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Magnetic and Radiometric Mapping of Felsic Intrusions in Carajás: Interpretations for the Igarapé Gelado–Salobo System

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Introduction

The Igarapé Gelado granite, located within the Carajás Mineral Province (CMP), is an elliptical felsic intrusion surrounded by metavolcano-sedimentary rocks. Its magmatic history remains debated, with hypotheses suggesting either a single emplacement event or multiple pulses with distinct geochemical characteristics. Understanding its internal architecture is critical to resolving this debate and advancing regional geological models.

Methodology

This study integrates airborne magnetic and gamma-ray spectrometric data to investigate the internal structure and geochemical variability of the Igarapé Gelado intrusive body. Magnetic data, acquired from the Western Carajás (1125) survey with 500-meter flight line spacing, were processed to enhance regional and local features. Techniques applied include first-order derivatives (X, Y, Z), total gradient magnitude, and tilt derivative filtering, delineating lineaments, lithological contacts, and potential internal discontinuities.

Gamma-ray spectrometric data provided concentration maps for potassium (K), equivalent thorium (eTh), and equivalent uranium (eU), along with interpretive products. A ternary RGB image (K–eTh–eU) supported lithological discrimination, while ratios such as eTh/K, eU/K, and eU/eTh highlighted compositional domains and potential alteration zones. The F-parameter ($F = \frac{K \cdot eTh}{eU}$) was computed to emphasize uranium-depleted areas potentially related to fluid interactions or weathering.

Results and Conclusions

The integrated interpretation of magnetic and gamma-ray spectrometric data reveals critical structural and compositional contrasts within the Igarapé Gelado–Salobo region. Magnetic derivatives and gradient magnitude maps distinguish two geophysically distinct domains: the Igarapé Gelado body and the Salobo domain, the latter positioned between segments of the former and exhibiting markedly different magnetic patterns. These differences suggest that Salobo does not belong to the same lithological unit and may be internally heterogeneous.

Gamma-ray data reinforce this distinction. The ternary (K–eTh–eU) image indicates compositional zoning, while radiometric ratios (eU/eTh, eU/K, eTh/K) and F-parameter maps highlight geochemical variability not aligned with mapped lithologic boundaries. These variations suggest that Igarapé Gelado and Salobo may have shapes and extents different from those portrayed in the literature, with Salobo possibly presenting internal deformation. The results suggest that these bodies' currently mapped limits and classification require revision. This study proposes a new structural and compositional layout for the Igarapé Gelado–Salobo system, contributing to a refined geological understanding of this segment of the Carajás Mineral Province.