Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.23487

Mineralogical deportment of critical minerals during porphyry Cu-Mo ore processing with implications for recovery

NADINE M PIATAK[1], ROBERT R SEAL II[2], ALEXANDER T TAYLOR[2], KATHARINA PFAFF[3], JAY M. THOMPSON[4], DARRYL A HOPPE[2], HEATHER A LOWERS[4] AND TAYLOR BIRD[5]

[1]U.S. Geological Survey

[2]U.S. Geological Survey, Geology, Energy & Minerals (GEM) Science Center

[3]Center for Mineral Resources Science - Colorado School of Mines

[4]U.S. Geological Survey, Geology, Geophysics, and Geochemistry Science Center

[5]Rio Tinto Kennecott

Presenting Author: npiatak@usgs.gov

Mineralogical deportment of critical minerals (CMs) during ore processing dictates CM partitioning into value and waste streams providing insight into where enrichment occurs and creating opportunities for targeted recovery. We investigated CMs and other valuable commodities during froth flotation of porphyry Cu-Mo ores at the Bingham Canyon mine in Utah, USA.

Mass-balance calculations based on bulk chemistry indicate that Re predominantly reports to the Mo concentrate where it is eventually recovered from as a byproduct. Additionally, appreciable amounts of Ag, Au, Bi, Pd, Te, Sb, Se, Zn report to the Cu concentrate; however, much of the remainder of these elements (approximately 40 to 60 wt. %) report to tailings. Some CMs such as Co, Ge, Ni, W, and REEs almost exclusively report to the tailings.

The mineralogical hosts of these elements control their partitioning during ore processing. For example, some CMs occur predominantly as discrete minerals such as Ge in catamarcaite, REEs in monazite and xenotime, and W in tungstenite and scheelite, which are not targeted during flotation, and thus report to tailings. Whereas some CMs occur in solid solution in other minerals, such as Re in molybdenite (average 90 µg/g Re). In contrast, Co and Ni mostly occur in solid solution in pyrite (averages of 500 µg/g Co and 435 µg/g Ni), which is intentionally sank during flotation and ends up in tailings. Interestingly, Te occurs both as sparse fine-grained discrete minerals (e.g., tetradymite, calaverite, coloradoite, hessite, sylvanite, and cervelleite) and associated with more abundant ore sulfides (i.e., chalcopyrite, molybdenite, pyrite and galena). Tellurium in liberated discrete minerals (predominantly tellurides) and associated with chalcopyrite primarily report to the Cu concentrate from which it is eventually recovered. Tellurium associated with pyrite, mostly as micrometer- and nanometer-sized inclusions commonly accompanied by Bi and/or Pb, likely accounts for much of the Te in tailings, which contain 2-3 wt. % pyrite.

Overall, knowledge of CM mineralogical hosts, which control CM deportment, is essential for identifying opportunities and developing optimization strategies for their recovery.