NEOGENE TO QUATERNARY STATE OF STRESS IN THE CENTRAL DEPRESSION AND ALONG THE LIQUIÑE-OFQUI FAULT ZONE (CENTRAL AND SOUTHERN CHILE)

Alain LAVENU [1,2], José CEMBRANO [2], Francisco HERVÉ [2],
Gloria ARANCIBIA [2], Gabriel VARGAS [2], Ivan GARRIDO [3], Sergio BARRIENTOS [4],
Tony MONFRET [1,4]

1, ORSTOM, casilla 53 390, Correo central, Santiago 1, CHILE. email: alavenu@dgf.uchile.cl
2, Departamento de Geología, Universidad de Chile, casilla 13 518, Correo 21, Santiago, CHILE
3, Phelps Dodge Chile, Santiago, CHILE
4, Departamento de Geofísica, Universidad de Chile, casilla 2 777, Santiago, CHILE

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INTRODUCTION

Great earthquakes have affected central and southern Chile during the last 400 years (Nishenko 1985; Barrientos 1988; Barrientos *et al.* 1992).

Multidisciplinary research programs have been set up by the Geology and Geophysics Departments of the University of Chile and ORSTOM with the goal of determining the Cenozoic long-term and short-term kinematics of this part of the Chilean Andes. The main objectives are:

1 - To assess the neotectonics of the 1500 km-long Central Depression, the development of its basins and the geometry and kinematics of regional-scale boundary faults;

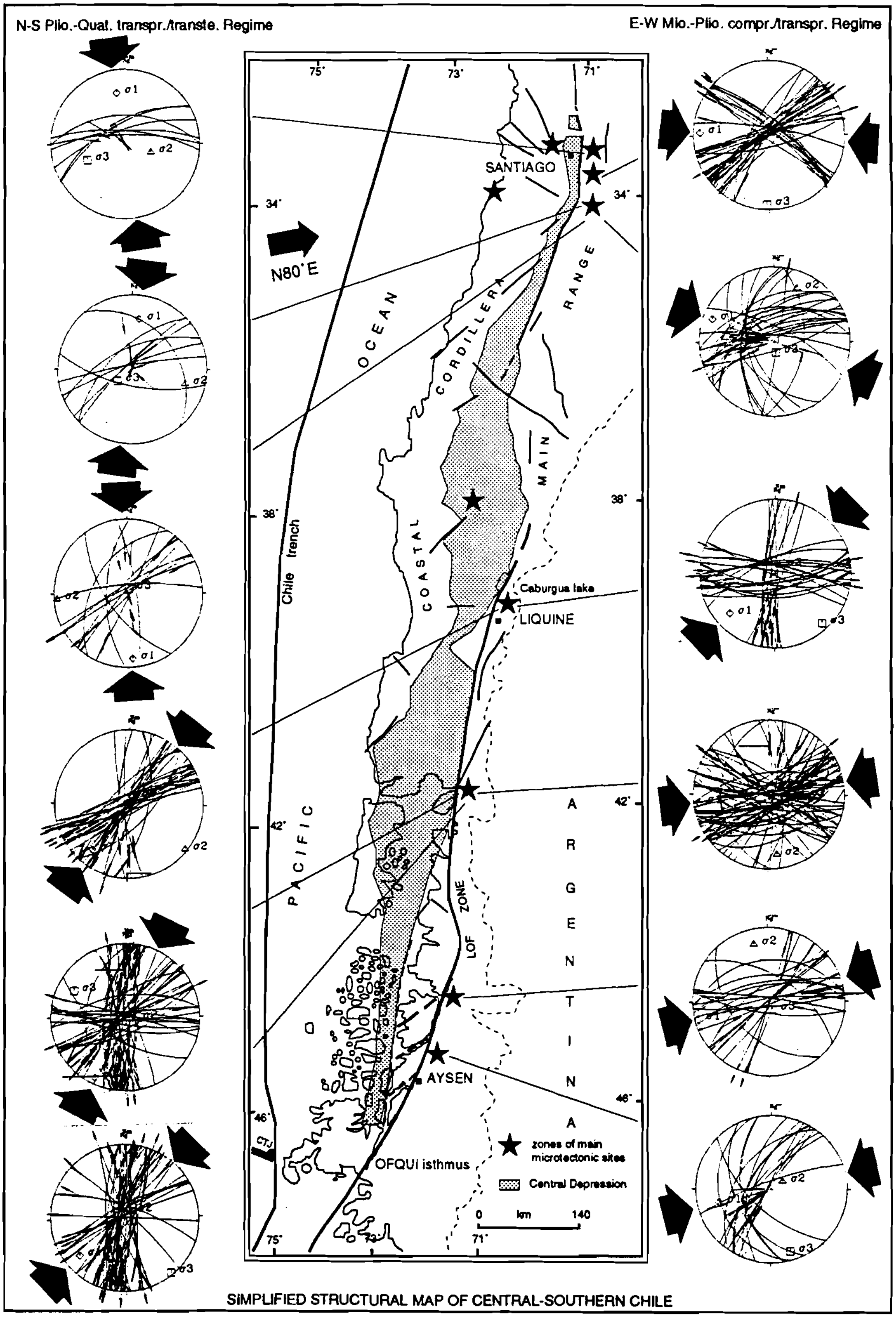
2 - To determine the kinematics and displacement rate of the Liquine-Ofqui fault zone which constitutes the eastern boundary of the southern Andes forearc.

