SEG 2017 Conference

Geology of the deformed and dismembered Kerr-Sulphurets-Mitchell porphyry Cu-Au-Mo district, British Columbia, Canada

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The Kerr-Sulphurets-Mitchell (KSM) porphyry Cu-Au-Mo district, located in northwestern British Columbia, hosts one of the world's largest undeveloped reserves of copper and gold. The district features five ore bodies: the Kerr, Sulphurets, Mitchell, and Iron Cap deposits, owned by Seabridge Gold, as well as the Snowfield deposit, owned by Pretium Resources. These five porphyry Cu-Au-Mo deposits are broadly contemporaneous, featuring predominantly hypogene mineralization centered on Early Jurassic intrusions emplaced in Late Triassic sedimentary and volcaniclastic wallrock. Each of the deposits displays a unique combination of important attributes, including the nature of the syn-mineral intrusions, overall Cu/Au ratio, deposit morphology, and proportion of mineralization hosted within wallrock.

The KSM deposits were affected by significant post-mineralization deformation during the development of the mid-Cretaceous Skeena fold and thrust belt. Imbricate east-vergent thrust faults cut through the district, resulting in porphyry deposit segmentation. In particular, the Snowfield Cu-Au-Mo porphyry deposit is interpreted to be the displaced cap of the Mitchell Cu-Au-Mo porphyry deposit, offset 1.5 km to the ESE within the hanging wall of the Mitchell Thrust Fault (MTF). This interpretation is based upon the observation of congruent metal zoning patterns at both deposits, as well as the abrupt termination of mineralization encountered below the MTF at Snowfield.

In addition to thrust fault dismemberment, Cretaceous deformation within the KSM district includes folding and penetrative cleavage development. Large variations in rock competence exist throughout the district, due to lateral and vertical zoning of the hydrothermal alteration assemblages surrounding the porphyry Cu-Au-Mo deposits. These variations in competence have resulted in differential strain partitioning throughout the district, with the relatively weak zones of intense phyllic and advanced argillic alteration at Kerr and Mitchell exhibiting the most intense deformation and the highest degrees of flattening.

Finally, Cretaceous deformation and low greenschist metamorphism are linked to the remobilization of some metals and metalloids within the KSM porphyry Cu-Au-Mo deposits. Sulfides and sulfosalts including galena, sphalerite, chalcopyrite, tennantite and tetrahedrite, occur in post-mineralization quartz + carbonate veins that exhibit little to no deformation – indicating that these veins formed during or following Cretaceous deformation. 3-D spatial analysis and correlation diagrams of assay data inform on the extent of redistribution for various metals, including Pb, Zn, Cu, Mo, As, and Sb. Understanding the process and extent of metal redistribution is critical forthe refinement of ore models of deformed deposits, and for exploration geologists seeking to employ geochemistry data to vector towards the center of a deformedore body.