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## Analysis of Visual Grading of the Hydrothermal Alteration of the Vazante Zn-Pb Deposit, Minas Gerais, Brazil: A New Vector for Exploration?

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The Vazante Zn-Pb deposit, located in the northwest of Minas Gerais, Brazil, is considered one of the largest hypogene willemite ( $Zn_2SiO_4$ ) deposits in the world. Its ore is structurally controlled by the Vazante Fault and hosted by dolomitic rocks from the Vazante Belt. The hydrothermal alteration is marked by strong silicification, dolomitization, and hematitization, composing a diverse brecciated zone. The colour variations induced by hydrothermal alteration has been a visual indicator for the superficial grading of ore in the Vazante and North Extension mines. Looking for new vectors of prospection and to validate this visual guide, Vazante's exploration team analysed the brecciated system through six cross sections within the mines. Five main lithotypes were defined in this evaluation by colour and composition for the brecciated zone: iron-carbonated dolomitic breccias, divided in weak, moderate and strong alteration type; hematitic breccia; and the willemitic ore. The Principal Component Analysis (PCA) of whole-rock samples from the drill holes in the cross sections shows element clusters that distinct the unaltered host rocks, the iron-carbonated dolomitic breccias, and display a progression of the alteration in between the five lithotypes towards the hematitic breccia and the willemite ore with the association of mineralization-related elements (Zn, Pb, Fe, Ag, As, Sb, Cd, Mo). PCA graphics also suggest provenance of determined elements and pathfinder elements that contribute to mineral exploration. The cross sections, however, exhibit a complex placement of the defined lithotypes, where the envelope progression expected for the brecciated zone and mineralization is inconsistently followed. This variability is attributed to interactions between host rock and fluids, or syn-post-mineralization displacement of the hydrothermal zone. The analysis bolstered the classification of Vazante's hydrothermal breccia with technical evidence, introducing efficient tools for pinpointing zinc ore deposits and enhancing predictability in mineral exploration in the region.