To address these problems we have started analyzing the brittle deformation and characterizing the stress field in the sedimentary rocks, recent volcanic deposits and intrusive rocks of the Central Depression, the Coastal Cordillera, and the Main Range (*cf.* Structural map; ~ 40 analyzed microtectonic sites). Seismologic and seismotectonic studies are currently being undertaken in the northern part of the region. We have also analized the Neogene-Recent stress field along the Liquiñe-Ofqui fault zone; a seismic survey started in 1995 to address the present-day seismicity of the fault.

CENTRAL DEPRESSION

First results of the microtectonic analysis of the Miocene, Pliocene and Quaternary faults have allowed to determine the stress field in the northern and central portions of the study area, using Carey's inversion algoritm (Carey and Brunier 1974; Carey 1979).

During the Late Miocene-Pliocene (9.8-2.7 Ma) the region from 33° to 38° S underwent brittle deformation compatible with a σ_{Hmax} (σ_1) trending E to NE. During the Pleistocene (post 2.7 Ma) σ_1 trended NNE (Central Depression and Main Range) and E in the Coastal Cordillera (*cf.* Table).

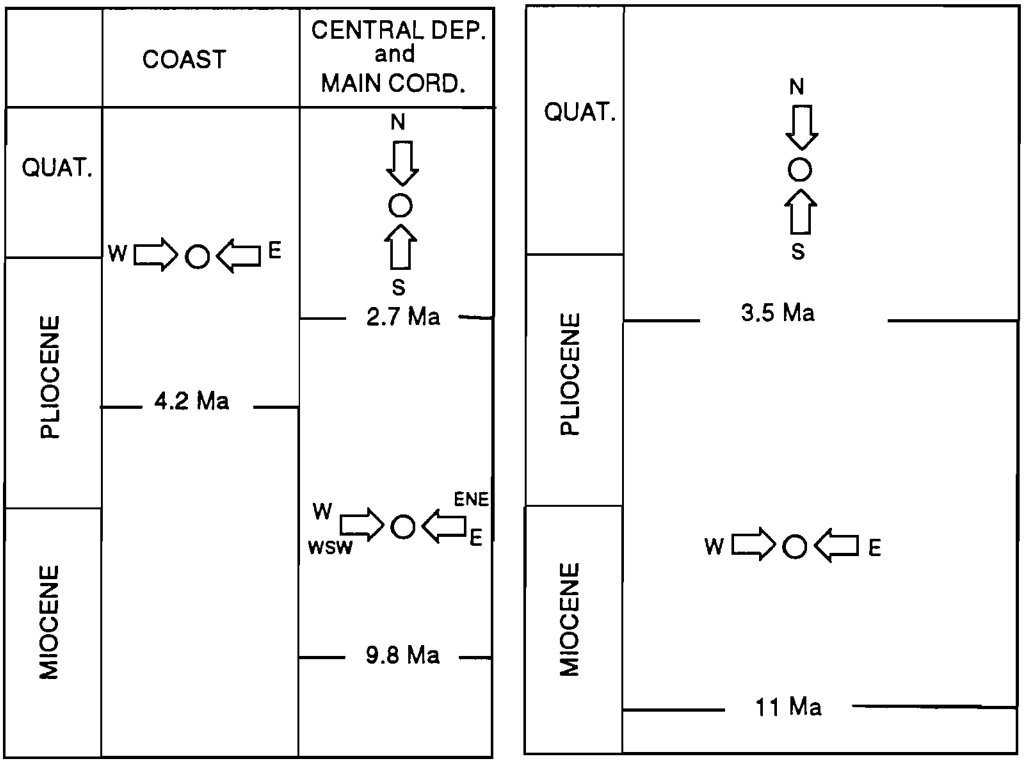


SIMPLIFIED STRUCTURAL MAP OF CENTRAL-SOUTHERN CHILE

LIQUIÑE-OFQUI FAULT ZONE

According to Cembrano *et al.* (1996a), the NNE-trending 1000 km long Liquiñe-Ofqui fault zone (LOFZ), is a Cenozoic dextral strike-slip duplex (*cf.* Map). Marked contrasts in the nature and timing of deformation recorded along the LOFZ suggest a more complicated history than previously recognized (Schermer *et al.*, 1995).

From Lago Caburgua (north) to Aysen (south) it was possible to identify two main brittle tectonic events, a compressive-transpressive one of Miocene-Pliocene age and a dextral strike-slip event of Plio-Quaternary age (*cf.* Table). An extensional event, with σ_3 trending NW, may be compatible with the emplacement of Holocene minor eruptive centers (Lopez-Escobar *et al.*, 1995).



