RESISTIVITY CROSS SECTION THROUGH THE SOUTHERN CENTRAL ANDEAN CRUST

Detlef KRÜGER(*) & Gerhard SCHWARZ(*)

(*)Freie Universität Berlin, Fachrichtung Geophysik, Malteserstr. 74 - 100, 1000 Berlin 46, Germany.

RESUMEN: A partir de mediciones magnetotelúricas se determinó a lo largo de un perfil a los 22°S, desde la Costa Pacífica hasta el Chaco, la distribución de resistividades eléctricas hasta 100 km de profundidad. Los resultados están basados en modelados magnetotelúricos bidimensionales, mediante los cuales pudo ser detectada una anomalía de alta conductividad que se extiende bajo la Cordillera Occidental, Altiplano hasta el sector occidental de la Cordillera Oriental.

KEY WORDS: Magnetotellurics - Geomagnetic deep soundings - 2D-modeling - Crustal high conductivity zones - Partial melting

INTRODUCTION

Magnetotelluric (MT) and geomagnetic deep sounding (GDS) experiments were done in the southern Central Andes between the Pacific coast of northern Chile and the Andean lowland plains of southern Bolivia and northwestern Argentina from 1982 to 1989 to investigate the crust and upper mantle structure (e.g., SCHWARZ et al. 1984, 1993, KRÜGER et al. 1990). Cross sections of previous publications are based on one-dimensional models only. Here, two-dimensional electrical resitivity models were constructed to better image conductivity structures. A resistivity cross section at lat 22°S based on 39 sites from the coastline across all morphostructural units up to the foreland region has been derived from three two-dimensional resistivity models using the finite element method.

CROSS SECTIONS OF ELECTRICAL RESISTIVITY

Two-dimensional resistivity models have been obtained by trial-and-error fitting of model data and those measured in the field. Both, MT-data as well as GDS induction vectors were used in modeling. A finite element forward algorithm as described by WANNAMAKER et al. (1986, 1987) was utilized.

Three EW-profiles were chosen for 2D-modeling across the Andes (fig. 1). They are described in detail by KRÜGER (1992, 1993). Due to the strong inductive effect (coast effect) of the Pacific Ocean the model for profile I, which starts at the coast and ends in the Western Cordillera, must include the ocean. The coast effect is caused by the Peru-Chile trench (depth ca. 8000 m), located nearly 100 km away from the coastline. Profile II crosses the Bolivian Altiplano at lat 21° 20' S and has a length of about 150 km. Profile III stretches from the western part of the Eastern Cordillera at about lat 22° 30' S eastwards to the

Andean foreland. It crosses west of Tarija a large scale conductive structure (fig. 1) observed earlier by geomagnetic deep soundings and inferred from 1D-model inversion of magnetotelluric data as well (SCHWARZ et al., 1986).

