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Three-dimensional resistivity structure of Furnas volcano (Azores archipelago, Portugal) revealed by magnetotelluric data

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The Furnas volcano is the eastern-most of the three active central volcanoes of Sao Miguel Island. The main caldera formed about 30 ka BP, followed by a younger eruption at 10-12 ka BP, which is responsible for the steep topography of more than 200 m in the target area. It contains several very young eruptive centers, and a shallow caldera lake. Tectonic features of varying directions have been identified in the caldera and its vicinity (Carmo et al., 2015). In the northern part of the caldera, containing the fumarole field of Caldeiras das Furnas, a detailed map of surface CO_2 emissions was recently made available (Viveiros et al., 2010).

Following a pilot survey of 13 AudioMagnetoTelluric soundings (AMT) and Electrical Resistivity Tomography (ERT) data collected along two profiles in the eastern part of Furnas caldera in 2015, a second campaign was completed in June 2016, yielding a total of 39 separate soundings including 15 broad-band magnetotelluric (MT) soundings to image the electrical conductivity of the subsurface. The data quality achieved by both techniques is very good, and initial results indicate a general correlation between regions of elevated conductivity at depth and the mapped surface CO_2 emissions, suggesting that they may both be caused by the presence hydrothermal fluids.

Dimensionality and directionality analysis using the WALDIM (Marti et al., 2009) approach in conjunction with Phase Tensor (Caldwell et al., 2004) indicate that the geo-electrical structure needs to be inverted in 3-D. Indicators of directionality derived from the analysis follow the general geological, fault dominated structural trend of NE-SW of Sao Miguel Island. A quantitative analysis of the potential influence of the Atlantic Ocean indicates that MT data up to 1 second period can be used in inversions with confidence without including the ocean. The 3-D inversions thus have been performed including only high-resolution topography and the Furnas lake bathymetry data employing the parallel version of the Modular system for ElectroMagnetic inversion code (ModEM; Egbert and Kelbert, 2012; Kelbert et al., 2014). The 3-D resistivity model shows a shallow conductive body at a depth of 90 m a.s.l. beneath the area of Furnas lake fumaroles. Deep-seated high conductivity regions have been imaged beneath the Trachytic domes of the inner caldera and the northern part of the inner caldera.

This work will focus on the processing, analysis and 3-D inversion results of the MT data along with an interpretation of the geological structures found. A joint interpretation of the MT results together with the ERT data covering the shallow regime with much higher resolution will also be presented.