CENTRAL CHILE (32° 30 - 38° S)

LIQUINE - OFQUI FAULT ZONE (39° - 43° S)

TABLE . Chronology and orientation of the different tectonic regimes

CONCLUSIONS

From this first systematic brittle kinematic analysis carried out in Neogene-Quaternary rocks over an area of several hundred square kms in central and southern Chile it is possible to identify a compressive to dextral strike slip event acting from the Late Miocene in the Central Depression and the Liquiñe-Ofqui fault zone.

From 10 Ma to 3 Ma the direction of σ_{Hmax} is roughly parallel to the Nazca-South America convergence direction (DeMets et al. 1990). This period may correspond to a high degree of coupling resulting from high convergence rates (David Engebretson, written communication). A compressive to transpressive tectonic regime would then prevail in the overriding plate.

From 3Ma, the direction of σ_{Hmax} is NNE to NS and may be related to a period of low degree of coupling related to slower rates of convergence producing a transpressional to transtensional tectonic regime (Zoback, 1991).

Different driving mechanisms have been proposed for intra-arc strike-slip faults, namely oblique subduction (Fitch 1972; Beck 1983; Jarrard 1986) or indenters (Tapponier and Molnar 1976; Woodcock 1986; Nelson et al. 1994). Considering the large scale of the forearc sliver outboard the LOFZ oblique subduction seems to be the more likely driving mechanism for intra-arc shear in southern Chile, ridge subduction may apply to a more local scale in the vicinities of the triple junction (CTJ), separating the Antartica, Nazca and South American plates.

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