



Age constraints and geochemical evolution of the Neoproterozoic mafic–ultramafic Wabassi Intrusive Complex in the Miminiska–Fort Hope greenstone belt, Superior Province, Canada



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ABSTRACT

The ca. 2.75–2.71 Ga Miminiska–Fort Hope greenstone belt (MFHGB) of the eastern Uchi domain of the Superior Province (northern Ontario) contains numerous mafic and ultramafic intrusions hosting Ni–Cu–(PGE) occurrences. The most significant, the mafic–ultramafic Wabassi Intrusive Complex and the nearby mafic Oxtoby Lake intrusion, formed between 2728 and 2727 Ma and at ca. 2717 Ma, respectively. The Max, Wabassi Main, and Wabassi South parts of the Wabassi Intrusive Complex and the Oxtoby Lake intrusion have been studied to establish their petrogenesis and metallogenesis, and to compare them to the highly prospective 2734 Ma mafic–ultramafic intrusions in the McFaulds Lake greenstone belt ~120 km to the north that host world-class Cr–(PGE), significant Ni–Cu–(PGE), and potentially significant Fe–Ti–V mineralization.

The ca. 2728 Ma ultramafic-dominated Max intrusion is relatively homogeneous in composition, comprising mainly harzburgite, lherzolite, and wherlites with minor olivine orthopyroxene, orthopyroxene, websterite, and mesocratic gabbroic rocks. It also contains disseminated to patchy net-textured Fe–Ni–Cu–(PGE) sulfides. In contrast, the ca. 2727 Ma Wabassi Main intrusion is a layered mafic-dominated intrusion that consists of: (1) a basal zone containing leucocratic to mesocratic olivine gabbro-norite and olivine norite, troctolite, lherzolite, and harzburgite with high Cr contents, olivine with Mg#_{78–72}, orthopyroxene with Mg#_{84–67}, clinopyroxene with Mg#_{95–91}, and plagioclase with An_{96–37}, (2) a lower zone containing mesocratic olivine gabbro-norite and up to 10% Fe–Ti oxides, olivine with Mg#_{64–19}, orthopyroxene with Mg#_{67–58}, clinopyroxene with Mg#_{80–56}, and plagioclase with An_{79–46}, (3) a middle zone containing leuco- to mesocratic gabbro-norite with up to 8% Fe–Ti oxides, orthopyroxene with Mg#_{57–56}, clinopyroxene with Mg#_{73–66}, and plagioclase with An_{71–63}, and (4) an upper zone containing mesocratic gabbro-norite, gabbro, and ferrogabbroic rocks with up to 50% Fe–Ti oxides, up to 8% apatite, low Cr and high P contents, orthopyroxene with Mg#₄₄, clinopyroxene with Mg#₆₀, and plagioclase with An_{63–52}. The ultramafic-dominated Wabassi South intrusion is homogeneous in composition and is composed of peridotite. All three intrusions are enriched in Th > LREE > MREE relative to Nb–Ta and Ti, suggesting that they incorporated significant amounts of upper crustal material. This, together with their overlapping petrographic, geochemical, and mineralogical characteristics, suggests that they are co-genetic. Their formation appears to have begun with the accumulation of olivine, pyroxene, and minor chromite from a contaminated high-Mg basaltic parental magma (~12% MgO) in the Max and Wabassi South magmatic conduits. Later, this magma crystallized cumulates in the Wabassi Main magma chamber with the following order of appearance of cumulus phases: olivine + chromite → orthopyroxene/clinopyroxene → plagioclase → magnetite + ilmenite → apatite. The parental magma composition is more evolved than magmas responsible for the generation of the Cr–(PGE) and Ni–Cu–(PGE) mineralization in the McFaulds Lake greenstone belt, but they may be more contaminated equivalents. The ca. 2717 Ma mafic Oxtoby Lake intrusion is more mesocratic with significantly different trace element signatures, suggesting that it is unrelated or only indirectly related to the Wabassi Intrusive Complex.

