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Geophysical survey as a follow-up method in mineral exploration – Electroresistivity and IP over boxwork occurrence in Aruanã (GO)

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Introduction

Mineral prospection is a costly endeavour, especially in greenfield projects, where economic returns are uncertain Therefore, cost-effective methods are crucial to minimizing risks and improving efficiency in locating and defining targets. This abstract outlines how geophysical surveys, namely resistivity and induced polarization methods were applied as a follow-up step in a multi-stage small scale exploration project developed in Paleoproterozoic boxwork-bearing quartzites in Aruanã, western Goiás state, Brazil. Through field mapping, this project initially identified boxwork structures disseminated within quartzite blocks at the base and along a 2.5 km-long ridge amid alluvial plains and lateritic soil with a deeply weathered profile. Trace amounts of pyrite and chalcopyrite were identified in the boxworks, prompting geochemical analysis and geophysical surveys, before assessing and planning exploratory drillholes.

Method

This exploration project followed a multi-stage investigation strategy. The initial phase involved the analysis of scientific literature and technical reports concerning the regional geology and mineral potential, complemented by data from regional aerogeophysical surveys. Additionally, processed satellite imagery from Copernicus Sentinel-2 (band 8) in visible and infrared spectral ranges was used in custom RGB compositions to enhance lithological and alteration mapping Geological field mapping was carried out in conjunction with soil and pan concentrate sampling, with samples analyzed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) following total fusion with Na2O2. Groundwater analysis from local wells contributed to the delineation of exploration targets, revealing a low-pH anomaly near the ridge, which was interpreted as potential evidence of sulfide oxidation at depth. To investigate the subsurface, electrical resistivity and induced polarization (IP) surveys were conducted along four 450 m-long lines, spaced 200 m apart, and oriented perpendicular to the tilted bedding of the quartzite ridge. Electrodes were placed at 10 m intervals . Data acquisition employed an Ares II multichannel 850 W, 2000 Vp-p, 5A with 100µV resolution, from GF Instruments. Time-domain IP measurements were collected using an integration time window between 4.0 and 2.0 ms. All data processing was performed using Oasis Montaj software by Seequent/Geosoft.

Results

The systematic, multi-method investigation effectively evaluated the mineral potential of the study area and provided a strong foundation for advancing the exploration program. Remote sensing, geological mapping, and geochemical analysis played a key role in narrowing down the initial target area and in outlining a mineralization model consistent with disseminated sulfides, with potential for Cu-(Au) enrichment. This data was critical in supporting the decision to continue exploration and in guiding the selection of suitable geophysical methods. The subsequent geophysical surveys yielded valuable information: inverted resistivity profiles revealed lithological domains with contrasting electrical responses, which are currently being compared with drill cores for validation. In parallel, induced polarization (IP) profiles delineated anomalous zones with elevated chargeability values (exceeding 16.0 ms), which were prioritized as drilling targets. These high-chargeability zones correlated spatially with the occurrence of disseminated sulfides at depth, demonstrating the effectiveness of geoelectrical methods in refining exploration targets and optimizing drillhole placement.