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Aerogeophysical Mapping of Gold-Related Alteration in the Alta Floresta Gold Province: A Case Study from Teles Pires

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Introduction

The Teles Pires region, located in the Alta Floresta Gold Province (AFGP), southern Amazon Craton, hosts several gold occurrences associated with Paleoproterozoic granitic and metavolcano-sedimentary rocks. Structural control and hydrothermal alteration are key exploration indicators in such mineral provinces. Airborne magnetometry and gamma-ray spectrometry have been widely used to map lithological units, structural lineaments, and geochemical anomalies, especially those related to hydrothermal fluid pathways.

Methodology

This study employed airborne geophysical magnetometry and gamma-ray spectrometry, acquired in the Alta Floresta Gold Province over the Teles Pires region, as part of the SGB/CPRM geophysical project 1121. Magnetic data were processed to generate two enhancement products: the Total Gradient, which emphasizes the edges of magnetic sources, and the Tilt Derivative combined with the gradient, highlighting subtle structures and enhancing lithological boundaries.

Gamma-ray spectrometry data were interpreted through the generation of the ternary image (K–eTh–eU) and specific radioelemental ratios: eU/eTh, K/eTh, and the F-parameter ($F = \frac{K \cdot eTh}{eU}$). These ratios are indicative of geochemical variations and potential hydrothermal alteration. All products were integrated for structural and geochemical interpretation, with known gold occurrences used as spatial reference points to assess the effectiveness of the geophysical indicators.

Results

Magnetic data analysis reveals that the known gold occurrences in the Teles Pires region do not coincide with prominent magnetic anomalies or clearly defined structural lineaments. The magnetic signal primarily reflects regional lithological variations, and while structural features are present, they do not show direct spatial correlation with mineralized zones. This suggests a limited direct structural control over gold deposition.

In contrast, gamma-ray spectrometry products indicate a more unmistakable geochemical signature related to mineralization. High K/Th values ($>$20) define zones of potassic alteration, while low Th/U ratios ($<$2) mark areas of uranium depletion—both indicative of hydrothermal processes. The F-factor and ternary maps highlight compositional anomalies near structural intersections, suggesting that magnetic structures do not directly host gold. Still, they may have influenced the pathways of mineralizing hydrothermal fluids. Thus, an indirect structural control, through fluid channeling and alteration zoning, is supported by the radiometric data.