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Hidden Byproduct Critical Element Supply Within Existing Mining Value Chains: Assessing the Tellurium Potential of the Australian Base and Precious Metals Sector

Brian A. McNulty, Simon M. Jowitt
University of Nevada Las Vegas, Las Vegas, NV, USA

The transition to low CO₂ energy generation, storage and transport will require a range of metals that are generally considered critical and are produced as byproducts of other metals, making increased production problematic. Here we demonstrate the hidden supply of critical elements that are necessary for the energy transition within existing mining supply chains using byproduct proxies and materials flows. The proxy-based tellurium supply potential of 52 active mines in Australia were assessed during this study. Although the abundance of tellurium and other critical elements in mineral deposits is a function of geology, the techniques used to extract the main metals (i.e., Au, Cu etc.) also influence the recoverability of byproducts metals. Tellurium materials flows were evaluated using supply potential proxies integrated with mineral processing and metal extraction methods for each mine. This analysis indicates that 23 precious metal mines have a combined Te-proxy inventory of ~31,830 t or 309 t/yr Te production potential in gold cyanide tank residuals. A further 27 base metal mines have ~57,940 t or ~204 t/yr Te production potential in sulfide metal concentrates produced by froth flotation. Australia produced an unknown amount of the ~490 t of worldwide tellurium production in 2020 with 90% of this global production from copper byproducts. This means that the Australian gold mining sector alone has the potential to produce ~63% of current annual tellurium production worldwide. However, tellurium from the Australian gold sector remains unevaluated, meaning that this potential Te supply will report to metallurgical and mine waste. The addition of 300 t/yr Te production is worth ~\$21 mUSD or ~4.5 GW of power generation capacity from CdTe photovoltaic cells. Realization of this hidden tellurium supply, and other critical elements, requires a holistic approach to byproduct production and the removal of silos between resource definition, mining, smelting and refining.