

Laminated Quartz Vein Evolution and Gold Mineralization at the Paraíba Mine, Juruaena–Teles Pires Province, Brazil

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The Paraíba gold mine represents the second mining operation and the first underground development within the Juruaena–Teles Pires Mineral Province, located in the southern portion of the Amazonian Craton, Brazil. This mineral-rich province hosts hundreds of gold and copper occurrences and has a long history of artisanal mining spanning more than four decades. Regionally, mineralization is structurally controlled by a network of NW-trending shear zones, commonly associated with subsidiary N–S and E–W structures, and later overprinted by NE-trending faults. The Paraíba deposit is specifically associated with an N05W-oriented shear zone. The host rocks comprise gneiss, foliated tonalite, and mafic to ultramafic amphibolites of Archean to early Paleoproterozoic age (ca. 2.8–1.98 Ga), intruded by younger units such as syenogranite and quartz–feldspar porphyry (ca. 1.79 Ga). Mineralization occurs as laminated quartz–sulfide–gold veins, typically 0.2 to 2.0 m thick, composed predominantly of quartz, pyrite, chalcopyrite, and native gold. Underground observations indicate that the contact between ore veins and host rocks is locally defined by two main structural features: (i) a narrow phyllonite zone (up to 1 m thick) with foliation dipping 60–80° SW, and (ii) breccia zones. Petrography, cathodoluminescence, and EBSD (Electron Backscatter Diffraction) analyses of the laminated veins reveal at least two phases of intracrystalline plastic deformation separated by a cataclastic event. This brittle episode is interpreted to be associated with the main mineralization stage and is characterized by quartz dissolution in equilibrium with fractured pyrite, chalcopyrite, and gold. These features suggest episodic fluid flow and gold deposition controlled by fault-valve mechanisms.