Unraveling the tectonic complexity of the Parnaíba Basin: A magnetotelluric approach

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SUMMARY

Located in the northeastern part of Brazil, the Parnaíba Basin is one of the largest Phanerozoic sedimentary basins developed on the South American platform, preserving significant records of the history of the formation of Western Gondwana. Despite extensive efforts in geophysical research studies, its internal structure and surrounding tectonic blocks remain unclear and subject to debate. In order to enhance our understanding of its deep structure and adjacent areas, we employed broadband magnetotelluric (MT) data to construct a three-dimensional electrical structure along a ~1400 km long EW oriented profile. The conductivity observed within the basin is intricately linked to a complex history involving geological processes of collisions and the amalgamation of tectonic blocks. The geo-electric model allows us to delineate the geometry and variation in resistivity of the lithospheric blocks comprising the Parnaíba Basin (Amazonian Craton, Parnaíba Block, and Borborema Province), which are delineated according to the geo-electric model by high resistivity anomalies. From west to east, the Amazonian Craton exhibits a conductive lower crust, transitioning to a more resistive domain at its eastern extremity due to the mafic composition of volcanic intrusions. Within the central part of the basin corresponding to the Parnaíba Block, MT data quality have proven to be quite poor due to electromagnetic noise; therefore, there is limited depth resolution, characterizing only the upper crust where high conductivity anomalies corresponding to Silurian-Eotriassic sedimentary sequences are identified. In the Borborema Province, a series of resistive and conductive anomalies are revealed in the mid to lower crust, providing evidence of collisional events in the block formation history and revealing the existence of a cryptic suture due to the deformation process of the orogenic system. Our study significantly contributes to a better crustal resolution regarding the geo-electrical behavior of the Parnaíba Basin, shedding new light on the tectonic evolution and formation models of Western Gondwana.

Keywords: Parnaíba Basin, magnetotelluric imaging, sedimentary basin structure.