

RECOMMENDATIONS for Exploration

2014 - 2015

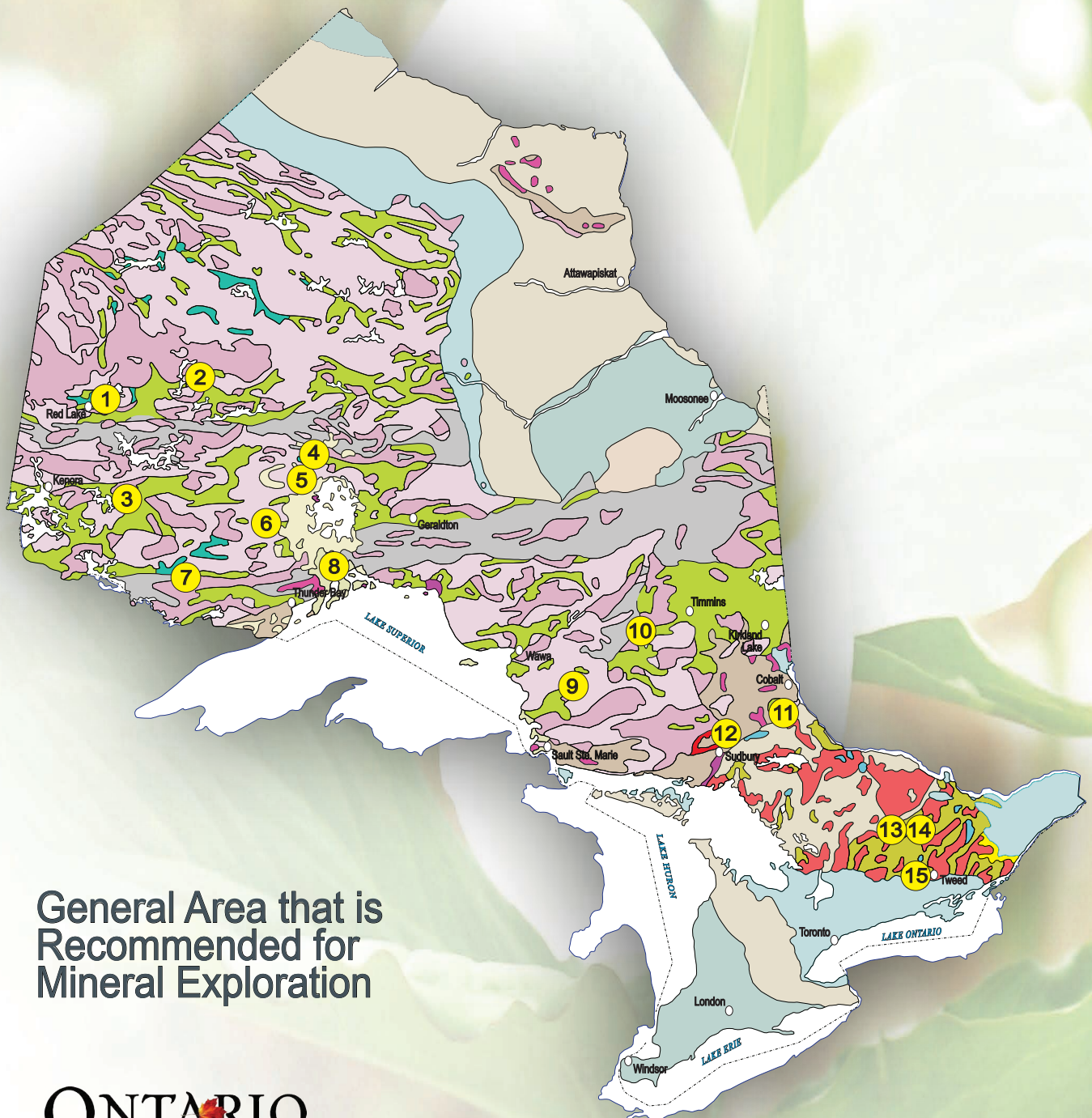


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Recommendations for Exploration

2014-2015



● General Area that is Recommended for Mineral Exploration

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Ontario Geological Survey

Resident Geologist Recommendations for Exploration

The Ontario Geological Survey is pleased to issue its 2014 Recommendations for Exploration. These recommendations are the product of the Ministry's dedicated and knowledgeable staff located across the province.

