Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35255

Characterizing mineralogical controls of waste-rock weathering and metal mobilization from the molecular scale to the field scale

ZHONGWEN BAO[1], TOM AL[2], JEFF G BAIN[3], HEATHER SHRIMPTON[3], CAROL J PTACEK[3] AND DAVID W BLOWES[3]

[1]Hefei Institutes of Physical Science, Chinese Academy of Sciences
[2]University of Ottawa
[3]University of Waterloo

Weathering of sulfide-bearing mine wastes can severely degrade nearby water quality and ecosystems at mine sites. To facilitate the optimal design and implementation of remediation action, it is necessary to investigate the coupled effects of hydrological processes, biogeochemical reactions and mineralogical transformation in mine wastes. This study aims to couple *nm*- and μm-scale mineralogical characterization by SEM, EMPA, TEM, and synchrotron-based XRF mapping and XANES measurements, with field-scale measurements of water quality to quantify the mechanisms of galena and sphalerite weathering and concomitant effects controlling the release of metals in an abandoned waste-rock pile. The results show that oxidative dissolution of sphalerite occurs congruently without forming secondary phases, resulting in elevated concentrations of Zn and Cd in the pore water and seepage from the waste-rock pile. Under neutral-pH pore-water conditions, galena oxidation is accompanied by formation of secondary surface coatings dominated by cerussite with covellite at the interface. The coatings constrain the concentrations of dissolved Pb and Cu in porewater. Understanding these mineralogical controls provides guidance to design remediation activities of the waste-rock pile and other sulfide-bearing mine wastes.