The Max, Wabassi Main, Wabassi South, and Oxtoby Lake intrusions are coeval with different volcanic assemblages of the MFHGB. Together with the mafic–ultramafic intrusions of the McFaulds Lake

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greenstone belt, they probably represent the remnants of an Archean large igneous complex that was emplaced within the northern Superior Province between ca. 2.88 and 2.70 Ga. Among these four intrusions, Max may be the most prospective for Ni–Cu–(PGE) mineralization. The high abundance of primitive ultramafic rocks suggests that it was an open, dynamic system that accumulated olivine and pyroxene, and the trace element signature is consistent with incorporation of significant amounts of upper crustal material, permissive to the formation of Ni–Cu–(PGE) mineralization.

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1. Introduction

The Miminiska–Fort Hope greenstone belt (MFHGB) of the eastern Uchi domain of the Superior Province contains several mafic and ultramafic intrusions (Fig. 1) that appear to be prospective for Ni–Cu–(PGE) mineralization (Sappin et al., 2013). Only limited work has been conducted within this area, including regional assessment and distribution of the mafic and ultramafic intrusions by Hulbert and Vaillancourt (2002) and targeted diamond drilling by mining company to assess PGE potential of some of the mafic and ultramafic intrusions (Vaillancourt and Bliss, 2010; Vaillancourt et al., 2011), and the overall geological setting of this part of the MFHGB remains poorly constrained. However, recent

discoveries in the 2.73 Ga McFaulds Lake greenstone belt (Fig. 1, inset) of world-class Cr–(PGE) mineralization (e.g., Black Thor, Black Label, Big Daddy, Black Creek, Blackbird), significant Ni–Cu–(PGE) mineralization (e.g., Eagle's Nest), and potentially significant Fe–Ti–V mineralization (e.g., Thunderbird) only 120 km to the NW, have highlighted the potential of this region to host significant orthomagmatic Ni–Cu–(PGE), Cr–(PGE), and Fe–Ti–V mineralization and have justified further investigation within the eastern part of the Uchi domain.

In this contribution, we present new mineralogical, geochemical, and geochronological data on four of the most significant mafic and ultramafic intrusions in the eastern part of the Miminiska–Fort Hope greenstone belt (Max, Wabassi Main, Wabassi South, and

