Geological environment and formational controls of auriferous massive sulfide deposits: An example from the Cambro-Ordovician Cu-Au Ming VMS deposit in the Newfoundland Appalachians*

Corresponding author: Jean-Luc Pilote, Memorial University of Newfoundland,jpilote@mun.ca

Co-authors:
Stephen J. Piercey, Memorial University of Newfoundland, spiercey@mun.ca
Patrick Mercier-Langevin, Geological Survey of Canada, patrick.mercier-langevin@nrcan-rncan.gc.ca

In ancient orogenic belts the origin of Au-enrichment in volcanogenic massive sulfide (VMS) deposits is often debated, with some workers favouring a syngenetic origin, whereas others arguing for an orogenic overprint, this is particularly so for Appalachian Au-bearing VMS deposits. The Cambro-Ordovician bimodal-mafic Ming Cu-Au-(Zn-Ag) VMS deposit provides a unique opportunity due to recent drilling, mining, and ongoing research, to evaluate the potential models for Au-enrichment in ancient VMS deposits. Utilizing a combination of geological mapping and drill core logging, our research is aimed at reconstructing the stratigraphy, structure, and hydrothermal alteration of the deposit in order to define the genesis of mineralization. The deposit is hosted in felsic rocks underlain by ~490 Ma ophiolite slivers of boninitic composition that formed in a peri-continental supra-subduction setting. The deposit consists of four elongated massive sulfide lenses gently plunging 30° to the northeast, formed in the uppermost part of a calc-alkalic (Zr/Y > 7) intermediate to felsic volcanic succession with minor associated volcaniclastic rocks. The immediate hanging wall is lithologically heterogeneous; varying from a highly silicified volcaniclastic rock to a magnetite-rich volcanogenic siltstone locally structurally removed juxtaposing the massive sulfide with mafic volcanic rocks of the overlying syn-obduction ophiolite cover sequence. Three generations of mafic to intermediate sills and dykes are present in the deposit and have distinctive lithogeochemical signatures; they are interpreted to be genetically related to the mafic rocks of the ophiolitic cover sequence.

The Ming deposit has distinct alteration assemblages including sericite, chlorite, quartz, biotite, tremolite, manganiferous garnet and calcite, green mica, epidote, magnetite, and pyrite. A Cu-rich zone consisting primarily of chalcopyrite, pyrrhotite, and pyrite with minor Bi-Te sulfosalts and sphalerite in a strongly chlorite-epidote altered felsic volcanic rock occurs 50 to 100 metres below the main sulfide lens, representing the high-temperature discharge zone of the Ming hydrothermal system.

The relationship between the stratigraphy, spatial distribution and styles of alteration, and the mineralization strongly favor a syngenetic origin for the ore zones and Au-enrichment. Despite local chemical and mechanical remobilization of the massive sulfide in the westernmost zone of the deposit (1807 zone) due to subsequent deformation events, the sulfide bulk composition for all zones, including the precious metals, has not been changed by deformation and metamorphism, suggesting formation from intrinsically Au-enriched VMS ore-forming fluids.