Electrical resistivity cross sections through the Central and South Andes

Subproject G5
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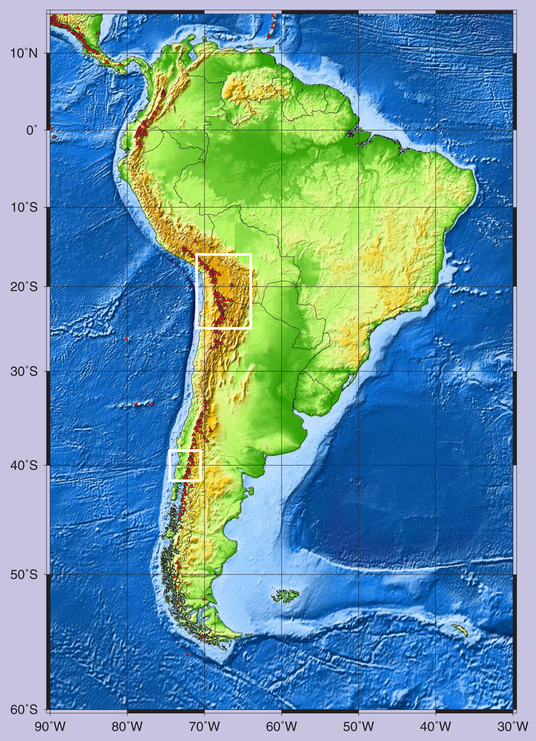
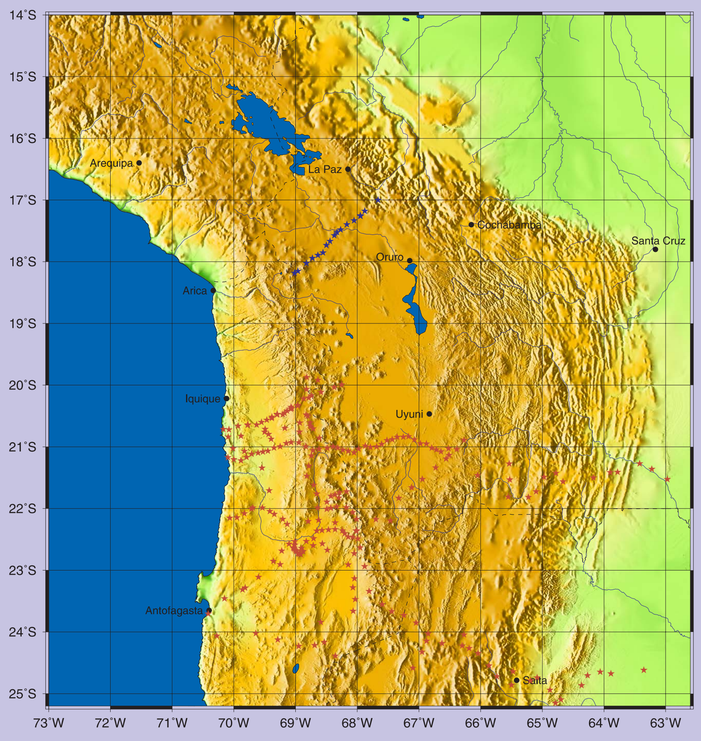
SFB 267



MT study areas in South America.



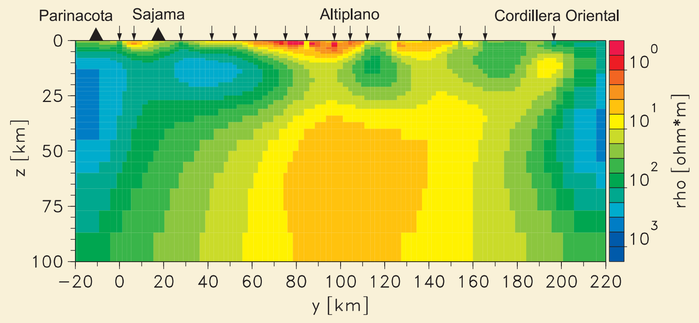
Magnetotelluric sites in the Central Andes. Red stars: previous sites; blue: sites from 2002

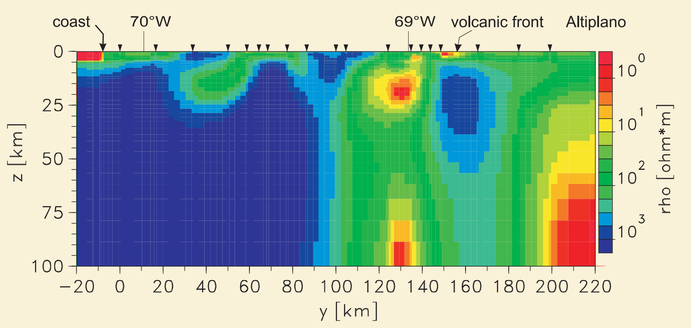
Left: The volcanic arc in the Central Andes (Payachata volcanoes Parinacota and Pomerape), right: in the Southern Andes (Villarica volcano).

