SEG 2024 Conference: Sustainable Mineral Exploration and Development

Hydrothermal Alteration and Volcanic Stratigraphy at the Paleoproterozoic Kay Mine Volcanogenic Massive Sulfide Deposit, Black Canyon City, Arizona USA

Aaron J. Adsit[1], Thomas Monecke[1], Mark D. Hannington[2], Miranda R. Lehman[1], David Smith[3]
1. Center to Advance the Science of Exploration to Reclamation in Mining, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, CO, USA, 2. Department of Earth and Environmental Sciences, University of Ottawa, Ottowa, ON, Canada, 3. Arizona Metals Corp., Toronto, ON, Canada

The Kay mine is a past-producing volcanogenic massive sulfide deposit located 70 km north of Phoenix Arizona. A historic estimate of resources and reserves totals 5.8 million tonnes grading 2.2% Cu, 3.03% Zn, 54.9 g/t Ag, and 2.8 g/t Au at a cut-off grade of 2% Cu equivalent. Kay is hosted in a bimodal volcanic and volcaniclastic succession of the 1750 Ma Black Canyon Creek Group. The massive sulfides are located along a favorable stratigraphic position that is marked by a change from mafic to felsic-intermediate volcanic rocks. A mudstone-matrix monomict rhyolitic to rhyodacitic breccia interpreted to be a peperite marks the paleoseafloor position. Massive sulfides at Kay formed through subseafloor infiltration and replacement of permeable volcaniclastic rocks beneath this breccia unit. Utilization of continuous core scanning X-ray fluorescence with a Minalyzer CS and hyperspectral core scanning with a HySpex SWIR-384 camera revealed the chemostratigraphy at Kay and uncovered the mineralogy of the hydrothermal alteration halo. Downhole geochemistry shows Na depletion surrounding the mineralization, a halo of K enrichment in the proximal hanging wall and distal footwall, and a zone of Mg enrichment beneath the mineralization. Hyperspectral imaging demonstrated that the enrichments in K and Mg correspond to strong muscovite and chlorite alteration. This was confirmed by thin section petrography, SEM-EDS analyses, and automated mineralogy scans. The observed alteration zonation reflects variations in the temperature of alteration with the high-temperature hydrothermal feeder zone being characterized by chlorite alteration and the surrounding lower-temperature alteration being dominated by muscovite. In addition, carbonate alteration dominated by ankerite is widespread at Kay. The combination of geochemistry and mineralogy determined by coregistered XRF and hyperspectral core scanning provides a means of precisely mapping the alteration zonation where deformation and metamorphism have obscured the primary textures.