Can Gold Mining Provide Critical Metals as By-Products Using Novel Solutions? A Case Study at Björkdal Gold Mine, Sweden

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The transition away from hydrocarbons requires a huge increase in metal and mineral consumption for low-carbon technologies. However, mining and minerals processing is energy intensive and can be environmentally harmful, thus there is a need for novel solutions in extraction and processing. Te, W, and Bi are designated critical metals by both the BGS and USGS, and gold mining is coming under increased scrutiny due to its environmental footprint. Therefore, a method of recovering critical metals from existing gold mines would be ideal for meeting some of the demand for these metals without opening any new mines.

Gold deposits are often enriched in other rare metals; for example, the Björkdal mine produces gold concentrates and tailings variably rich in Te-, Bi-, and W-bearing minerals. Currently, there is no incentive to optimise for by-product recovery and few options by which to process and extract these additional metals for the mine operator. Deep eutectic solvents, which operate at low temperatures and are environmentally benign, are a promising development of recent years as an organic chemistry alternative to conventional metallurgy. Prior work has shown success with leaching of select metals and minerals including bismuth tellurides and gold, and there is some evidence that W-bearing minerals could also be amenable.

This work looks at tracing the flows of Te, Bi, and W through the Björkdal processing plant and mineralogically characterising feed, tailings, and concentrates. Bulk geochemistry of ore, concentrates, and tailings is compared to automated SEM analysis. Target metals deport almost entirely into bismuth telluride minerals (Bi and Te) and scheelite (W), which are well liberated in all concentrates and tailings. Characterisation enables assessment of the feasibility and impacts of inserting leaching stages with DESs, and/or altering the processing procedures, in order to maximise by-product recovery in an environmentally friendly and low-energy process.