CENOZOIC THRUSTING AND RIGHT LATERAL WRENCHING IN THE BARILOCHE AREA, SOUTHERN ANDES.

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INTRODUCTION AND GEOLOGICAL SETTING

In Northern Patagonia, the Andean chain is made of several structural and topographic units (Cingolani et al., 1991): the Coastal Ranges (an accretionary prism), the Central Valley, the main Cordillera (containing the current volcanic arc) and the Sub-Andean zone (Fig. 1). These units formed during subduction of the Nazca plate along the Chilean trench. The plate boundary between Nazca and South America is oblique to the direction of relative plate convergence (Fig. 1).

The Bariloche area straddles the eastern part of the main Cordillera and Tertiary sediments of the Sub-Andean zone between 40° and 42°S. The area includes the northern part of the Ñirihuau Basin, south of lake Nahuel Huapi (41°S).

The eastern part of the main Cordillera is made of metamorphic and intrusive rocks (Cazau et al., 1989) and remnants of Mesozoic sedimentary basins which are inverted grabens. Early Tertiary volcano-clastic rocks (Huitera and Ventana formations), a product of the volcanic arc, have been incorporated into the main Cordillera north of lake Nahuel Huapi.

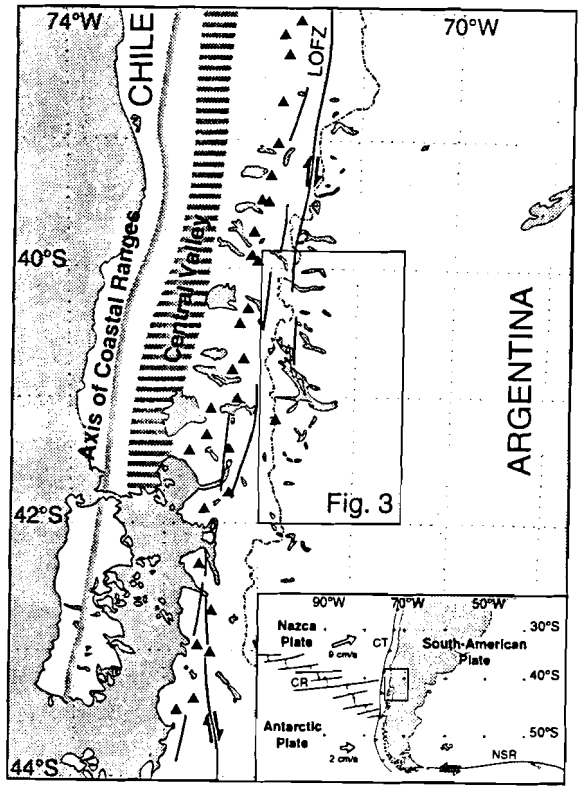

Figure 1: Schematic map showing location of area studied. Inset shows tectonic setting of southern South America with adjacent oceanic areas. White arrows, indicating relative motion between plates, are from model NUVEL-1 of Gripp and Gordon (1990). CR: Chile Ridge, CT: Chile Trench, NSR: North Scotia Ridge. Main map shows Central Valley (dashed zone) between Coastal Ranges (grey line) and main Andean Cordillera. Altitudes over 1000 m. are shaded (grey). Solid triangles indicate volcanoes. The Liquiñe Ofqui Fault Zone (LOFZ) is a set of right-lateral fault segments (black lines with opposing arrows) visible on Landsat images (after Dewey and Lamb, 1992).

In the Late Tertiary, volcanic activity diminished and the Ñirihuau Basin developed in a back-arc context. It contains shallow-marine and fluviatile sediments (Ñirihuau Formation, Lower to Middle Miocene), followed by continental sediments with some volcanics (Collon Cura Formation, Upper Miocene and Pliocene).

Our structural interpretation of the area is based on field observations, digital data and a kinematic analysis of fault-slip data.

REGIONAL STRUCTURES

A digital topographic image shows the general northerly trend of the Andes and its sharp eastern boundary (Fig. 2). Major transverse valleys are occupied by Quaternary glacial lakes. A close correlation between topography and regional structures is revealed by superimposing digital geological and topographic maps. Major structures follow two main trends (Fig. 3). Reverse faults trend SE, as along lake Nahuel Huapi. High-angle oblique-slip fault systems (reverse, right-lateral) trend N, as in the valley north of El Bolsón and within both basement and Tertiary sediments north of 41°S.

