The Singular Polymetallic Occurence in Zona Basal, Quadrilátero Ferrífero, Brazil: Mineralogical and Geochemical Characterization and Genetic Implications

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The Quadrilátero Ferrífero (QF) mining district, one of the main Au-Fe metallogenic provinces in Brazil, holds historic, strategic, and economic importance. Located in the southern São Francisco craton, it comprises gold deposits discovered as early as in the 17th century. The Turmalina area deposits are amongst those, and are modernly known to be hosted in amphibolite-facies rocks of the Archean Pitangui Greenstone Belt (PGB) in the northwestern portion of the QF. While the most widely known deposits in the QF are regarded as classic orogenic gold type, those situated in the PGB (such as Satinoco—part of the Turmalina area—and São Sebastião) show hypozonal orogenic gold characteristics. The recently discovered Zona Basal (ZB) gold prospect in the Turmalina area shows even further differentiation, as it displays a singular Au-Ag-Cu-Zn-Pb-Sb association. Since base metal occurrences in the QF are scarce, geochemical, mineralogical, and textural analyses of ZB deposit samples are key to revealing the deposit's genetic conditions. So far, geochemical and mineralogical characterization unveiled two stages of mineralization: an Au-W-As late- to post-tectonic stage, displaying arsenopyrite-pyrrhotite-pyrite assemblages associated with gold and scheelite; and the following Ag and base metals stage, with its strictly post-tectonic pyrrhotite-pyrite-sphalerite-chalcopyrite-galena-ullmanite±meneghinite± fahlore± miargyrite± pyrargyrite assemblage. While the first stage crystallized from ~491° to 404°C, during the transition from peak greenschist facies to retrograde metamorphism, the second stage crystallized from ~400° to <170°C. Possible mechanisms that may elucidate the chemical changes between both stages are participation of magmatic-hydrothermal, relatively low-temperature fluids, associated with syn- to late-tectonic granite intrusion, or localized re-concentration of base metals caused by fluid immiscibility after the transition from ductile to brittle conditions, generating fluids with contrasting salinities. Those results point to the necessity of understanding the nature of reactions of mineral re-equilibrium in complex ore formation.