This contribution summarizes modelling results for several magnetotelluric (MT) profiles in the Central and South Andes. They are restricted to two dimensions; although 3-D effects are observed in certain areas, these models give a first order approximation of the true resistivity distribution at depth. 3-D modelling was conducted for the forearc region of northern Chile.

MT 2-D models: Central Andes

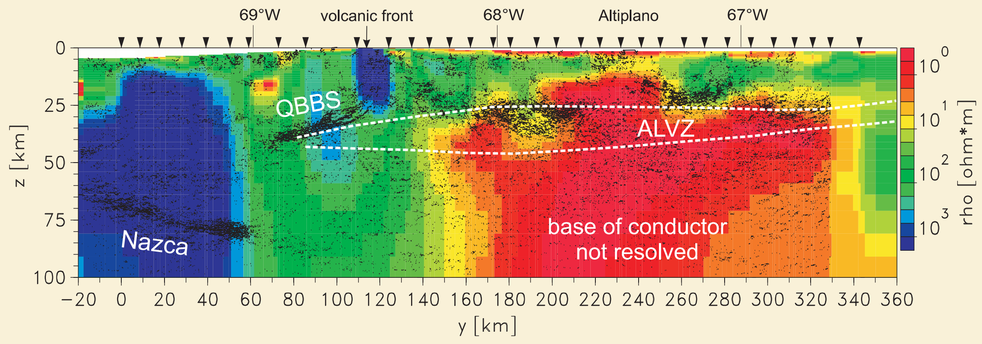
Altiplano 17.5°S

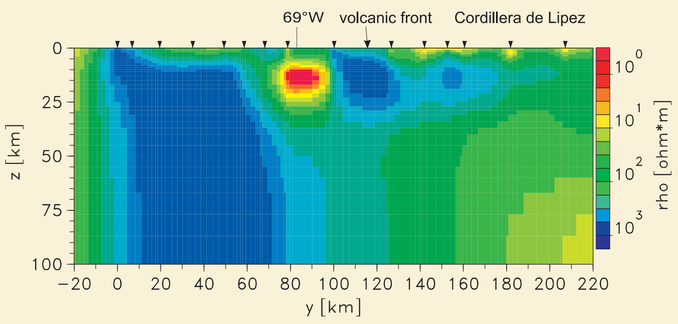




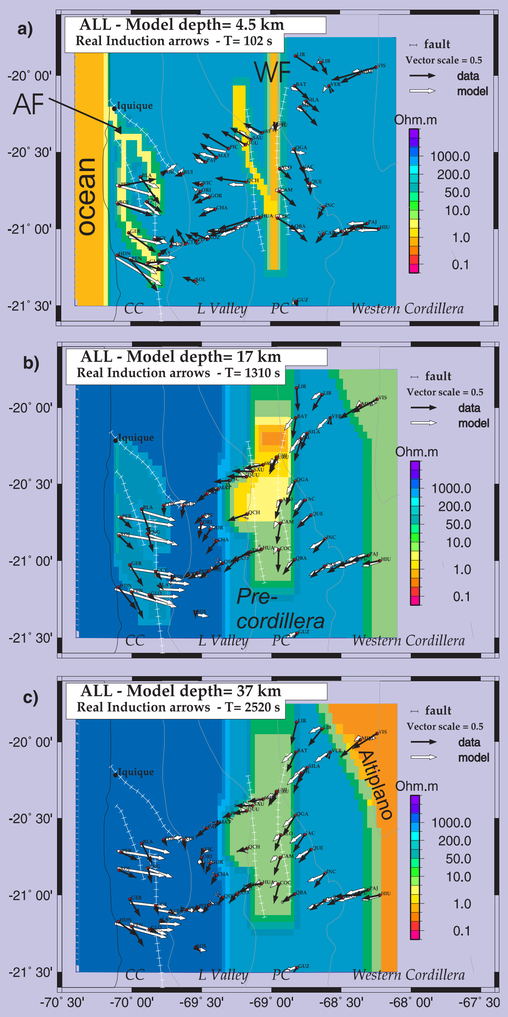
Pica 21.5°S

ANCORP 21.0°S





Chuquicamata 22.2°S

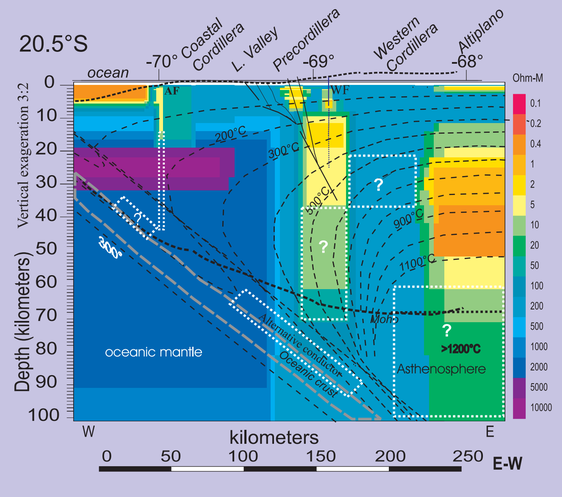


3-D model to explain induction vectors in the forearc of North Chile.

