Cobalt Trace Element Mineralogy and Geometallurgy in the Mount Lyell Copper Mine Tailings, Tasmania, Australia

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Cobalt (Co) is a critical metal due to its key role in battery technologies. It is rare for cobalt to be the primary commodity at a mine site (e.g. cobaltite deposit at Mount Cobalt, Queensland, Australia). Instead, most of the world's Co is produced as a by-product, and significant concentrations of copper (Cu) are contained in secondary resources, which may be a key component of ensuring Co supplies. Pyrite is the most common secondary source of Co (may contain >5 wt.%) and is the most abundant sulfide in metalliferous tailings dams generated from Cu mining operations. In this study, we analysed fresh tailings samples collected from the Princess Creek tailings dam (storing 20 years' worth of tailings from the Mount Lyell Copper Mine, Tasmania, Australia) and weathered tailings samples from sediment banks of the King River, which mine tailings were flushed down from 1914-1994. Mineralogy and trace element systematics were analysed using X-ray fluorescence (XRF), scanning electron microscopy (SEM) including automated mineralogy and laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) for trace element mineralogy analysis. Gravity and flotation experiments, followed by the same analytical techniques, were used for the geometallurgical testwork. LA-ICPMS spot analysis shows that Co concentrations in pyrite (>40% of the tailings modal mineralogy) regularly exceeded 0.1 wt.% with a maximum of 0.66 wt.% Co). The applied processing route has proven successful in producing a concentrate of cobaltiferous pyrite. Comparison of fresh (Princess Creek) and weathered (sediment banks and delta of the King River) tailings was undertaken to contrast the deportment of cobalt and other critical metals in fresh and weathered pyritic tailings. Fresh samples from the tailings impoundment contain a lower portion of iron (oxyhydr)oxides than weathered samples, meaning that different Co processing and extraction pathways may be required depending on the Co distribution.