Characterization of historical Joma mine tailings using automated mineralogy

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Abstract

Historical mining activities have left a legacy of sulfidic mine tailings that pose significant environmental and human health challenges due to their elevated sulfide content and the use of inadequate disposal methods in the past. Understanding the chemical and mineralogical composition of these tailings is imperative for evaluating their environmental impact and developing effective remediation strategies, thereby turning what was once considered waste into a resource (Lottermoser, 2010).

This study presents a comprehensive mineralogical characterization of the historical Joma mine tailings using automated mineralogy based on Scanning Electron Microscopy – Energy Dispersive Spectroscopy (SEM-EDS) and Electron Probe Microanalyzer (EPMA). Joma mine tailings originate from flotation of sulfide ore from the Joma VMS deposit – one of the largest base metal mines in Norway. The Joma orebody was mined primarily for copper and zinc during 1972-1998 producing over 11 million tonnes of ore (Eilu, 2012). XRF and ICP-MS analyses show significant concentrations of copper and zinc (0.5 - 1 wt%) along with critical raw materials such as cobalt (300 ppm). Their distribution varies with particle size, with most of the zinc occurring in <38 μm size fraction, while copper is more evenly distributed as a consequence of the employed flotation circuit and the original ore textures. Mineralogy is dominated by pyrite and pyrrhotite, in predominantly unweathered state, indicating that the submerged disposal of tailings preserved sulfides from oxidation. Chalcopyrite and sphalerite are the main ore minerals with a considerable fraction occurring in potentially recoverable liberation state. Electron Microprobe analyses on sulfide phases indicate the distribution of critical metals such as cobalt, silver within pyrite, as well as gold within sphalerite, which has important implications for their reprocessing.

The results of this study show that the historical Joma mine tailings have a substantial potential for environmental impact due to their high content of unweathered sulfides and at the same time contain potentially recoverable amounts of copper, zinc, cobalt and silver. The results can be used to design a more comprehensive sampling campaign of the Joma tailings and evaluate reprocessing strategies.

References

Eilu, P. (2012). Mineral deposits and metallogeny of Fennoscandia. Geological Survey of Finland, Special Paper 53, 401 p. https://doi.org/10.2113/econgeo.107.5.1075

Lottermoser, B. (2010). Mine Wastes: Characterization, Treatments and Environmental Impacts. Springer, Berlin. https://doi.org/10.1007/978-3-642-12419-8