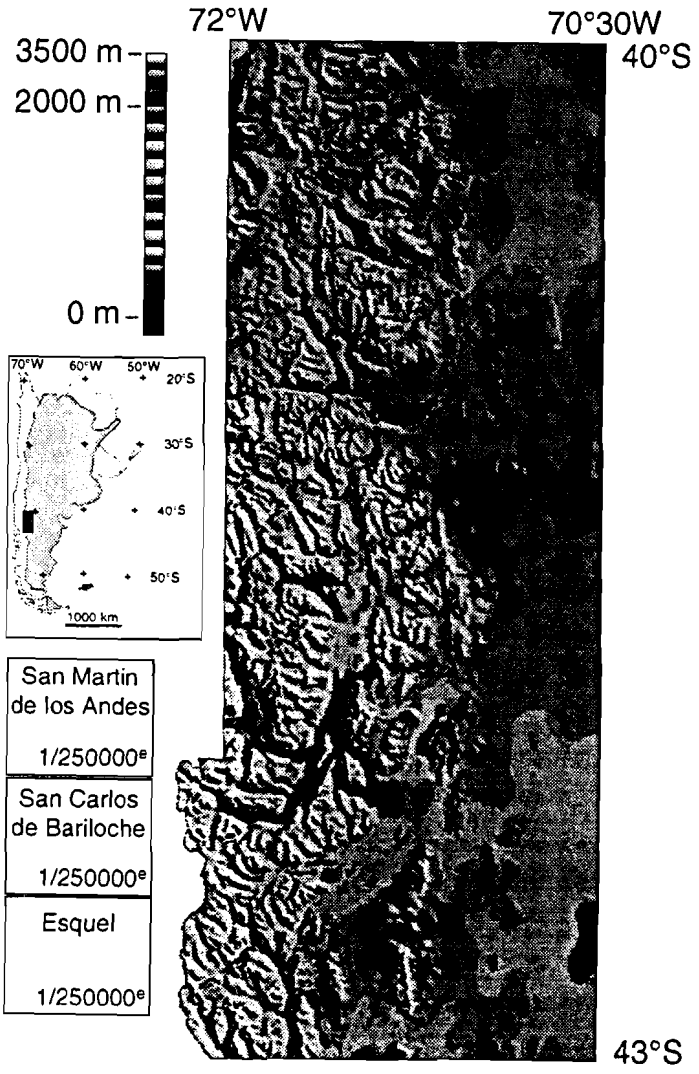

Figure 2: Digital topographic image, compiled from the following maps edited by the Instituto Geográphico Militar Argentino at 1/250 000: San Martín de los Andes (4172-II), San Carlos de Bariloche (4172-IV) and Esquel (4372-II and 4372-I). Artificial illumination is from the NE.

FAULT KINEMATICS

We have mesured striated fault planes at 33 outcrop localities, located in both basement and cover rocks (Fig. 4) and have analysed the fault-slip data using graphical and kinematic methods. The principal direction of shortening is sub-horizontal and strikes between NNE and ENE at regional scale; the principal direction of extension is also sub-horizontal (Fig. 4). Strain ellipsoids are estimated to be mainly of plane-strain to flattening type.

At outcrop scale, fault-slip data provide information on the relative proportions of crustal thickening and strike-slip faulting. Predominant are faults with components of right-lateral strike-slip trending N or conjugate left-lateral strike-slip trending E.

CONCLUSIONS

Throughout the area, major reverse faults and thrusts trend SE, forming the edges to Cenozoic basins of foreland or ramp styles. Some of these are inverted grabens of Mesozoic age. The dominant strike-slip faults are right-lateral and trend nearly N, parallel to the Andean chain. Conjugate left-lateral faults trend nearly E.

From the fault-slip data, the principal direction of shortening trends NE. It is compatible with the oblique direction of convergence between the Nazca and South America plates. However, we also infer

a regional component of right-lateral wrenching. This tectonic style seems to have lasted throughout the Neogene.