Each year recommendations are developed based on the wealth of geological and exploration data available to our staff (and you) and any new information or concepts derivative from the current year's activities.

Please review our current recommendations and feel free to discuss these in detail with any of our geoscientists.

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About the Resident Geologist Program

Resident Geologists are the stewards of public geological and mineral exploration information for their districts. They provide a broad range of advisory services on geological topics of interest to the public, municipal governments, and the mineral industry.

They are the local experts on why geoscience information is important, what information is available and what's been happening in exploration.

The program provides primary client services through a network of 8 field offices strategically located across the province. Services include:

- collecting and maintaining geological data
- monitoring exploration activity
- conducting property examinations
- providing geological and exploration advice

We provide geoscience information to support:

- public safety
- environmental planning
- land use planning
- mineral sector investment and economic development

We provide information and training to First Nation Communities regarding prospecting, mineral exploration and mining.

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HIGHLIGHTS



- **New discoveries in the shadows of headframes ...**
- **Recent exploration discoveries show that the Red Lake camp still has life**

Gold in the Historic Red Lake Camp

Red Lake is a gold camp and gold exploration and production has long been the mainstay of the local economy. The discovery of the High Grade Zone at the Goldcorp Red Lake Gold Mines in 1995 emphasized the fact that there are significant discoveries yet to be made and it revitalized exploration in Red Lake. Recent exploration by Goldcorp Red Lake Gold Mines has expanded known resources and has made new discoveries within the mine envelope maintaining a high level of interest in the Red Lake Camp. Diamond drilling on the H.G. Young property adjacent to the Campbell Complex (the former Placer-Dome Campbell Mine) has returned high grade intercepts (www.goldcorp.com News Release Goldcorp Announces Strong Second Quarter Financial Results) indicating a possible new high grade resource. Goldcorp is working at their Bruce Channel Discovery (purchased from Gold Eagle Mines Ltd.) under Red Lake and close to the past producing Cochenour-Willans Mine. Rubicon Minerals Corporation is continuing development of its Phoenix Project F2 Zone ([Rubicon Minerals Intersects 136.5 grams per tonne Au](http://www.rubiconminerals.com)) with production expected in 2015. The Phoenix Property (also known as the McFinley) was first discovered in 1926. These discoveries were made in a mature camp and indicate that there is still potential for more high grade gold.

Little of the Red Lake camp has been explored below the 500 metre level and deserves continued exploration for gold using the most modern exploration theories and methods. There are many historic gold properties that are under explored and offer excellent potential for high grade gold mineralization. In addition to the Red Lake greenstone belt, the Birch-Uchi greenstone belt and the Northern greenstone belts all have properties that deserve re-evaluation (for example the Sandy Lake Belt where Goldeye Explorations Ltd is working on the Weebigee project. <http://www.goldeye.ca/>).

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HIGHLIGHTS



- **Two key properties, the Sor Lake and Altered Zone, both with potential for significant gold mineralization, remain open for staking**
- **Several key occurrences throughout the LMGB with favourable geology for precious and base metal mineralization, remain open for staking**

Gold Potential at the Sor Lake and Altered Zone Properties; Lang-McVicar Greenstone Belt

The Lang-McVicar Lake greenstone belt (LMGB) is located approximately 80 km west of the town of Pickle Lake and 20 km southeast of the First Nation community of Cat Lake. The LMGB is accessible by fixed-wing aircraft or helicopter. A winter road from Pickle Lake to Cat Lake is situated 3 km south of the belt where a backhoe trail leads north to the central portion of the belt.

