Rare Earth Elements' Secondary Prospectivity of Mine Waste in South Australia

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In recent years, the demand for rare earth elements (REEs) has significantly increased due to their essential role in a broad spectrum of modern high-tech applications and geopolitical challenges linked to their supply. As a result, mine waste has recently attracted interest as an unconventional yet promising secondary source of critical metals. In South Australia, various forms of REE mineralisation occur associated with primary commodities of copper, gold, and uranium.

To assess the potential of mine waste in South Australia as a secondary source of REEs, the content and distribution of critical metals were investigated at two key sites: Paratoo, a sediment-hosted copper (Cu), and Port Pirie, the site of a former uranium processing and monazite REE extraction facility. At Paratoo, waste rock samples were collected, while at Port Pirie, the sampling focused on tailings, sludge, and thorium-rich waste. The collected samples were analysed using ICP-MS, XRD, MLA, and LA-ICPMS. At Paratoo, the primary REE-hosting minerals were identified as azurite and malachite, which are enriched in both light rare earth elements (LREEs), such as La (82,000 ppm), and heavy rare earth elements (HREEs), such as Gd (9,600 ppm). In contrast, at Port Pirie, REE enrichment is associated with monazite and REE-carbonates. Monazite is predominantly enriched in LREEs (Ce at 552,000 ppm), while the REE-carbonates show higher concentrations of HREEs (Dy at 8,200 ppm).

Metal deportment of rare earth elements was assessed in host mineral phases at both sites. Gaining a clear understanding of REE deportment is essential for evaluating the economic feasibility of their recovery and for developing effective extraction and processing methods. At Paratoo, bioleaching presents a potential approach for extracting REEs from secondary copper minerals. Meanwhile, at Port Pirie, pug leaching could be investigated as a method for recovering REEs from monazite and REE-carbonate minerals.