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Imaging hydrothermal systems at Furnas caldera (Azores, Portugal): Insights from Audio-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 forms the steep topography of more than 200 m in the measuring 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. 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.

In 2015, a pilot survey of 13 AudioMagnetoTelluric soundings (AMT) and Electrical Resistivity Tomography (ERT) data were collected along two profiles in the eastern part of Furnas caldera in order to image the electrical conductivity of the subsurface. The data quality achieved by both techniques is extraordinary and first results indicate a general correlation between regions of elevated conductivity and the mapped surface CO_2 emissions, suggesting that they may both be caused by the presence hydrothermal fluids.

Tensor decomposition analysis using the Groom-Bailey approach produce a generalised geo-electric strike direction, 72deg East of North, for the AMT data compared to the surface geological strike derived from the major mapped fault crossing the profiles of 105deg. An analysis of the real induction arrows at certain frequencies (at depths greater than 350 m) infer that an extended conductor at depth does not exactly correspond to the degassing structures at the surface and extends outside the area of investigation.

The geometry of the most conductive regions with electrical conductivities less then1 ´m found at various depths differ from what was expected from earlier geologic and tectonic studies and possibly may not be directly related to the mapped fault systems at the surface. On the eastern profile, which seemed to be more appropriate for 2-D modelling with 72deg strike angle, a deep structure starting north of the major mapped fault crossing this profile can be found. It extends far to the south, with a top of approximately 150 m below the surface at the northern limit. A deeper conductive structure (top at about 300 m) is emerging at the southern end of the profile, though not fully resolved by the existing data.

This work will focus on the processing, analysis and preliminary modelling results of the AMT data. A joint interpretation of the AMT results together with the ERT data covering the shallow regime with much higher resolution will be presented.