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Modeling of an alkaline volcanic occurrence using audiomagnetotelluric (AMT) data in southeastern Brazil

Lucca Franco (Observatório Nacional), Emanuele Francesco La Terra (Observatório Nacional), Liliane Paiva Panetto (Observatório Nacional), Miguel Tupinambá (UERJ)

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Introduction

Located in southeastern Brazil, the Alto Paranaíba Igneous Province (APIP) comprises a complex geological setting that includes Eocretaceous fluvio-deltaic and aeolian siliciclastic rocks of the Areado Group, volcanic rocks of the Mata da Corda Group, and the underlying Neoproterozoic basement of the Bambuí Supergroup, all within the stratigraphic context of the Sãofranciscana Basin. This project seeks to model and delineate in 3D the structural framework of kamafugitic volcanic occurrences in this region. To achieve this, audiomagnetotelluric (AMT) data are being used to investigate subsurface electrical conductivity, enabling the identification of geoelectrical contrasts among the different geological units. In addition, lithological analyses of core and outcrop samples are being carried out and will be essential for future correlations between the interpreted geophysical models and well log data.

Method and/or Theory

The main objective of this study is to delineate the 3D structure of kamafugitic volcanic rocks by analyzing geoelectrical contrasts between the volcanic body and surrounding lithologies within the study area. Audiomagnetotelluric (AMT) data are used to achieve this, given the method's proven effectiveness in detecting geoelectrical signatures in similar geological contexts, such as kimberlitic occurrences in western Minas Gerais and other mineral exploration studies. AMT is a passive, non-invasive technique that estimates subsurface electrical resistivity by measuring natural time variations in electric and magnetic fields—signals primarily generated by atmospheric phenomena like lightning storms. Although widely applied in shallow subsurface investigations, AMT can also reveal valuable structural information in complex volcanic environments.

Results and Conclusions

So far, we have completed the 3D inversion of AMT data for 167 stations, covering an area of approximately 16 km², with good resolution down to a depth of 600 meters. The 3D model generated from this process allowed for the identification of a clear geoelectrical contrast between the Eocretaceous siliciclastic units and the Neocretaceous volcanic rocks, as anticipated by geological maps and borehole core analyses. Vertically oriented conductive anomalies were observed in parts of the model, which may be associated with magma feeder conduits and zones of volcanic hydrothermal alteration.

The study is being carried out in partnership with Sirius Pesquisas Minerais Ltda. company, that provided us with a study area, research-wise.