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Arsenic-enriched CU-NI-PGE mineralization along the basal zone of the Duluth Complex, Minnesota, USA

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The Duluth Complex (Minnesota, USA) hosts several Cu-Ni-PGE-Sulfide deposits along the basal contact, between the mafic intrusive Complex rocks and the underlying Paleoproterozoic metasediments and Neocharchean metagranitoids. The study areas are (1) the Wetlegs deposit within the southwestern Partridge River Intrusion (PRI), known for its highly mineralized portions containing Cu-Ni-Fe-Sulfides, platinum-group minerals (PGMs) and arsenic-enriched ores; (2) the famous Babbitt deposit with its characteristic massive sulfide occurrences, ascribed to the newly defined Bathtub Intrusion (BTI). The BTI marks the contact between the PRI and the South Kawishiwi Intrusion (SKI), the northernmost area of interest, where the (3) Serpentine deposit hosts massive sulfides, related to pyrrhotite-rich footwall metasediments.

Based on textural relationships, mineral compositions and sulfur isotopic studies, all deposits are characterized by a disseminated primary magmatic (pyrrhotite, chalcopyrite, pentlandite and cubanite) and secondary sulfide mineralization within a troctolitic matrix. Several occurrences of arsenic-enriched ores, some findings of PGMs and base metal minerals, either appear along primary magmatic sulfide rims, or are associated with various hydrothermal alteration events. The arsenic-enriched mineralization is found within recrystallized footwall metasediments and in the overlying troctolitic rocks. Associated minerals are monoarsenides (nickeline), diarsenides and sulfarsenides. The presence of arsenides, sulfarsenides and graphite in footwall rocks may suggest these metasediments as a potential source of As, Sb, and C. $\delta^{34}S$-data from representative Wetlegs samples (+ 2.04 and + 22.80 ‰) suggest the involvement of crustal materials, in addition to the magmatic sulfur source in the Cu-Ni-PGE mineralization. We acknowledge financial support by the Austrian Research Fund (FWF-P23157-N21) to A. Mogessie.