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Magnetic signatures and 3D characterization of Archean iron formations in the São José do Campestre Terrane, Borborema Province (NE-Brazil)

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Introduction

The Archean banded iron formations of the northern portion of the Borborema Province are located in the São José do Campestre Terrane (NE-Brazil), which contains some of the oldest rocks in South America. They are characterized by alternating iron- and silica-rich layers, generally composed of magnetite and quartz, deformed and metamorphosed during Paleoproterozoic and Neoproterozoic events. This study describes the main magnetic signatures associated with the iron formations and the 3D distribution of magnetization of subsurface sources, with depth estimates and indication of structural controls. These results were correlated with field information, borehole core data, and Fe content.

Method

Aeromagnetic data contracted by the Geological Survey of Brazil (SGB) in N-S direction flight lines and spaced 500 m apart, and at 100 m above the terrain were used. Qualitative interpretation of the aeromagnetic data was used to support the investigation and selection of areas for modeling. The magnetic vector inversion (MVI) was implemented semi-automatically to calculate the effects of induced magnetization, remanence and rock anisotropy (magnetic domain amplitude and direction) in the main subareas with prospective potential. 3D Euler deconvolution was also performed to complement the three-dimensional description of the magnetic signatures.

Results and Conclusions

The magnetic signatures of the main targets associated with iron mining in the region (i.e. Cavalo Branco, Pegasus and Bandeiras) indicate high Fe content (magnetite, > 500 nT). The qualitative interpretation of the magnetic lineaments shows linear (NE-SW, NW-SE, E-W) and elliptical patterns, reflecting the deformation tectonics that affected the rocks of the Archean nucleus.

The inverted data delimit the main targets. The 3D magnetization models indicate high values of magnetic susceptibility (> 0.01 SI) and, sometimes, evidence of remanent magnetization. The determination of magnetic susceptibility isosurfaces integrated with the 3D Euler solutions and correlated with information from drill holes show that the main bodies are shallow and have a few hundred meters of thickness.

The results of this study provide evidence for the formulation of prospective models with a view to expanding iron reserves in the São José do Campestre Terrane, as well as to clarify the structural complexities of iron formations in metamorphosed and tectonically deformed Archean rocks.