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Hydrothermal Alteration Mineralogy, Zoning and Paragenesis at the Low-Sulfidation Epithermal Cerro Blanco Deposit, Guatemala

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The Cerro Blanco deposit in southeast Guatemala is a classic hot spring-related low-sulfidation epithermal system with gold resource of 3 million ounces (61 million tonnes grading 1.5 g/t Au in Measured and Indicated categories), within a 400-m-wide and 900-m-long area. Hydrothermal alteration and mineralization of the Cerro Blanco deposit, mineral chemical composition, and textural and overprinting relationships are successfully characterized using a combination of hyperspectral imaging spectroscopy in the VIS-NIR-SWIR wavelength range, petrography, SEM, and EDS studies.

High-grade gold mineralization (>5 g/t Au) is primarily hosted in the Tertiary Mita Group sedimentary and volcaniclastic rocks within 60 currently defined veins that form two upward-flaring swarms converging downwards and merging into basal feeder veins. The overlying Salinas Group locally hosts low-grade (0.5–2 g/t Au), disseminated gold mineralization in silicified polymictic conglomerate and volcaniclastic rocks intercalated with siliceous sinter horizons formed by hot-spring activity. The Cerro Blanco deposit is located within a north-south striking graben. The East Fault separates the Au-Ag-bearing quartz-adularia veins from the Mita geothermal field with present-day active hot springs. The overall shape of the orebody is related to the geometry of pre-mineral faults, associated hydrothermal veins, and alteration zones.

Veins are dominated by crustiform, colloform, and amorphous quartz with associated adularia and calcite. Results of $^{40}Ar/^{36}Ar$ geochronology analysis on vein-hosted adularia indicate an age of 4.93 ± 0.47 Ma. The pristine nature of the veins at Cerro Blanco is explained by the young age of the deposit and lack of post-mineral faulting.

The main ore minerals are electrum (<1 mm) and gold as native inclusions (<500 µm) in pyrite, chalcopyrite, and acanthite. Selenides, sphalerite, and galena are sparse but also present. Two paragenetic stages of vein formation and hydrothermal alteration are defined. The main auriferous veins consist of crustiform and colloform bands that are characterized by paragenetic stage 1 equilibrium assemblage of quartz(chalcedony)-adularia-calcite-ankerite. Sulfides are located in ginguro bands consisting of fine-grained acanthite, with minor pyrite, chalcopyrite, and tetrahedrite. Stage 2 of the paragenesis is characterized by intense overprinting of the quartz-adularia-calcite-ankerite veins by montmorillonite and interstratified illite, and quartz replacement of bladed calcite. The bladed calcite veins are characteristically devoid of sulfides and gold. Hydrothermal alteration in the proximal zone of the sedimentary and volcaniclastic wall rocks is characterized by paragenetic stage 1 with quartz-adularia-illite-calcite and locally montmorillonite. The distal alteration zone is marked by quartz-illite-chlorite-calcite.

Wall rock-hosted illite suggests a temperature of formation >230°C. The crustiform and colloform-banded texture of quartz-adularia and carbonate veins, the location of native gold in stage 1 veins, lattice-bladed calcite and associated silica replacement are compatible with episodic fluid boiling and drop in the total confining pressure. The combination of these mineralogical and textural features suggests hydrothermal boiling is the principal precipitation mechanism for gold, silver, adularia, and bladed calcite.

The results of this hydrothermal alteration study carry significant implications for exploration, including targeting for extension of high-grade (>5 g/t Au) gold veins in the Cerro Blanco deposit and nearby concealed orebodies and new epithermal deposits in the region.