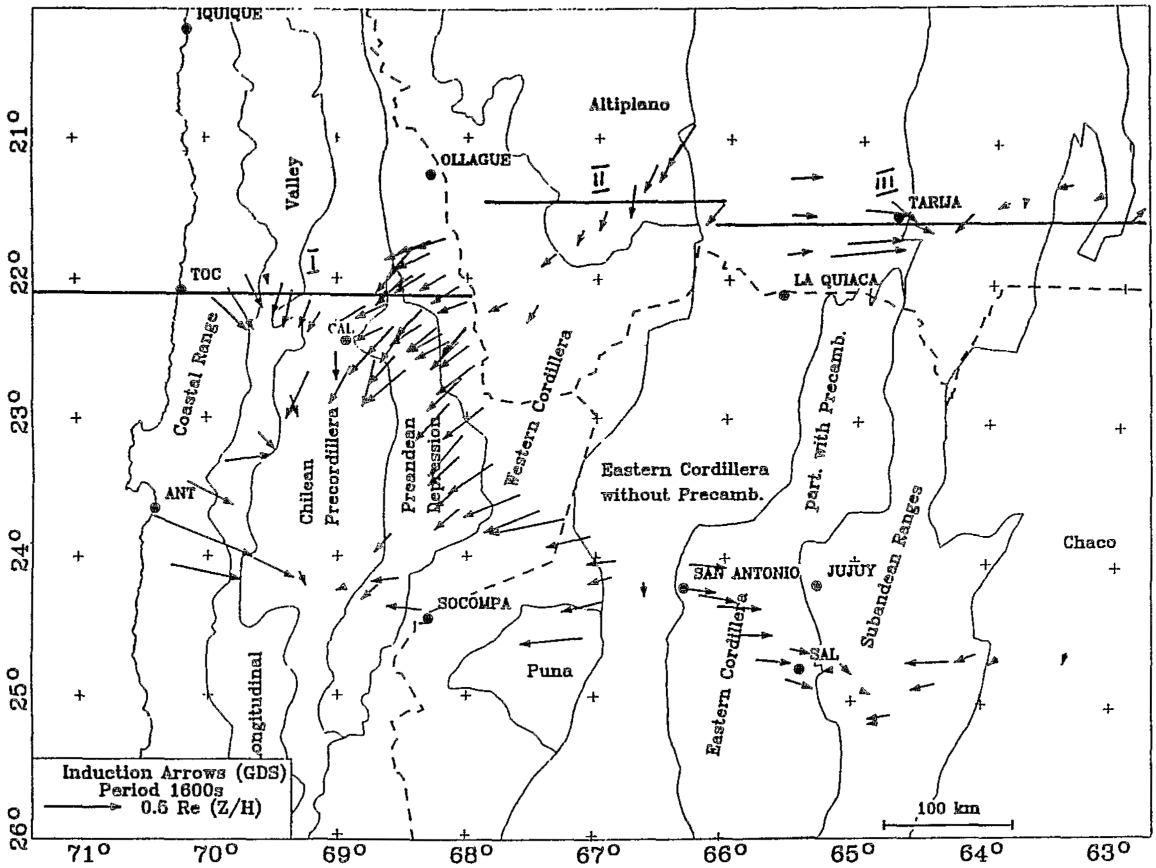

Fig. 1: Induction arrows, pointing away from anomalous high electrical conductivity zones, as results of GDS-data. The profiles, where the two-dimensional model search was carried out, are marked.

CONCLUSIONS

A cross section of the southern Central Andes showing schematically the modelled distribution of the electrical resistivity in the crust is presented in figure 2. The main features described from W to E are:

The crust below the Coastal Cordillera has high resistivities of more than 3000 ohm*m.
In this area the MT-data of E-polarization (parallel to strike of conductive structures) show a good conductor in the upper crust.
The resistivity of the 'normal Andean' upper crust seems to be relatively low, having values of 50 ohm*m < rho < 200 ohm*m.

A high conductivity zone (HCZ) is observed at shallow depth under the Western Codillera with a total conductance (conductivity-thickness product) of more than 25,000 Siemens. Another HCZ is located below the Altiplano with a total conductance of about 15,000 S in the lower crust and uprising from W to E. In the western part of the Eastern Cordillera the total conductance first increases and then drops abruptly somewhere between La Quiaca and Tarija. The HCZ in the western part may be caused by partial melting in the crust, whereas the eastermost HCZ could be related to tectonic features such as deep rooted thrust levels.

The lowland plains of the Subandean and the Chaco are characterized by a low resistive cover. The resistivity of the crust and upper mantle increases from W to E to more than 3000 ohm*m.

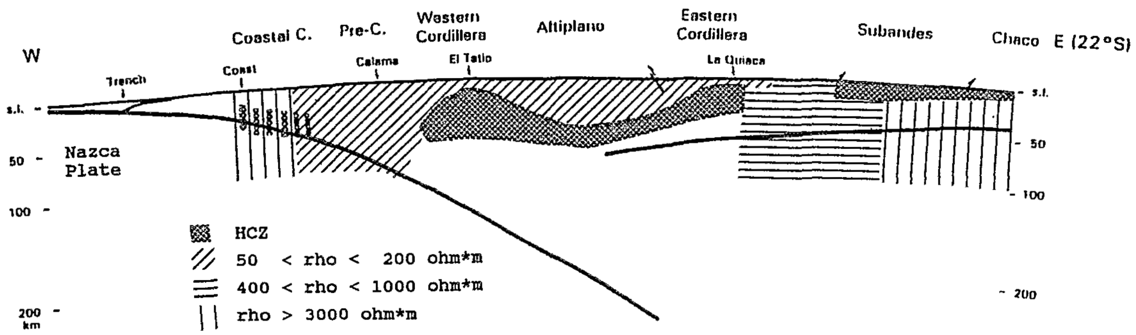

Fig. 2: Cross section (1:1) of the southern Central Andes at lat 22° S showing schematically the observed resistivities at different depth ranges. Most remarkable is a crustal zone of very high electrical conductivity which extends from the W-Cordillera eastwards for about 250 km. Thick lines mark seismological interfaces (WIGGER et al., this vol.).

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