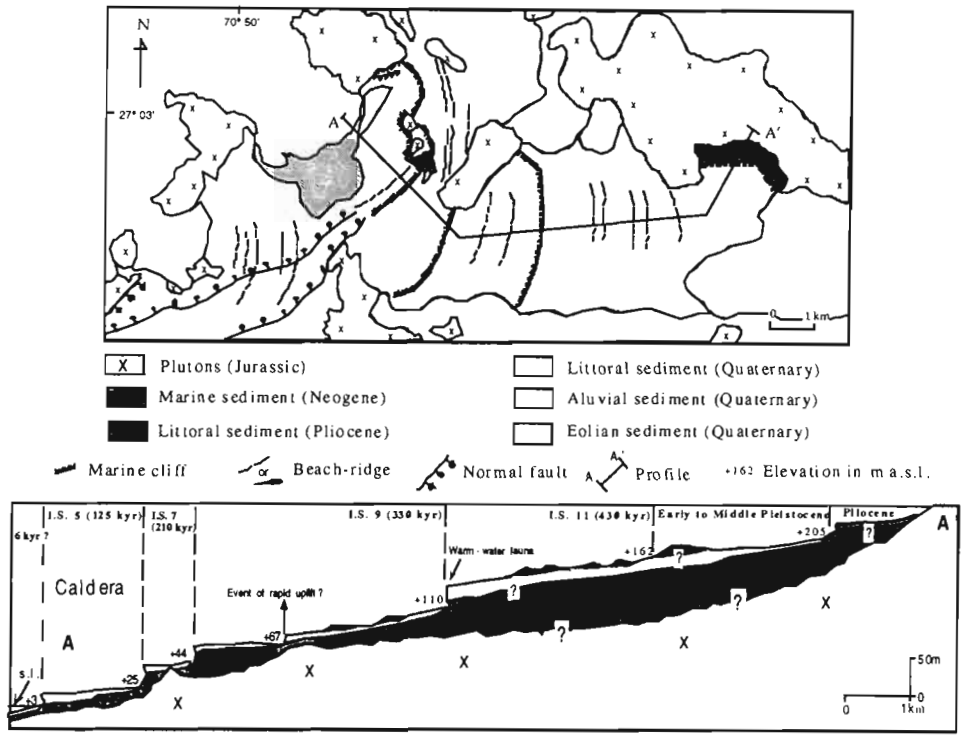

Figure 2. Marine terraces and associated deposits in the Caldera area.

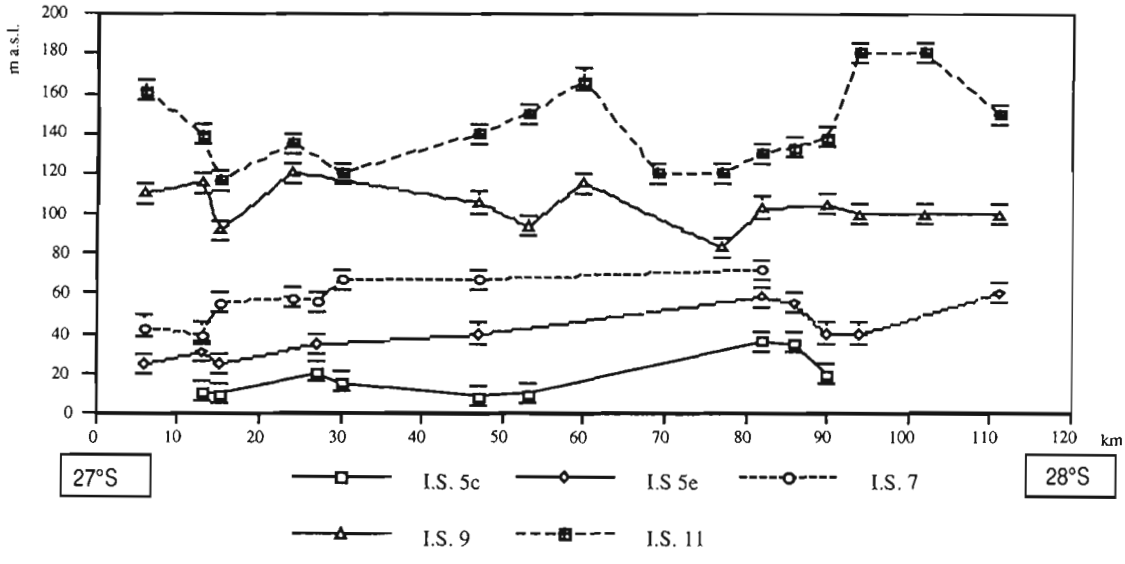

Figure 3.- Vertical and lateral distribution of the remmants of the transgressive maxima of the Middle and Late marine terraces in the Caldera area. Elevations are in m a.s.l.. Age estimation for each terrace should be considered as hypothetical (see text).

CONCLUSIONS

The hypothetical ages of the terraces, mainly deduced from geometrical considerations and from assumptions regarding the faunal composition of 430 ka deposits, lead us to estimate local and regional uplift rates for the last half-million years. The whole set of data obtained in the Caldera area thus suggest that the uplift rates varied in the range of 0.4 to 0.2 m/ky during the last 0.5 My. In a similar way than what was done in Baja California (Ortlieb, 1991) or in California (Hanson *et al.*, 1994), an elevation vs. inferred age plot (figure 3) shows important deformation patterns. The uplift rates varied through time and within the study area, even if part of the observed lack of parallelism between the inferred correlation lines (figure 3) may be attributed to local faulting activity (see Marquardt & Lavenu, 1999).

The Caldera area was submitted to uplift motions which compare with those determined in the Hornitos-Mejillones area (23°S), and are much higher than those calculated for the southeastern rim of the Antofagasta bay (Ortlieb et al., 1995, 1996a, 1997).

ACKNOWLEDGEMENT

This study was supported by the Chilean Servicio Nacional de Geología y Minería, as a part of its "Geological Mapping of the Atacama Fault System and Coastal Belt between 26° and 28°S", a project supervised by Estanislao Godoy. We thank E. Godoy for his help in the field and in the preparation of this work.

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