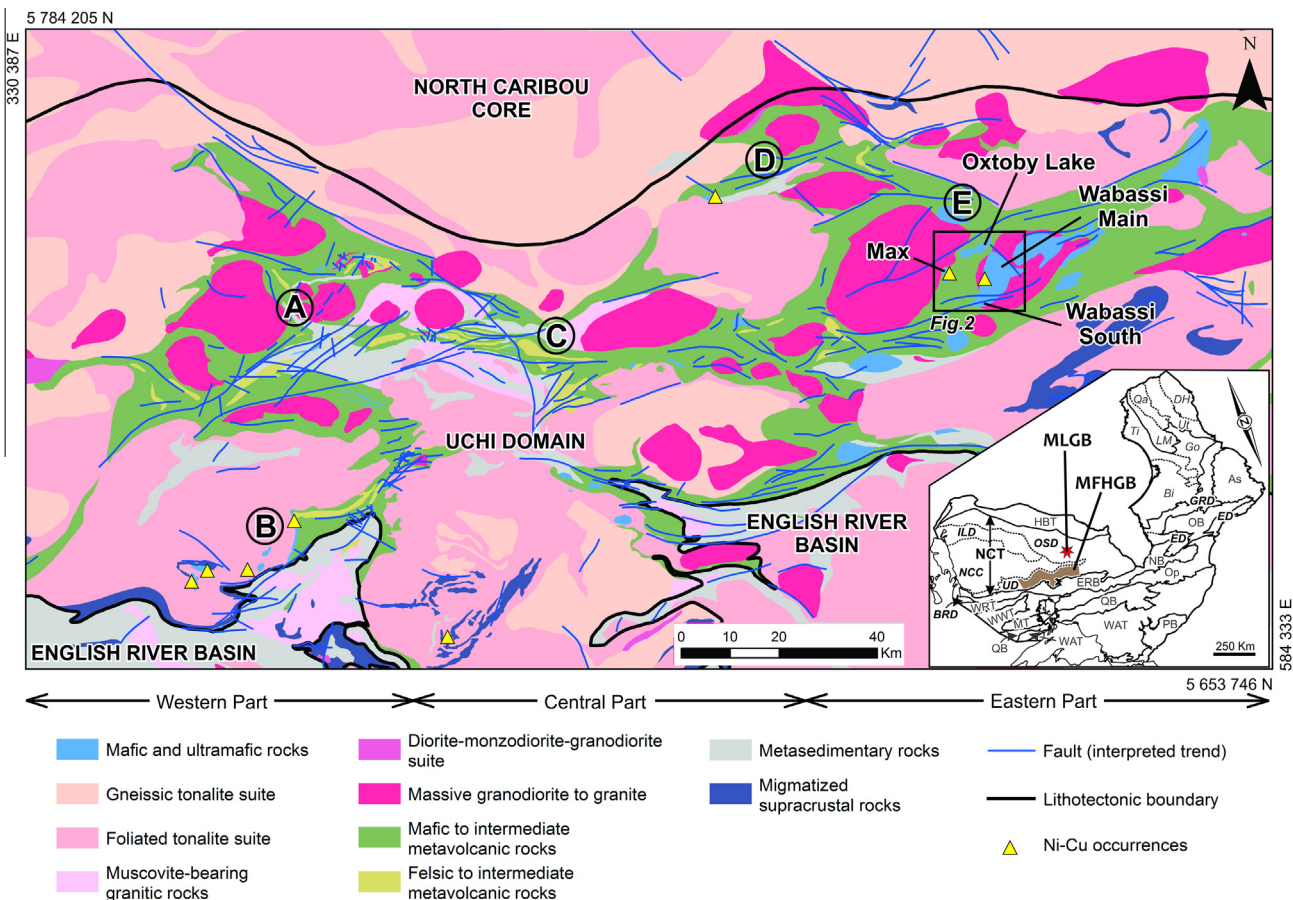


Fig. 1. Simplified geology of the eastern Uchi domain in the Superior Province, general location of the Keezhik-Miminiska Lakes areas (A), Attwood Lake area (B), Opikeigen-Eabamet Lakes area (C), Norton Lake area (D), and Wabassi River area (E) which hosts the Max, Wabassi Main, Wabassi South, and Oxtoby Lake intrusions, and location of Fig. 2. The geology is from Stott and Josey (2009), the lithotectonic boundaries have been modified from Stott (2011) and Percival et al. (2012), and the Ni–Cu occurrences have been modified from the Mineral Deposit Inventory (OGS, 2015). *Abbreviations:* MLGB = McFaulds Lake greenstone belt, MFHGB = Miminiska–Fort Hope greenstone belt, HBT = Hudson Bay terrane, NCT = North Caribou terrane, OSD = Oxford-Stull domain, ILD = Island Lake domain, NCC = North Caribou core, UD = Uchi domain, ERB = English River basin, BRD = Bird River domain, WRT = Winnipeg River terrane, WWT = Western Wabigoon terrane, MT = Marmion terrane, QB = Quetico basin, WAT = Wawa Abitibi terrane, DH = Douglas Harbour, Ut = Utsalik, Qa = Qalluivartuuq, LM = Lac Minto, Ti = Tikkerutuk, Go = Goudalie, Bi = Bienville, As = Ashuanipi, GRD = La Grande Rivière domain, OB = Opinaca basin, ED = Eastmain domain, NB = Nemiscou basin, Op = Opatca, PB = Pontiac basin. The OSD, ILD, NCC, UD, BRD, ED, and GRD belong to the Bird River – Uchi – Oxford-Stull – La Grande Rivière – Eastmain (BUOGE: Houlié et al., 2015) domains.

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