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NEW INSIGHTS FROM TEXTURAL, PETROGRAPHIC, AND GEOCHEMICAL INVESTIGATION OF THE GABBROIC ROCKS OF THE BIRD RIVER INTRUSIVE EVENT WITHIN THE BIRD RIVER GREENSTONE BELT, SOUTHEASTERN MANITOBA

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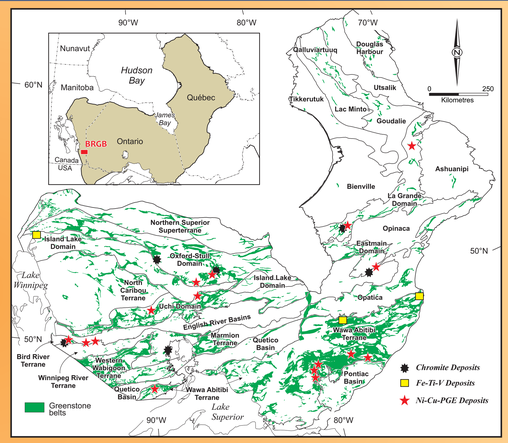

Figure 1. Schematic geological map showing the main Ni-Cu-(PGE) sulphide and Cr deposits of the Oxford–Stull, LaGrande and Eastmain domains, and the Bird River and the Abitibi greenstone belts within the Superior Province. Terranes, domains and boundaries are modified from Stott et al. (2010). The Bird River greenstone belt (BRGB) is located in the western part of the Superior Province (insert map) within the Bird River terrane of Stott et al. (2010).

Numerous mafic and ultramafic intrusions are widely distributed within both arms of the Neoarchean Bird River greenstone belt (BRGB) in southeastern Manitoba (Figure 1). These intrusions occur over a strike length of ~75 km, and host significant Ni-Cu-(PGE) magmatic sulphide and chromite deposits/occurrences. In the southern arm, several of these are interpreted to belong to the Bird River magmatic event including, from east to west, Bird Lake, Maskwa-Dumbarton, Page, Peterson, Chrome, and National-Ledin (Figure 2). Each of these intrusions is characterized by a lower ultramafic and an upper mafic zone of variable relative proportions (Figure 3). The Coppermine Bay intrusion (CBI), located close to the western end of the southern arm, is interpreted to be related to volcanic rocks of the Northern-MORB formation, although similar, in part, to some rocks of the Bird River magmatic event. In the BRGB northern arm, there are additional intrusions interpreted to belong to the Bird River magmatic event, including (from east to west) Euclid Lake (ELI), New Manitoba, Mayville East, and Mayville intrusions. The mafic-ultramafic intrusions within both arms contain significant Cr and Ni-Cu-(PGE) deposits/occurrences. In this contribution we report detailed field, textural, petrographic and geochemical observations on two of these intrusions, the CBI and the ELI, located within the southern and northern arms respectively.

The CBI is dominately mafic and composed largely of gabbro, leucogabbro, anorthositic gabbro, and rare pyroxenite. Two styles of mineralization occur within the CBI: 1) PGE±Ni±Cu mineralization associated with disseminated sulphides and 2) thin chromitite seams; these are both associated with gabbroic, melanocratic phases of the intrusion.

The ELI is a mafic-ultramafic body that consists of a lower ultramafic zone characterized by alternating peridotite and chromitite layers, and an upper mafic zone composed of variable proportions of gabbro, leucogabbro, anorthositic gabbro, and rare olivine-rich pyroxenite. The only significant mineralization observed in the ELI consists of chromitite seams within the ultramafic zone. The historic resource estimate is 4.16 Mt of ore grading 6.42% Cr_2O_3.

Preliminary results from this study suggest that the CBI exhibits textural and petrographic characteristics very similar to the ELI, and furthermore that both intrusions are comparable to the Mayville intrusion, supporting their proposed linkage with the Bird River magmatic event. This interpretation, as well as the similar styles of mineralization among the CBI, ELI and other mafic-ultramafic intrusions, strongly suggests that the potential for Ni-Cu-PGE-Cr mineralization extends well beyond the traditionally explored areas within the Bird River Sill and the Mayville intrusion.

