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A combined on- and offshore magnetotelluric study in South Chile

G. Kapinos and H. Brasse
FU Berlin (kapinosg@geophysik.fu-berlin.de)

As a part of the multi-disciplinary TIPTEQ programme a magnetotelluric profile was established at the southern Chilean margin between latitudes 37.5° - 41°S in 2004/2005. It belongs to a large-scale long-period magnetotelluric network with 3 profiles from the coast of the Pacific Ocean to the volcanic arc, several connecting sites and more detailed investigations around the active Villarrica and Llaima volcanoes. For imaging fluids in the interface between the downgoing Nazca and the overriding South American plate the last profile was extended with sea-bottom stations across the trench towards the Pacific plate.

While analysis of offshore data is still ongoing, the onshore data display an unexpected first-order effect: without exception real induction vectors at all sites point consistently NE for long periods over the whole study area, overprinting any other effect which might be connected to conductivity anomalies along the N10°E striking continental margin. While 3-D models with realistic geometries cannot account for this highly anomalous behaviour of tippers, quite simple 2-D models incorporating anisotropy explain the data at least qualitatively. The ocean (modeled with crude bathymetry) accounts for the large tipper magnitudes, while an anisotropic layer in the upper-middle crust is responsible for the deflection of vectors. The direction of the highly conductive axis is NW-SE, in good agreement with the multitude of fault systems observed at the surface in the forearc and arc regions. The South Chilean crust has thus to be considered as deeply fractured with far-reaching consequences for migration of fluids and melts, where appropriate conditions exist.