CRUSTAL ELECTRICAL RESISTIVITY STRUCTURE IN THE SOUTHERN CENTRAL ANDES

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Since 1982 we have done long period magnetotelluric (T: 40 - 20,000 s) and geomagntetic deep soundings at more than 120 sites in northern Chile, southern Bolivia and northwestern Argentina (Fig. 1). Two profiles of more than 700 km length each between 21° and 25° southern latitude are crossing all struc-tural units from the Pacific coast in the West towards the Andean foreland in the East. Schwarz et al. (1984, 1986) described measuring procedures as well as data analysis.

The main structural features of the Andean orogene could be seperated by their electrical resistivity structure quite well. The active foreland is characterized by a very low resistive cover, although three-dimensional in its structure, overlying a moderately resistive crust and upper mantle. In the Subandean Ranges we observed a very similar situation, but crustal resistivities never exeed 100 ohm m.

The Eastern Cordillera has high resistivities in its eastern part, correlating with the uprising precambrian basement. In the western part of the Eastern Cordillera, west of Tarija in Bolivia we measured extreme low values of only some ohm m at shallow depth. Further towards south, in Argentina, the situation is not that clear: West of S. Antonio de los Cobres low resistive structures were found again at crustal depth. Their connection with the structures observed further north is not yet clear, due to a gap in measuring sites at that latitude. But we may assume that the very low resistive zone is related to a thick sedimentary cover and young magmatic processes with subsequent hydrothermal circulation in the upper crust. These processes formed the so-called tin belt, which stretches from southern Peru towards northwestern Argentina.

The Bolivian Altiplano and the Argentine Puna can be seperated very well by their different crustal resistivity structure. The Altiplano - two-dimensional in its structure - has a well conducting cover, a moderately resistive middle crust, and at a depth below 40 km a very low resistive zone (1 - 2 ohm m), of which the lower bound is unknown. The crust of the Puna is moderately conductive too, but the low resitivity layer found in the North is missing - or found at much greater depth, e.g. at about 80 km.

The most striking feature on the traverse are very low resistive upper crustal structures in the Western Cordillera of northern Chile - striking approximately SSE - NNW and bending

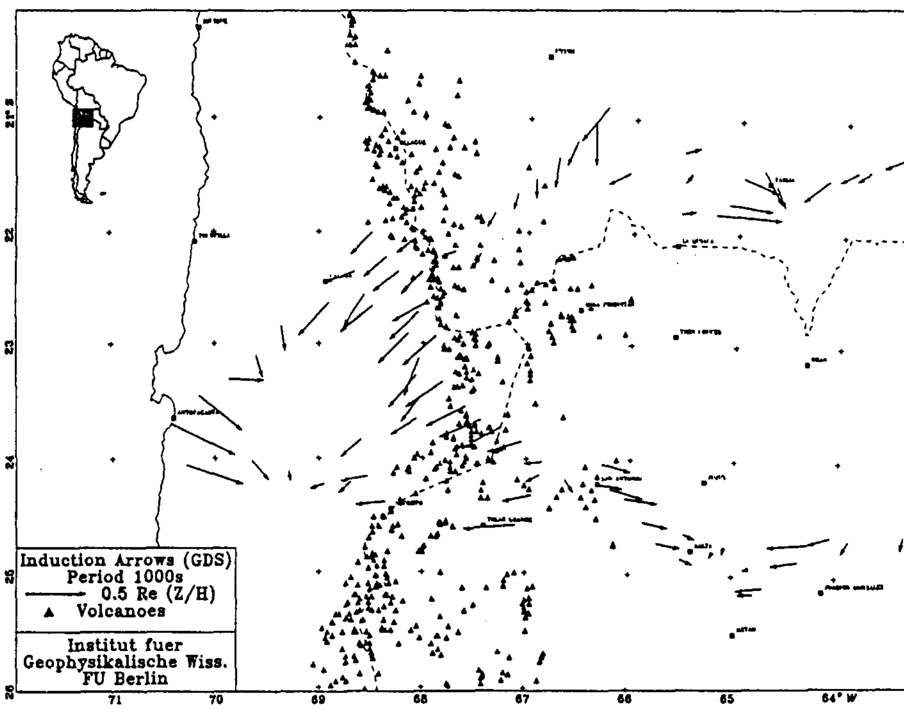

Fig. 1: Geomagnetic deep sounding data from the Southern Central Andes together with distribution of volcanoes: Induction arrows (period T: 1000 s) as the reversed path finders for zones of high electrical conductivity in the crust, pointing away from anomalous zones. A zone of high electrical conductivity (conductance of 20,000 - 30,000 S) beneath the Western Cordillera (the volcanic belt) of northern Chile and southwestern Bolivia is striking under NNW-SSE, running into northwestern Argentina. The eastern border of this large scale anomaly is found in the Eastern Cordillera of southern Bolivia and northwestern Argentina. High electrical conductivity should be related here to thick sedimantary layers and hydrothermal circulation in the upper crust.

further towards W at about 22° southern latitude. Total conductance (the thickness-resistivity ratio) is reaching values between 20,000 to 30,000 Siemens, pointing towards the extreme physical state of the crust. These values may originate from partially melted acidic rocks - stuck in the crust, as well as from uprising fluids penetrating the continental crust due to dehydration processes at depth of the descending Nazca plate. The very low resistive zone of at least 20 km thickness correlates with a zone of reduced seismic velocities (Wigger 1988), attenuation and/or scattering of seismic waves (Chinn et al. 1980), as well as with an extended low in residual gravity (Götze et al. 1988). Local induction anomalies were found as well within the preandean depression zone, e.g. the Salar de Atacama

The Pre-Cordillera and the Longitudinal Valley show again a moderately, but not very well structured crust. Geomagnetic deep sounding data suggest deeply fractured zones within the Coastal Cordillera, striking about E-W.

We summarize that more or less all data observed indicate a moderately to low resistive Andean crust, with even lower resistivities beneath the Western Cordillera, the Altiplano and the western ranges of the Eastern Cordillera. This shows that the process of subduction of the Pacific Plate beneath western South America affects the whole Andean crust from the coast towards the foreland.

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