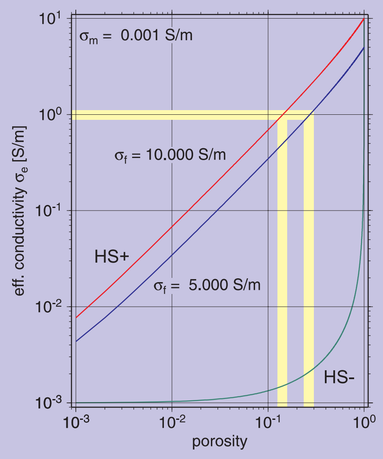
Left: 4 resistivity sections through the Central Andes, including a re-compilation of older data collected on a profile in the Chilean forearc at 22°S and a new profile across the central Bolivian Altiplano. Main conductive features comprise the Falla Oeste, a vast anomaly below the southern Altiplano (which is correlated with a zone of high attenuation of seismic waves, reflective bands and a low velocity zone) and, less obvious, the Atacama Fault. While fluids are thought to be resonsible for enhanced conductivity in the faults, partial melting (with melt rates up to 10% or more) is the most obvious explanation of the Altiplano anomaly. Although less pronounced, this anomaly extends at least to the central Altiplano south of La Paz. Different from expectation, the MT models exclude a voluminous high-conductivity zone below the volcanic arc.

Right and below: 3-D modelling of forearc structures generally supports the 2-D models by identifying conductive features extending slightly oblique from a N-S direction.

Left bottom: A melt rate of > 10% is calculated from 2-phase mixing laws, and the most probable explanation of the Altiplano anomaly is a large migmatitic body at depth.

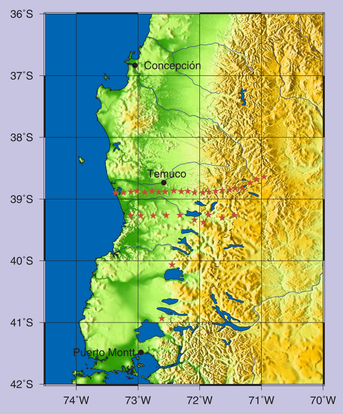


Below: The South Andes show a different image of resistivity distribution. There is no deep crustal conductor corresponding to the Altiplano anomaly in the north. In contrast, a conductor with moderately low resistivities underlies the volcanic arc, thought to be controlled by the Liquiñe-Ofqui megashearzone. Analogous to the Central Andes, a large fault is again imaged in the forearc (Gastre Fault).
The data between 39°S and 41°S show a pecularity rarely observed in magnetotelluric soundings: All induction vectors (not shown here), derived from the ratio of vertical to horizontal magnetic fields, point consistently to the NW and not W-E as expected, if only N-S striking anomalies would be present. Thus an additional structure exists, and anisotropic modelling hints at (paleo) fault zones in the forearc



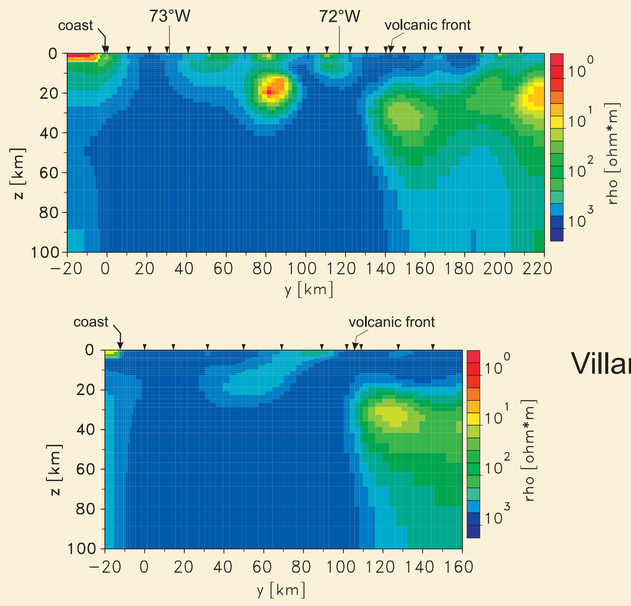
Migmatite shows melt fraction of up to 25%.

Left: Hashin-Shtrikman upper bound yields porosities (melt rates) > 10%.



Magnetotelluric sites in the South Andes.

MT 2-D models: Southern Andes



Llaima 38.9°S

Villarrica 39.3°S

References

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Lezaeta, P. (2001): Distortion Analysis and 3-D Modeling of Magnetotelluric Data in the Southern Central Andes, PhD thesis,