Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.25571

Secondary Sulfates as Hosts of Critical Metals in Mining Tailings

JAVIERA PAZ GERDING[1], JONNATHAN ALVAREZ[1], JUAN MORALES SÁNCHEZ MIGALLÓN[2], JAVIERA PEREZ[3] AND EMILIO PIÑIÑURI[3]

[1]Instituto Geologia Economica Aplicada, UdeC
[2]University of Salamanca
[3]Universidad de Concepcion

In arid and semi-arid climates, sulfate crusts frequently develop on pyrite-bearing mine tailings due to acid mine drainage (AMD). Among these sulfates, the copiapite and halotrichite groups have been identified in previous studies as the most effective hosts for critical metals such as Co, Cu, and Ni.

This study investigates the capacity of different members of the copiapite group (Fe-Copiapite, Mg-Copiapite, and Copiapite) and the halotrichite group (Pickeringite (Mg), Apjohnite (Mn), and Halotrichite (Fe)) to incorporate Cu, Co, and As cations. These sulfate phases were synthesized in the laboratory, both as pure compounds and with varying concentrations of As, Co, and Cu (100, 500, and 1000 ppm of each cation in solution). The results were then compared with naturally occurring sulfate phases found in mine tailings from northern Chile.

Mineralogical and chemical characterization was performed using X-ray diffraction (XRD), scanning electron microscopy with energy dispersive spectroscopy (SEM-EDS), inductively coupled plasma optical emission spectrometry (ICP-OES), and laser-induced breakdown spectroscopy (LIBS) and visible to near and shortwave infrared (VNIR-SWIR) spectroscopy.

Results show distinct precipitation patterns among the investigated sulfate phases. In both groups, Mg-rich end-members (Mg-Copiapite and Pickeringite) exhibited the highest metal uptake capacities. Furthermore, precipitation kinetics and phase dominance were influenced by the presence of different cations. For instance, in the presence of As and Fe^{3+}, copiapite phases did not precipitate, and rhomboclase was instead favored.