

Mineralogical Characterization and Spatial Zoning of Gold (Au) as an Opportunity to Increase Its Recovery in Cu and Pb Concentrates

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Cerro Lindo is one of the main underground polymetallic mines in Peru, where gold (Au) is produced as a by-product and recovered mainly in Pb and Cu concentrates. During the last three years, the average gold production has been close to 3,000 ounces per year; however, its metallurgical recovery has not historically been prioritized due to the limited understanding of its spatial distribution, geological controls, and mineralogical occurrence within the deposit. In a context of increasing gold prices and growing demand as a safe-haven asset, improving its recovery represents a significant strategic opportunity for the operation.

The objective of this study is to perform a mineralogical characterization of gold and to define a spatial zoning model within the Cerro Lindo Mining Unit, integrating geological, structural, and geochemical information. The deposit is located in the western part of Peru, within the Casma Group volcanic–sedimentary sequence, where mineralization is hosted in NW-trending structural corridors associated with the Huaranguillo Formation. Several mineralized domains have been defined in the mine (V, F, VM, SSM, SPP, and SPB), showing variability in sulfide assemblages and metal distribution, which directly influences the occurrence and concentration of Au.

Geochemical correlation using ICP multielement analysis including Au, together with petrographic, mineragraphic, and mineralogical studies, allowed the identification of spatial patterns related to structural controls and mineralization domains. Historical production data, metallurgical balances, and laboratory classifications were compiled and statistically evaluated to support the interpretation.

The results allow the definition of geometallurgical criteria and spatial domains that can be incorporated into grade control and production planning, improving the predictability of gold behavior during the concentration process. This approach provides technical guidelines to optimize ore blending strategies, enhance gold recovery, and increase the economic value of the deposit without affecting current operational objectives.