Submission code: 6P7856YBVN

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Geological and Geophysical Characterization of the Occidental Terrane of the Ribeira Belt Using the Magnetotelluric data

Gabriel Gama Lima (Observatório Nacional), Monica Heilbron (Universidade do Estado do Rio de Janeiro), Artur Benevides (Observatório Nacional), Sergio Fontes (National Observatory (Brazil)), Adevilson Alves (Observatório Nacional)

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Introduction

This study presents a NW-SE magnetotelluric (MT) profile approximately 200 km in length, consisting of 37 broadband stations, 10 of which also include long-period recordings, with spacings of 5 km and 15 km, respectively. The profile is located in southern Minas Gerais, Brazil, and is set within the context of the tectonic interaction between the São Francisco Craton and the Ribeira Belt, a region with complex geological understanding. The investigated region belongs to the Occidental Terrane of the Ribeira Belt, which corresponds to the reworked margin of the São Francisco paleocontinent associated with the Brasiliano orogenic cycle. During this deformational event, Paleoproterozoic basement units of the craton were affected by thrust faulting and became interleaved with metasedimentary sequences of the Andrelândia Supergroup, a neoproterozoic passive margin basin developed along the São Francisco paleocontinent. Due to its great significance for understanding the tectonic framework involved in the amalgamation of Western Gondwana, this region has been studied for decades through geological mapping, geochronology, and geochemistry. However, few studies have been published about the deep extent of suture zones associated with basement tectonic units and their boundaries. To achieve this objective, this study integrates subsurface features revealed by magnetotelluric resistivity models with well-constrained geological structures mapped at the surface.

Method and/or Theory

The MT stations were processed using a robust methodology for estimating the impedance tensor and tipper, covering a frequency range from 10^{4} Hz to 10^{-4} Hz. The profile containing all stations was inverted using the 3D Nonlinear conjugate gradient (NLCG) code from ModEM to obtain a resistivity model. A set of inversion runs were carried out to reach the best data fit and a model of homogeneous half-space of 100 Ohm.m was used with the bathymetry included (ocean layer of 0.3 Ohm.m). The final inversion converged and modeled data fit very well with the field-measured curves (nRMS: 2.4), and the Niblett-Bostick analysis showed a sensitivity depth of 100 km which is considered suitable for interpreting the crustal electrical structure of the study area.

Results and Conclusions

Based on the final resistivity model, the highly resistive upper crust was divided into Autochthonous and Allochthonous Domains, considering their structural characteristics, which were likely shaped by collisional events of the Brasiliano cycle during the Neoproterozoic Era. The resistivity model also indicates a regional significant decrease in resistivity at the transition from the upper to the lower crust. Additionally, interesting subvertical conductors are interpreted as Paleoproterozoic suture zones separating basement crustal blocks of the Occidental Terrane of the Ribeira Belt, which were potentially reactivated during Neoproterozoic collisional events.