

Geochemistry of the Black Thor Intrusive Complex, McFaulds Lake Greenstone Belt, Ontario, Canada

H.J.E. Carson¹, C.M. Lesher¹, M.G. Houlé^{2,1}

¹Mineral Exploration Research Centre, Department of Earth Sciences, Goodman School of Mines, Laurentian University, Sudbury, ON, Canada; ² Geological Survey of Canada, Québec, QC, Canada

Abstract

The Black Thor Intrusive Complex (BTIC) is a semi-conformable sill-shaped intrusion that can be subdivided into: 1) a *lower ultramafic series* of basal olivine websterites and lherzolites, interlayered dunites and lherzolites with minor interstitial chromite, and overlying websterites, 2) a *middle ultramafic series* characterised by a basal chromitite horizon (Black Label), olivine websterites, lherzolites and dunites, and an upper chromitite horizon (Black Thor), and 3) an *upper ultramafic to mafic series* of websterites, melaleucogabbros and lesser anorthosites. A Late Pyroxenite composed primarily of websterite intruded the lower and middle ultramafic series and locally brecciated the Black Label chromitite horizon.

There are two major trends on MgO variation diagrams reflecting variable mixtures of olivine-orthopyroxene and olivine-chromite. There are also clusters of Opx-rich rocks averaging 50% SiO₂, 27% MgO, >5% Al₂O₃ and ≤2.5% CaO; Chr-rich rocks (40-90%) containing up to 45% Cr₂O₃, 15-30% MgO, and 10% Al₂O₃; and apparently consanguineous gabbroic rocks of the upper mafic series containing <45% SiO₂, ~30% Al₂O₃, ~<5% MgO, and 2.5% FeO.

The lower part of the lower series exhibits an overall trend of increasing Mg and decreasing Si-Al-Ca, reflecting increasing accumulation of Ol-(Chr) with decreasing cooling rate away from the basal contact. The upper part of the lower series exhibits an overall trend of decreasing Mg-Cr, reflecting decreasing amounts of cotectic Ol-(Chr) accumulation with decreasing flow rates.

The base of the middle series is marked by a major increase in Cr (Black Label), an overall upward trend of increasing Mg-Cr with increasing flow rate, and marked at the top by another major increase in Cr (Black Thor). Mg-Cr decreases through the upper series and is capped by Cr-poor gabbro.

Variations in the degrees of Ol-(Chr) accumulation correspond to variations in magma flow-through rates. Flow rates decreased and then increased abruptly prior to the formation of Black Label (consistent with physical transport or magma mixing), but increased gradually prior to the formation of Black Thor (more consistent with physical transport of fine dispersed chromite).

Preliminary trace element geochemical studies suggest that all rocks are enriched in highly incompatible lithophile elements, suggesting source enrichment and/or wholesale crustal contamination.