

## **Mineralogical Characterization and Zonation of the Payandé Cu Skarn, Central Cordillera, Colombia**

Julian David Medina Arboleda,\* Julian David Melo, and Andrés Felipe Gonzalez

Universidad Nacional de Colombia Sede Bogota, Bogotá, Cundinamarca, Colombia, \*e-mail, jdmedinaa@unal.edu.co

The Payandé Cu skarn deposit is located approximately 180 km SW of Bogotá in the eastern flank of the Central Cordillera of Colombia. The geology of the area is dominated by the Payandé Formation, which comprises a Triassic limestone sequence. This sequence is intruded by the Payandé stock, a Jurassic igneous body of granodioritic to quartz-dioritic composition. Such an intrusion generated metasomatism and mineralization in the country rocks surrounding the stock. This deposit was exploited for copper throughout the last century in an artisanal way. Nevertheless, no significant research has been carried out to characterize the ore mineralogy of the deposit. This work identifies the mineralogical zonation, and the temporal and genetic relationships between the distinct ore-forming stages, including the gold and bismuth occurrences.

There is a zonation generated by the contact metamorphism through its prograde stage. This includes an exoskarn which is zoned outward from the intrusion. The most proximal zone comprises reddish-brown garnet, followed by a zone of green garnet, then a wollastonite- and diopside-bearing marble, and finally a calcite-bearing marble. The mineralization crosscuts these contact metamorphic facies and it is made up of five distinct mineral assemblages.

The mineralization stages in chronological formation order are as follows: i) lenses and veins of massive magnetite  $\pm$ chalcopyrite  $\pm$ phlogopite  $\pm$ actinolite  $\pm$ epidote  $\pm$ titanite, with a replacement and pseudomorphism of magnetite after garnet; ii) chalcopyrite  $\pm$ bornite  $\pm$ cubanite  $\pm$ pyrite  $\pm$ wolframite  $\pm$ bismuth sulfosalts  $\pm$ electrum; iii) sphalerite-chalcopyrite-calcite, in which chalcopyrite occurs within the sphalerite in the form of blobs and through the cleavage planes; iv) drusiform veins and veinlets of specularite-quartz and chlorite (magnetite martitization); and v) supergene oxidation that resulted in the formation of malachite-azurite and covellite.

A micro-Raman analysis pointed out that all the garnet compositionally corresponds to the andradite member. Moreover, electron microprobe analysis indicates that the gold grains are silver-rich (electrum) in association with bismuth sulfosalts and iron-bearing wolframite that developed during a late-stage retrograde episode.