An electrical resistivity model of the San Pedro – Ceboruco graben: 3-D inversion studies and comparisons between standard and advanced Magnetotelluric transfer functions

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SUMMARY

A large set of Magnetotelluric (MT) surveys has been carried out along the Tepic-Zacoalco Rift (TZR) for geothermal exploration and to determine the deeper electrical conductivity distribution of the subsurface.

The available data set was carefully analyzed and the time series of those low-quality stations were reprocessed using a multivariate robust remote reference approach (Hering, 2019), improving the estimation of the frequency-dependent MT response functions, especially for Tippers.

Here, we perform a dimensionality analysis of the data using the MT Phase Tensor (PT, Caldwell et al., 2004) and the Complex Apparent Resistivity Tensor (CART, Brown, 2016, Hering et al., 2019). Both parameters have distinct features and sensitivities, which can be directly related to the conductivity distribution of different geological units. The comparison highlights the benefits of the interpretation of MT data sets using the novel CART. A spatially-constant phase split within the PT and coincident small induction vectors were observed between 10^1 – 10^2 period range, followed by a decrease in the phases for the longer periods, associated with an increase of the electrical resistivity.

Subsequently, 110 MT broadband stations were used to derive a high-resolution resistivity model of the San Pedro-Ceboruco (SPC) graben. 3-D inversion models derived from Impedance tensor and Tipper (Z and T) are compared to those resulting from PT and CART inversions. The model results reveal improvements for the advanced MT transfer functions, which result in a better resolution of vertical and horizontal resistivity gradients.

The resistivity model reveals a high conductivity ascent path, which connects the Ceboruco volcanic edifice to a mid-to-lower crust mush zone within the Tepic-Zacoalco Rift. Furthermore, the observed constant phase split and the small induction arrows coincide with the electrical anisotropy zone previously identified in the Ceboruco volcano by Hering et al. (2021).

Keywords: Magnetotellurics, Complex Apparent Resistivity Tensor, Electrical Anisotropy

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