

Refining Igneous Stratigraphy and Geological Controls on Mineralization in the Serpentine Deposit, Duluth Complex

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The Serpentine deposit is a large, undeveloped magmatic Cu-Ni-Co deposit located within the 1.1 Ga Duluth Complex in northeastern Minnesota. The deposit comprises an indicated mineral resource of 21.6 million metric tonnes grading 0.46% Cu, 0.16% Ni, and 0.014% Co, with an inferred mineral resource of 279.9 million metric tonnes grading 0.37% Cu, 0.12% Ni, and 0.007% Co. Disseminated sulfide zones are located within ultramafic and mafic rocks assigned to the South Kawishiwi intrusion, which is one of several intrusions making up the Duluth Complex. In the Serpentine area, the footwall to the South Kawishiwi intrusion is comprised of metasedimentary rocks of the ~1.90-1.87 Ga Animikie Group. Injection of sulfide melts into the footwall rocks has resulted in the development of low-tenor massive sulfide deposits.

Small-scale lithological variability makes the recognition of igneous stratigraphy within the South Kawishiwi intrusion challenging. In addition, subtle variations in cumulate mineralogy and mineral abundances are difficult to recognize in drill core. This study aims to refine the igneous stratigraphy of the Serpentine deposit and evaluate its relation to sulfide mineralization through the integration of logging and core scanning using continuous X-ray fluorescence and hyperspectral imaging in the visible to near-infrared. The data sets are combined to identify lithologic contacts and define units that can be used for multi-hole stratigraphic correlation within the South Kawishiwi intrusion. The spatial distribution of sulfur and base metals is evaluated relative to the refined stratigraphic framework to better constrain geological controls on mineralization.