The current initiative is a collaborative effort between the Geological Survey of Canada (GSC) under the Targeted Geoscience Initiative Phase IV (TGI-4) Ni-Cu-PGE-Cr project and the Manitoba Geological Survey with noteworthy logistical and technical support from Mustang Minerals Corp., Gossan Resources Ltd. and Stillwater Canada Inc., that aims to characterize mafic and ultramafic intrusions and associated magmatic mineralization within the BRGB.

Table 1. Compilation of historical production and resources for nine Ni-Cu-(PGE) and Cr-(PGE) deposits/occurences of the Bird River greenston belt.

DEPOSIT	DISTRICT	Ore (Mt)	Ni (%)	Cu (%)	PGE (ppm)	Cr_2O_3 (%)	
Mayville	Bird River North	31.80	0.18	0.45	0.19		(Mustang Minerals Corp.)
New Manitoba/ Cat Lake*	Bird River North	0.60	0.24	0.58			Manitoba Mineral Inventory File No. 217
Maskwa*	Bird River South	8.27	0.61	0.13	0.42		(Coats et al . 1979; Mustang Minerals Corp.)
Dumbarton*	Bird River South	1.54	0.81	0.30			(Coats et al . 1979)
Page & Ore Fault Deposits	Bird River South	0.55	0.94	0.56	0.35		(Marathon PGM Corp.)
Euclid Lake*	Bird River South	4.69				6.44	(ILAM Associates)
Bird Lake*	Bird River South	1.12				7.53	(ILAM Associates)
Chrome*	Bird River South	1.34				9.65	(ILAM Associates)
Page*	Bird River South	1.71				7.40	(ILAM Associates)

*Not NI 43-101 compliant

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Mustang Minerals Corporation, Press Release, April 8, 2014

Regional Distribution

The BRGB in southeastern Manitoba consists of two Neoarchean supracrustal packages, the southern and northern arms, which are located between the English River and Winnipeg River subprovinces. Numerous mafic and ultramafic intrusions are distributed over a strike length of ~75 km within both arms, hosting significant chromite and Ni-Cu-PGE sulfide deposits/occurrences (Figure 2).

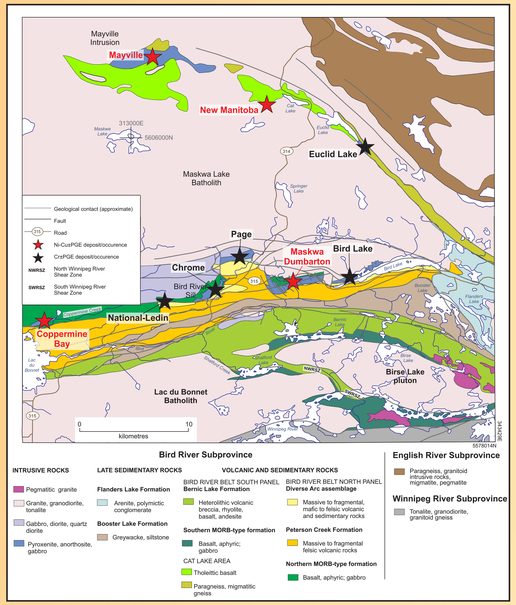

Figure 2. Simplified geology of the southern and northern arms of the Bird River greenstone showing the main mafic and ultramafic igneous bodies and their Ni-Cu±PGE and Cr±PGE deposits/occurences (modified from Bailes et al., 2003; Gilbert et al., 2008)

Internal Stratigraphy

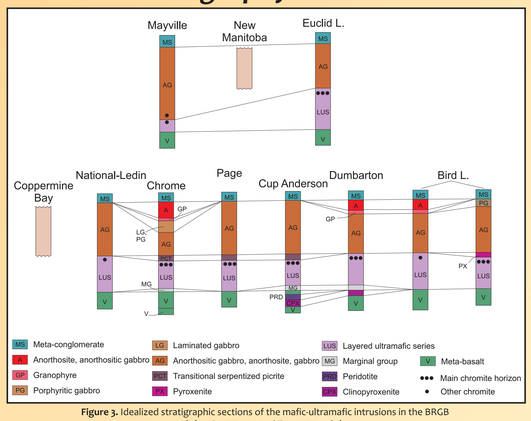

Figure 3. Idealized stratigraphic sections of the mafic-ultramafic intrusions in the BRGB (after Bannatyne and Trueman, 1982).

