

Gold Deposit Formation during Collapse Tectonics: Structural, Mineralogical, Geochronological, and Fluid Inclusion Constraints in the Ouro Preto Gold Mines, Quadrilátero Ferrífero, Brazil

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Abstract

The gold deposits of the Ouro Preto area (Minas Gerais, Brazil) occur along the main tectonic contact responsible for the thrusting of the Paleoproterozoic units (Minas Supergroup) onto the gneissic and metasedimentary Archean units (Rio das Velhas Supergroup) during the Brasiliano (ca. 600 Ma) tectonic event. These deposits are claimed to be the most complex of the Quadrilátero Ferrífero, with orebodies lying parallel to the thrust-related stretching lineation. Based on structural, mineralogical, geochronological, and fluid inclusion constraints, our study demonstrates that the gold-bearing quartz veins were formed in response to late orogenic collapse tectonics that led, in this area, to gravity backsliding of the nappes. During these movements, sigmoidal voids were created and filled by elongate quartz grains associated with sulfides, tourmaline, and carbonates. Inferred hydrothermal effects were responsible for the formation of illite, sulfides, carbonate, garnet, and green biotite within the matrix. Large arsenopyrites within the veins were affected by three stages of fracturing during which the metallic phases and associated gold were deposited. Gold, wherever it is in contact with Bi-related minerals, occurs in the form of electrum, maldonite, or aurostibite. Fluid inclusion studies show that this event was associated with the entrapment of both CO₂-rich and H₂O salt-rich fluids. The process was initiated after the Brasiliano thrusting event (ca. 500°C, 8 kbars) and in P-T conditions close to 300° to 400°C and 2 kbars. An age of ca. 485 to 490 Ma has been obtained by ⁴⁰Ar/³⁹Ar dating of hydrothermal biotite and muscovite. This study demonstrates that the Ouro Preto gold deposits were formed in a context of late orogenic collapse tectonics, drastically different from the conventional auriferous shear zone model. This could account for their relative paucity compared to other mesothermal gold deposits.