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Three-dimensional magnetotelluric exploration of Tenerife geothermal field (Canary Islands, Spain).

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Several magnetotelluric (MT) surveys have been carried out to investigate the geothermal system in Tenerife Island (Canary Islands, Spain). These data have been acquired since 1987 till 2012 by different agencies and institutions. In 1987 and 1991, two MT surveys were carried out by the Spanish Geological Survey (IGME). These data in paper format (129 MT sites in total) were collected and digitized. In October 2009, 83 stations were acquired for Petratherm Ltd., and 25 stations in March 2012 by the University of Barcelona. In total, 237 MT stations distributed around the island center are available for this study.

A simplified conceptual model of the island using known geological and geophysical data has been created to identify the ocean and topography effects on the MT data. The typical conceptual model of a generic high temperature volcanic geothermal system (Cumming, 2009a; Pellerin, 1996) and the 1D models from the MT data have played a key role for the correct construction of this conceptual model. Synthetic forward modeling was performed on a set of models to determine the effect of topography and of the conductive Atlantic Ocean.

Finally, a 3D resistivity model of Tenerife Island has been computed with modEM code (Egbert and Kelbert, 2012). Out of the 237 MT sites available, 87 stations were discarded because of computational capability problems. Thus, for this new 3D model, 150 MT sites have been taking into account from the different field surveys. The model is discrtized on 94x65x133-layer grid and the inversions are undertaken using the off-diagonal components (Zxy, Zyx) of the impedance tensor for 16 periods in the frequency range from 1000 to 0.1 Hz. In the inversion processing we assumed a 5% error floor in the impedance components and the final RMS is 3.5.

The 3D inversion model shows the typical layered pattern expected from a volcanic complex (andesite, basalt) with a possible geothermal overprint; a resistive fresh volcanic structure near the surface (up to 1 km depth in some areas) overlying a broad conductive zone associated to an hydrothermal clay alteration cap, overlying a higher resistive core.