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Typical Gabbroic Rocks within Mafic / Ultramafic Intrusions in the BRGB

CM-1 Coppermine Bay intrusion

- Anorthositic gabbro to gabbro, coarse to medium- / fine-grained;
- Amphibole±biotite±chlorite±carbonate alteration;
- Disseminated to semi-massive chromite withine gabbro and rare thin altered peridotite intervals;
- Contains the Ni-Cu Coppermine showing that grades up to 0.20% Cu, 0.11% Ni and 0.92 g/t Pd+Pt+Au over 22 m (*PR*- Gossan Ressources Ltd., June 12, 2009).

CHR-1 Chrome

- Normal gabbro from Lower Gabbro Zone, Mafic Series;
- Anorthositic gabbro to pyroxene rich, coarse to medium–grained;
- Rare occurrence of cm-thick chromitite layers;
- Stratigraphically above the Ultramafic Series that host the chromitiferous zone of the Chrome property (1.34Mt @ 9.65% Cr_2O_3 - *ILAM Associates, 1988; not NI43-101 compliant*)
- U-Pb on zircon age of 2743.0±0.5 Ma (Scoates an Scoates, 2013)

(photograph and description from Williamson (1990))

MAY-1 Mayville intrusion: anorthositic gabbro zone

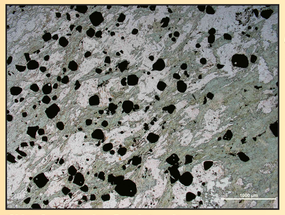
- Anorthositic gabbro to anorthosite, very coarse to medium-grained;
- Minor chlorite alteration;
- Dominating sequence of the Mayville intrusion;
- Stratigraphically above the sequence that host to the Mayville Ni-Cu-PGE deposit (M2: 9.42Mt @ 0.23% Ni, 0.61% Cu, 0.72% PGE - Mustang Minerals Corp., 2010).

MAY-2 Mayville intrusion: heterolithic breccia zone

- Anorthositic gabbro to gabbro, coarse to medium- / fine-grained;
- Chlorite-±biotite±carbonate alteration;
- Net and diffuse contact with altered pyroxenite/ pyroxene rich peridotite with disseminated chromite;
- Host of the Mayville Ni-Cu-PGE deposit (M2)
- U-Pb on zircon age of 2743±1 Ma (Houlé et al., 2013)

EU-1 Euclid Lake intrusion

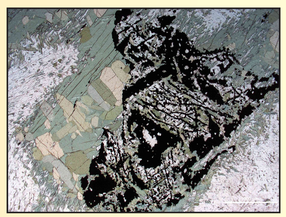
- Anorthositic gabbro to gabbro, coarse to medium- / fine-grained;
- Amphibole±chlorite-±biotite (Fe-rich?)±carbonate alteration;
- Stratigraphically above the Layered Upper Mafic Sequence that contain chrome ressources (4.16Mt @ 6.42% Cr_2O_3 - *ILAM Associates, 1988; not NI43-101 compliant*)



CM-2 Coppermine Bay intrusion

Microphotographs

- Left picture: melagabbro at Coppermine with disseminated chromite. Inclusions in chomite grains are mostly magnesio-hornblende with minor chlorite.
- Right picture: anorthositic gabbro at Euclid Lake with skeletal ilmenite associated with magnesio-hornblende



EU-2 Euclid Lake intrusion

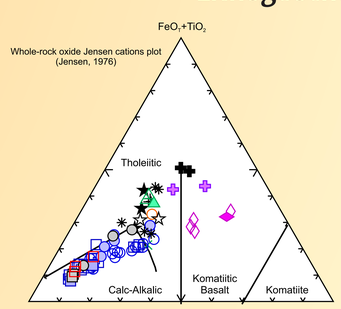
CM-3 Coppermine Bay intrusion

Microgabbro

- Gabbro to melagabbro, fine-grained to aphanitic;
- Amphibole±chlorite alteration;
- Subophitic texture occasionally recognized;
- Left picture: microgabbro at Coppermine with sharp to diffuse contacts with gabbro/leucogabbro
- Right picture: microgabbro in footwall of talc-carbonate altered peridotite host sequence of the Ni-Cu-PGE Maskwa deposit.

