

Investigation of the Neoproterozoic Sunrise VMS Deposit, Beaulieu River greenstone belt, Northwest Territories, Canada

Emily J. MacMillan¹, Michelle DeWolfe^{1,3}, Bernadette Knox², Camille Partin³

¹ Department of Earth and Environmental Science, Mount Royal University, ² Northwest Territories Geological Survey, ³ Department of Geological Sciences, University of Saskatchewan,

Summary

The Neoproterozoic Beaulieu River greenstone belt, located approximately 100 km east northeast of Yellowknife, is part of the Slave craton. It contains one of the largest volcanogenic massive sulfide deposits in the Northwest Territories: the Sunrise Deposit (with historic indicated resources of 1.52 Mt at 5.99% Zn, 2.39% Pb, 0.08% Cu, 262 g/t Ag, and 0.67 g/t Au). The Sunrise Deposit is a banded polymetallic Zn-Pb-Cu-Ag-Au sulfide lens hosted by rhyolitic rocks, but the age, stratigraphy, and volcanic setting is not well understood.

The Sunrise Deposit was extensively explored in the late 1980's and 1990's. The area was subjected to intense forest fires in 2014 and much of the drill core was lost; however, the drill core from 27 drill holes was recovered. Four of these drill holes intersect the Sunrise ore horizon and were logged and sampled for this study. Detailed core logging shows that the footwall to the Sunrise Deposit is dominantly intermediate and felsic lavas and volcanoclastic rocks with minor mafic rocks. The felsic and intermediate lavas show evidence of subaqueous eruption (e.g., pillow or lobe structures and hyaloclastite). The volcanoclastic rocks range from monolithic to heterolithic and are massive, normally graded, reverse graded and seldom cross-laminated. These volcanic facies indicate deposition by subaqueous debris flows and eruption-fed density currents. The mafic rocks compose a small percentage of the core and are typically gabbros. Wall rock alteration includes chloritization, silicification, sericitization, and carbonatization with varying intensities. The ore mineralogy consists of: 1) major amounts of pyrite, sphalerite, and galena; 2) minor amounts of chalcopyrite, tetrahedrite, arsenopyrite, and pyrrhotite; and 3) trace native silver and gold. Ore textures include massive to semi-massive, stringers, and disseminated sulfides.

Lithofacies and geochemical data (whole rock geochemistry, Sm-Nd and S-isotopes) indicate the volcanic rocks that comprise the footwall to the Sunrise Deposit are a product of subaqueous lava flows and pyroclastic eruptions in an arc-like setting. Sulfur isotope data likely reflect primary seafloor mineralization with sulfur sourced from both seawater and leaching from the volcanic rocks. The calc-alkaline and arc-like geochemical signatures of the host rocks differ from the majority of volcanic belts in the Slave craton and may account for VMS mineralization in the Beaulieu River greenstone belt.