The LMGB is approximately 40 km long and varies in width from 8 to 11 km (Sage and Breaks 1982). Stott and Corfu (1991) describe the LMGB as being dominated by tholeiitic basalt flows and calc-alkaline pyroclastic deposits, with the eastern portion of the belt containing a significant metasedimentary package hosting iron formation horizons. The entire belt has been folded into an east trending and east plunging syncline (Thomas 1988). Late stage intrusive rocks intrude older, folded rocks and comprise a large, elongated mafic sill in the Sor-McVicar Lakes area. A north trending felsic intrusion in the Shonia-McVicar Lakes area divides the mafic intrusion into two parts (Sage and Breaks 1982). The dominant structural feature in the region is the Bear Head Fault Zone, a northwest-southeast striking, regional scale dextral shear zone located in the southwest portion of the belt (Stott and Corfu 1991). Splays off the Bear Head fault are interpreted to be the main controls on gold mineralization in the Lang-McVicar greenstone belt (S. Magnus, Ontario Geological Survey, personal communication, September 2014). Thomas (1988) interpreted the LMGB to originally be part of the Meen-Dempster belt (to the south) which was rafted away due to late stage extensional tectonics.

The Lang-McVicar greenstone belt is currently being mapped by the Earth Resources and Geoscience Mapping Section (ERGMS) of the Ontario Geological Survey which will provide insights into the general geology, litho-tectonic evolution and mineral potential of the belt. The staff of the Resident Geologist's program visited the LMGB with the ERGMS crew in August of 2014. Several occurrences in the belt were visited and traverses were conducted to study the general geology of the area. Of particular interest were two significant properties which remain open for staking; the Sor Lake property and the Altered Zone property. The Sor Lake property (*see map*) is approximately 100 to 300 m wide and up to 2 km in length and contains the Sor Lake Sill occurrences, the Jay Zone and the Sor Lake Sill Shear. The occurrences are hosted within the Sor Lake sill which is a variably altered and deformed tonalite intrusion with alteration consisting of Ca- and Fe-rich carbonate, sericite and silicification (McKay 2004). Mineralization occurs within quartz veins and shears where the most significant assay results returned 3.20 g/t Au over 1.0 m from a quartz vein (channel sample; referred to as occurrence #6 by McKay (2004)) and 122.94 g/t Au from a shear located ~1 km east of occurrence #6, (grab sample; referred to as occurrence #10 by McKay (2004)). The Altered Zone prospect (*see map*) is located at the eastern end of McVicar Lake and is hosted within a northwest-trending ductile shear zone. Gold mineralization at the Altered Zone is present within a dilation zone associated with the faulting. Gold occurs in lenticular quartz ± iron carbonate veins with minor pyrite and rare chalcopyrite within mafic metavolcanic and gabbroic rocks. Channel sampling returned values up to 12.77 g/t Au over 0.8 m. The most significant historical drill intersections are reported as 14.4 g/t Au and 33.0 g/t Au over 4.63 m and 1.87 m, respectively (McKay 2004).

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Gold Potential at the Sor Lake and Altered Zone Properties; Lang-McVicar Greenstone Belt

