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Geochemical and Petrographic Analysis of a Copper Sediment-Hosted Mineralization at Chiquinquirá Village, Boyacá Department, Colombia

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Colombia has three major cordilleras. The Oriental Cordillera is currently being mined and explored for oil, coal, and emeralds. Other commodities like copper, zinc, and lead have not been extensively explored. Taking into account the thick marine Cretaceous sequences and the important regional faults present in the cordillera, its potential for sediment-hosted deposits should be evaluated. In this study, we present the geological setting and ore mineralogy of an abandoned copper mine near Chiquinquirá, Boyacá. Mineralization at Chiquinquirá consists of a 4-m-thick lode which is made up of siderite + sphalerite + chalcopyrite ± quartz ± pyrite and galena. The lode is structurally controlled by a second-order fault located on the western flank of the Buenavista syncline. The mineralization is emplaced discordantly in black mudstones of the Areniscas de Chinquinquirá Formation, dated as late Albian-Cenomanian. Five different facies were recognized within the mineralized areas, named as HR, AHR, A, B, and C, ordered from the farthest to the closest to the center of the lode. HR stands for the non-altered host rock, AHR corresponds to altered host rock crosscut by siderite-chalcopyrite veinlets, A consists of breccias with a siderite ± sphalerite ± chalcopyrite matrix with abundant clasts of the host rocks, B is siderite veins of more than 5 cm thick, with host-rock clasts, and C is siderite-sphalerite or sphalerite + chalcopyrite bands separated by thin host-rock films; crystal size varies between the different layers. A, C, and AHR facies have crosscutting relationships that indicate the involvement of numerous hydrothermal pulses and their close association with the fault development. A metalliferous zonation within the lodes exists, where the Cu content increases with depth. X-ray fluorescence analyses in sphalerite, chalcopyrite, and carbonates indicate that carbonates are mainly siderite with an important Mg component. Two distinct chalcopyrite families are recognized, the first ones are sulfur and copper rich with an Fe/Cu ratio near 1; the second ones have lower sulfur and copper contents and show an enrichment in iron, and the Fe/Cu ratio is >1.5. The former chalcopyrite is related to facies B and C, whereas the latter is related to facies A. Analysis in sphalerite crystals yielded a consistent composition: 57% Zn, 39% S, 0.9% Cd, and 0.6% Fe. The Zn/Cd is near 57, which is highly anomalous. Based on the field relationships and petrographic observations, the deposit can be classified as clastic epigenetic discordant Cu-Zn sediment hosted.