Structure of the San Pedro-Ceboruco graben (Mexico) inferred from 3-D magnetotelluric data

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SUMMARY

Imaging the architecture of volcanic systems is essential for understanding their evolution and assessing their potential as renewable energy resources. The magnetotelluric method effectively images volcanic plumbing systems by mapping the electrical resistivity distribution at depth. It places particular interest on highly conductive zones, which may be linked to rock alteration, magma, partial melt, or related fluids.

The San Pedro-Ceboruco graben is a subduction-related extensional basin located in the northern part of a wider tectonic structure called Tepic-Zacoalco rift in NW Mexico. In this region, the complex extensional tectonism is associated with the emplacement of volcanic and subvolcanic bodies since the Pliocene, such as the active Ceboruco stratovolcano, the Tepetiltic volcano, the Amado Nervo shield volcano, and the San Pedro-Cerro Grande volcanic complex.

A broad-band magnetotelluric dataset was collected along the San Pedro-Ceboruco graben to characterize the electrical resistivity distribution beneath this complex structural basin. The dataset was processed using the multivariate processing approach implemented within the FFMT software package developed at Frankfurt University. Here, we present the electrical resistivity model of the San Pedro-Ceboruco graben derived from the joint 3-D inversion of the full impedance tensor and tipper data from 41 sites, covering a frequency range from 400 Hz to 1000 s. The resulting 3-D inversion resistivity model imaged several interesting features along the San Pedro-Ceboruco graben. These include an extensive shallow conductor within the first kilometers of depth, a deeper conductor at ~10 km, and vertical conduits suggesting the presence of hydrothermal activity related to the volcanic systems in the graben. Additionally, a notable resistive feature was interpreted to be the granitic unit known as Jalisco Block.

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