

Zonation in Carbonate Species in the La Colorada Zn-Pb-Ag Skarn-CRD-Epithermal Deposit, Mexico

Joshua Ebner¹, Zhaoshan Chang¹, Pedro Francisco², Dante Juarez², Patricio Perez², Chris Emerson²

¹Colorado School Of Mines, Golden, United States, ²Pan American Silver, , Mexico

The La Colorada deposit in the Chalchihuites District of Zacatecas, Mexico, features intermediate sulfidation epithermal (IS), carbonate replacement (CRD), skarn, and porphyry styles of mineralization. Volcanic-hosted IS veins transition to CRD veins in underlying carbonates, with total (measured, indicated, inferred) resources of 18.3 Mt containing 161.3 Moz Ag, 0.1 Moz Au, 0.3 Mt Pb, and 0.5 Mt Zn separate of total reserves (proven, probable) of 9.5 Mt containing 90.7 Moz Ag, 0.06 Moz Au, 0.1 Mt Pb, and 0.2 Mt Zn (6/30/2025). To depth, CRD veins transition to massive CRD, which transitions to skarn. The skarn was first drilled in 2018 by Pan American Silver and contains 327.1 Mt of total (indicated, inferred) resources hosting 367.3 Moz Ag, 4.2 Mt Pb, and 9.1 Mt Zn (9/11/2024).

Skarn surrounds eastern and western concealed intrusive centers. Stage 2 (prograde) skarn minerals are spatially zoned. From proximal to distal, garnet color lightens from red to brown to yellow-green; pyroxene color changes from green to brown with minor rhodonite, and the garnet to pyroxene ratio decreases. This study investigates zoning in the composition of Stage 4 (late retrograde) carbonate minerals that occur together with quartz, sulfides and sulfosalts through Electron Micro-Probe Analysis (EPMA). Siderite is slightly paragenetically earlier than calcite and contains up to 9.0 wt% MnO. In the eastern center, MnO in calcite increases from 1.5 wt% (red garnet skarn) to 3.1 wt% (brown pyroxene skarn) and remains 3.1 wt% ~150 m beyond the skarn (CRD), ~740 m from a ~600 m wide syn-skarn rhyodacite porphyry (RDP) stock. In the western center, MnO in calcite decreases from 2.5 wt% (brown garnet skarn) to 0.1 wt% (green pyroxene > yellow garnet skarn), ~500 m from a ~20 m wide syn-skarn RDP dike, indicating that this small center is relatively more distal.