Magnetotelluric and Geothermal analysis of the lithosphere beneath São Francisco Craton and Ribeira belt

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SUMMARY

The southeastern region of Brazil, encompassing the São Francisco Craton (SFC) and the Ribeira Orogen (RO), has a complex geodynamic history shaped by collisional events during the formation of Gondwana and the subsequent separation of the South American and African continents. This study integrates long-period magnetotelluric (LMT) and geothermal data to investigate the deep structure beneath the SFC and RO. Electrical resistivity models derived from LMT surveys provide insights into the state of the lithosphere, as bulk electrical conductivity is primarily controlled by temperature and mineralogical composition in the mantle. Temperature measurements from wells are used for determining thermal gradients and surface heat flow, which are necessary for modeling the temperature distribution in the crust and upper mantle. Low-resistivity zones in the lithosphere may indicate regions with hydration, partial melting, or conductive minerals, potentially associated with ancient subduction or collision zones. Conversely, high-resistivity zones are typical of stable, thermally cold, and thick cratonic areas, although other factors, such as the presence of crystalline igneous rocks, can also influence resistivity. Geothermal models can help differentiate electrical anomalies associated with thermal events and variations in mineralogical composition, such as the presence of graphite and carbonatite. In this study, the lithosphere-asthenosphere boundary (LAB) topology is also analyzed with MT data by using wavelet transforms to detect the resistivity variation associated with the transition from a mechanically rigid and cooler lithosphere to a plastic and hotter asthenosphere. The LAB is well established, resulting from mineral phase transition highly dependent on pressure. For the geothermal models, the thermal boundary layer (TBL) is defined as the approximately 1300ºC isotherm, the melting point of mantle rocks. LAB are obtained for both SFC and RO regions, while preliminary results show TBL thicker below the craton than for RO. The wavelet analysis of the resistivity profiles reasonably agree with TBL depths; however, it displays spatially more variability in SFC indicating mineral composition as the first constraint controlling conductivity but further investigations is required.

Keywords: LMT, Geothermal, Craton, Orogen, LAB