

SEG 2026 Conference in Salt Lake City, United States

Beyond Primary Ores: Utilizing Geochemical Data to Uncover Critical By-Product Potential in Existing Supply Chains

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The global transition toward low-carbon energy has drastically shifted commodity demand, placing unprecedented focus on critical by-product metals like bismuth (Bi), gallium (Ga), indium (In), and tellurium (Te). However, because they are predominantly co-produced with major metals, they are rarely reported in mineral resource estimates, resulting in substantial quantities being lost to waste streams or left unrecovered. Although regions like Chile, Nevada, and Western Australia are globally renowned for precious and base metal production, their role as critical mineral suppliers remains largely unrealized due to this lack of targeted resource quantification. This study applies a novel proxy-based methodology to quantify hidden critical mineral inventories within existing primary metal supply chains. Utilizing data from the OSNACA database and public operational reports, we assessed the critical by-product metals potential for dozens of active projects, including porphyry copper and orogenic gold systems. By assuming a conservative 50% recovery factor, our models enable the calculation of equivalent critical by-product credits capable of reducing the All-In Sustaining Cost (AISC) per ounce or tonne of primary metal production. By integrating proxy-based assessments, the mining industry can leverage overlooked primary systems to ensure long-term sustainability and meet new technological demands through sustainable processing.