Aerogeophysical Mapping of the Igarapé Gelado Area: Implications for Mineral Exploration

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Abstract

This study presents a comprehensive analysis of aerogeophysical data collected in the northern Serra dos Carajás, specifically in the Igarapé Gelado area, located south of Pará state in north Brazil. The Geological Survey of Brazil (SGB) provides a publicly accessible database of aerogeophysical projects nationwide, which serves as a valuable resource for understanding the geological framework of various regions. The central objective of this study is to examine geophysical anomalies and patterns that reveal the geological structures of the study area. Data from geophysical projects 1097 and 1129, using high-resolution magnetometry and radiometry, provided detailed measurements of magnetic and radiometric properties.

The Carajás Province, situated within the Amazon Craton, is geologically rich and divided into the Rio Maria and Carajás domains. The Rio Maria Domain is characterized by Mesoarchean granitoid-greenstone terrain, while the Transamazonas and Tocantins provinces bound the Carajás Province. This region hosts numerous world-class mineral deposits, including iron, manganese, copper-gold, nickel, cobalt, zinc, aluminum, chromium, platinum group elements, tin, and tungsten. Additionally, the area is known for its numerous gold and gemstone mines.

Magnetic data processing followed this approach: Upward Continuation was applied to reduce high-frequency noise, Analytic Signal Amplitude (ASA) was used to centralize magnetic anomalies, and Tilt Derivative was employed to enhance magnetic lineaments. For the gamma data, a ternary map was generated to observe the composition of the three primary radioactive elements (potassium, uranium, and thorium), facilitating the identification of major granitic bodies. This method provides a clearer picture of the surface geology and helps distinguish different rock types based on their radiometric signatures.

The aerogeophysical data in the Igarapé Gelado region revealed significant geophysical anomalies, indicating the presence of both superficial and deep geological structures. Variations in magnetic and radiometric properties suggest high concentrations of mineral deposits, particularly iron, copper, and nickel. These magnetic anomalies are critical indicators of mineralization zones and provide valuable insights into the distribution and extent of these resources. Radiometric variations further indicate the presence of other elements, such as cobalt and zinc. Granites were identified in the data, and regions showing these granitic signatures, combined with the results from the Tilt Derivative analysis, point to potential gold and manganese deposits.

Integrating these aerogeophysical datasets enhances the understanding of the geological structures in the Igarapé Gelado area. The analysis highlights the region's substantial mineral potential and demonstrates the effectiveness of aerogeophysical techniques in identifying and delineating mineral resources. This study contributes to the scientific knowledge of the area's geology and provides valuable information for future mineral exploration and economic development in the Carajás Province.