MAS-1 Maskwa pit

Lithogeochemistry



Legend

Gabbro
- Coppermine
- Euclid Lake
- Chrome (Mealin, 2008)

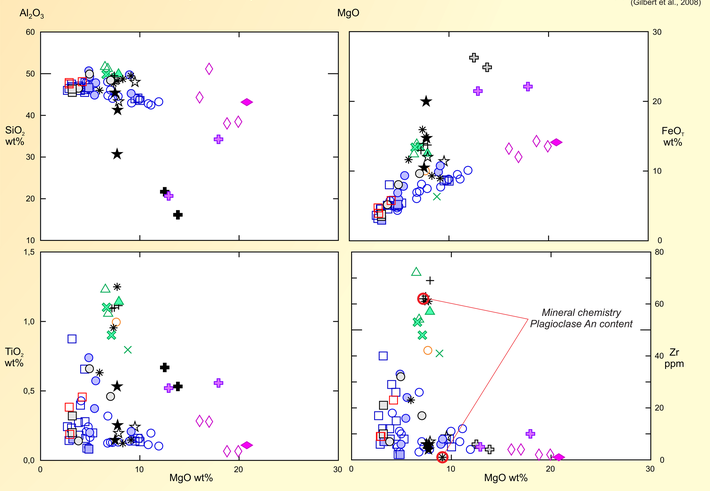
Anorthositic Gabbro
- Coppermine
- Euclid Lake
- Chrome (Mealin, 2008)
- Mayville

Microgabbro
- Coppermine
- Euclid Lake
- Maskwa

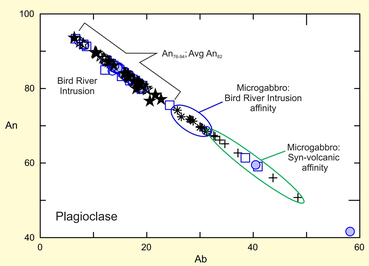
Melagabbro
- Coppermine (1-5% chromite)
- Coppermine (10-20% chromite)

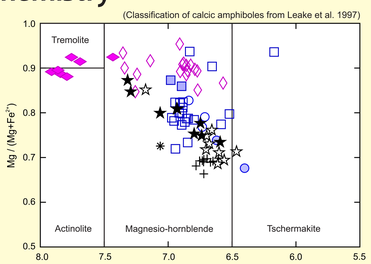
Ultramafic units
- Coppermine (Alt. Peridotite)
- Euclid Lake (Alt. Pyroxenite)
- Mayville (Alt. Pyroxenite)
- Mayville (Alt. Pyroxenite 40-70% chromite)

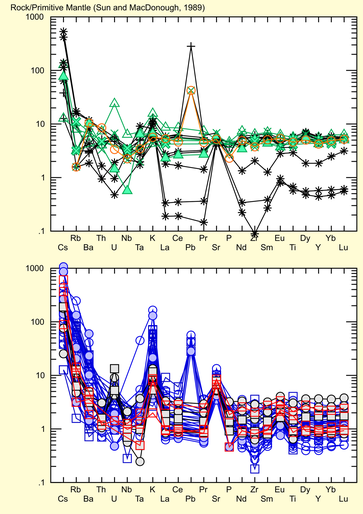
Mafic Volcanic units
- Coppermine
- Euclid Lake
- Dumbarton
- NMORB-type units (Gilbert et al., 2008)



Mineral chemistry







Preliminary Results

- The gabbroic units of the Coppermine Bay intrusion (CBI) and the Euclid Lake intrusion (ELI) show similar texture, petrography, mineral chemistry and whole-rock lithogeochemistry.
- These units are comparable to other gabbroic units found at Chrome Property and the Mayville Intrusion thus suggesting a linkage between these intrusions and the Bird River magmatic event.
- Microgabbroic units are common. At CBI and ELI, while field observations do not allow for a net discrimination, the TiO_2, Zr and REE ratios show marked distinctions between the microgabbros and the other gabbroic units. This allowed to distinguish two series of microgabbros; one of syn-volcanic affinity and another associated with the gabbroic units interpreted to be linked to the Bird River magmatic event.
- Mineral chemistry on plagioclase show similarities between interpreted intrusion related gabbroic units (average An_{82}), while two microgabbro samples, one of syn-volcanic affinity and the other of intrusive affinity exhibit lower, distinctive, An content.
- Ultramafic rocks are observed in various proportion at CBI and ELI and exhibit similar oxide and Zr content.

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