SEG 2024 Conference: Sustainable Mineral Exploration and Development

Geometallurgical Characterization of Potential By-Products in the Spremberg-Graustein-Schleife Kupferschiefer Deposit

Zahra Nourizenouz[1], Max Frenzel[1], Bradley M. Guy[1], Joachim Krause[1], Doreen Ebert[1], Aratz Beranoaguirre[2, 3], Jens Gutzmer[1]
1. Helmholtz-Zentrum Dresden Rossendorf, Helmholtz Institute Freiberg for Resource Technology, Freiberg, Germany, 2. Karlsruhe Institute for Technology, Chair of Economic Geology and Geochemistry, Karlsruhe, Germany, 3. Goethe University-Frankfurt, Institute of Geosciences, Frankfurt am Main, Germany

The Kupferschiefer ore deposits that occur along the southern margin of the Central European Permian Basin constitute one of the largest and highest-grade sediment-hosted copper provinces in the world. Mineralization formed when oxidizing and metal-rich basinal fluids interacted with a thin but laterally persistent carbonaceous black shale/marl unit at the base of the Permian Zechstein succession. In addition to copper, Kupferschiefer ores also contain elevated concentrations of silver, lead, zinc, cobalt, nickel, rhenium, and gold. While some of these metals (especially Ag) already contribute as by-products to the overall revenue generated, quantitative geometallurgical studies exploring the deportment and spatial variability of all these metals are still lacking.

In this study, we investigate multi-metal deportment (i.e., Ag, Pb, Zn, Co, Ni, Re, Au) at the Spremberg-Graustein-Schleife deposit, located in Lusatia in SE Germany. This investigation is carried out through a comprehensive approach that integrates data from laser ablation ICP-MS (LA-ICP-MS), electron microprobe analysis (EPMA), and mineral liberation analysis (MLA) on samples from the mineralized intervals of three exploration drill cores. The results illustrate that the deportment of Ag is particularly complex, as it occurs as i) substitution in the crystal lattices of ore-forming Cu and Cu-Fe sulfides, ii) micro-inclusions within Cu-enriched zones in pyrite/marcasite, and iii) isolated grains of electrum. Galena and sphalerite are the main hosts of Pb and Zn, respectively. Cobalt and Ni, in contrast, are found as Co-Ni-arsenides and sulfides, with chalcopyrite and pyrite exhibiting enrichment in cobalt. Such quantitative information can not only facilitate the integration of processing of the by-products into the geometallurgical models, but also enable the prediction of the mineralogical distribution of these elements within drill cores, using bulk geochemical data.