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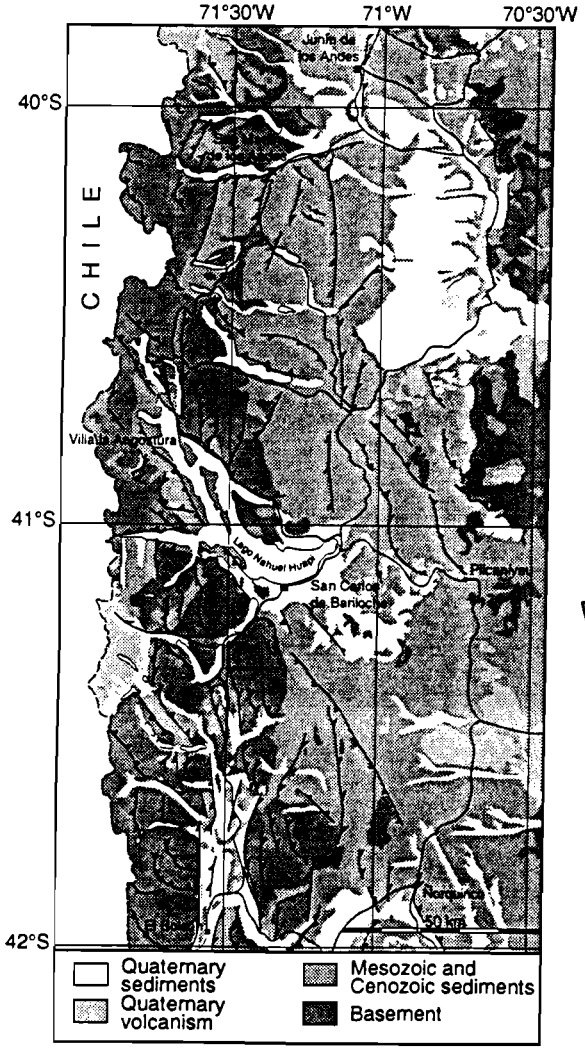

Figure 3: Schematic structural and geological map (Mercator projection) of area studied. Major reverse faults are from Landsat interpretation and from superimposed geological maps and digital topographic data (see Fig.3). Black triangles point in directions of underthrusting.

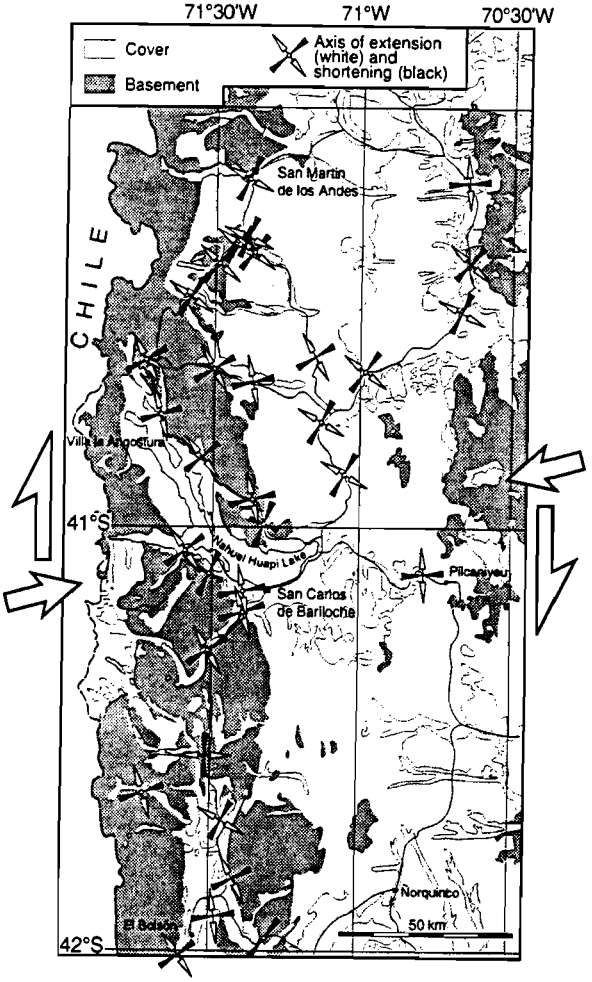

Figure 4: Results of kinematic fault analyses. Map shows directions of shortening (black arrows) and extension (white arrows for horizontal extension, white circles for vertical extension) at 33 localities.