The Integration of Mineralogical, Geochemical and Physical Rock Properties Applied to the Exploration of Large Hypogene Zinc Silicate Deposits: A Case Study of the Vazante Zinc Deposits, Minas Gerais, Brazil

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Abstract

Exploration for large zinc silicate deposits is more challenging than zinc sulfide deposits, as they do not exhibit similar geophysical anomalies. The Vazante deposit, is the world's largest zinc silicate deposit, occurring in brecciated dolomite composed of mainly willemite with various proportions of hematite, and minor franklinite and sphalerite. In the Vazante region, the exploration challenge is enhanced as outcrops are rare, bedrock generally sits below 10s of metres of laterite cover and barren hematite-rich breccias have a similar geophysical signature to willemite ore bodies. In order to evaluate the applications of geophysical surveys in the exploration of this type of deposit, data from 475 samples was investigated from drill holes representative of the various types of ore, host rocks and zones of known geophysical anomalies in the Vazante District. Geochemical (ICP-MS and XRF) and mineralogical (optical, EMPA, SEM and MLA) data were integrated with physical rock properties (density, magnetic susceptibility and K-U-Th gamma ray spectrometry) to assist in finding new ore zones. The most distinct physical property of the ore is density (3.0-4.3 g/cm3), compared with the host rocks (2.7-3.0 g/cm3). This is due to high proportion of denser minerals (hematite and willemite) in the ore. However, barren hematite breccias also have high densities (3.0-4.5 g/cm3). The zinc ore and hematite breccias yielded higher magnetic susceptibilities (0.1-38 x10-3 SI) than the surrounding host rocks, with the highest values associated with greater proportions of franklinite and magnetite (7-38 x10-3 SI). Zinc ore has elevated U concentrations (up to 33ppm) relative to the various host rocks (1-7 ppm), yielding higher gamma spectrometric values. The results of this investigation indicates that an integration of magnetic, gravimetric and radiometric surveys would be required to identify zinc silicate ore zones and potentially differentiate them from barren hematite breccias and host rocks.