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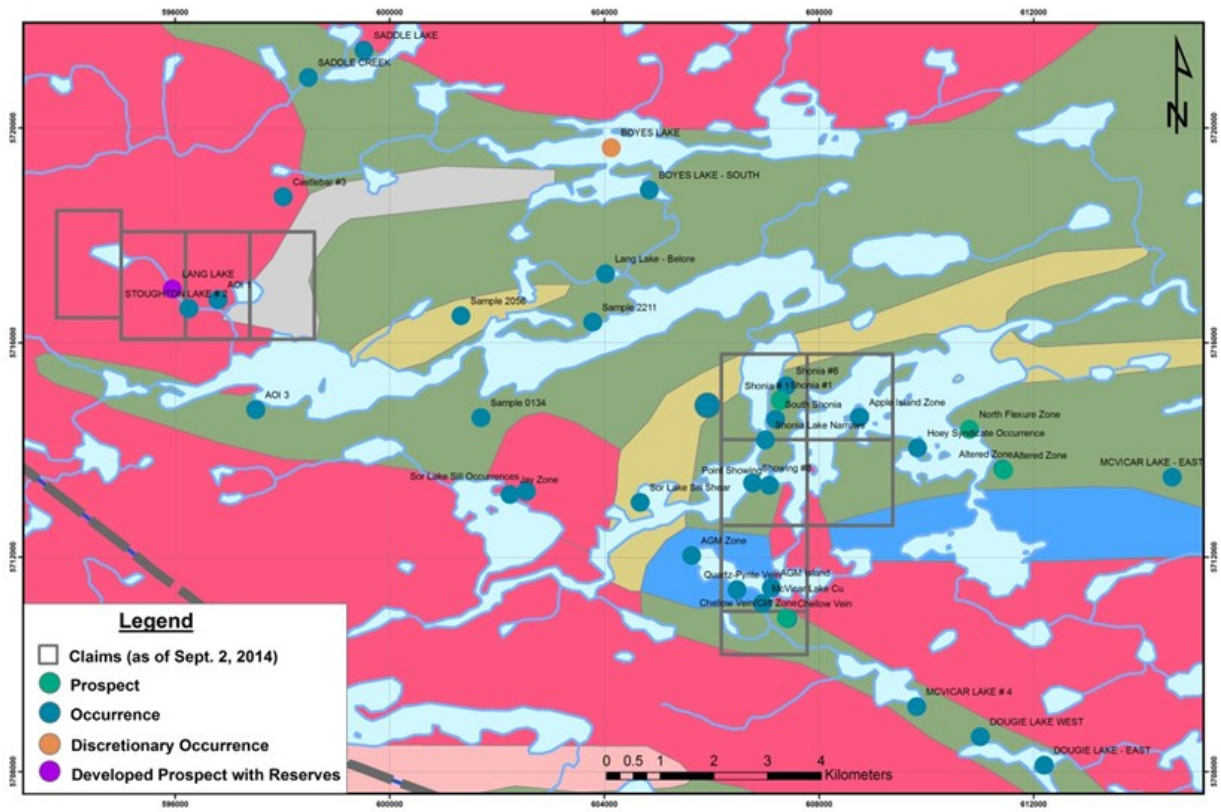


Figure: Geology map showing Mineral Deposit Inventory (MDI) points, Lang-McVicar Lake greenstone belt (NAD 83, Zone 15; claim units as of September 2, 2014; bedrock geology from OGS 2003)

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HIGHLIGHTS



- **3 gold deposits in the Kenora District present unique styles of mineralization**
- **An early mineralizing event may be obscured by later alteration and metamorphism**
- **Multiple generations on pyrite may be present**

Gold-Sulphide Association and Pre-Orogenic Model for Mineralization

Unique styles of gold mineralization, situated in different geological settings have been identified at three gold deposits in the southwestern part of the western Wabigoon Subprovince; a) the Angel Hill Gold Zone deposit is hosted in mafic intrusive rocks (Secord 2011); b) the Cameron Lake deposit is hosted in mafic volcanic rocks (Melling, Taylor and Watkinson 1988); and c) the Rainy River deposit is hosted in sedimentary and pyroclastic rocks (Wartman 2011).

Gold-pyrite association at deposits

Stable isotope geochemistry of gold-bearing rocks from these deposits, indicates the initial precipitation of gold is closely linked to a specific generation of pyrite. Gold may occur along pyrite grain boundaries, within individual grains and along intergranular fractures in pyrite (Wyman, Kerrich and Fryer 1986). The studies on these three deposits suggest that not all pyrite is associated with gold, and that there may be multiple generations of pyrite. A common feature of the three deposits is that a specific silica-dominated quartz event(s) is related to the precipitation of gold and could also be linked to the formation of sulphide minerals.

Pre-orogenic atypical greenstone belt gold model

The paragenetic sequence relative to gold deposition interpreted for these three gold deposits is atypical of common greenstone hosted gold deposits. Groves et al. (2003) mention “these types of [atypical] deposits form prior to the major phase(s) of orogenesis, involving compressional to transpressional deformation, regional metamorphism, and postvolcanic granitoid magmatism during which the orogenic gold deposits form”. Robert and Poulson (2001), Groves et al. (2003), Robert et al. (2005, 2007) provide detailed descriptions of the geological setting of atypical greenstone hosted gold deposits and their affiliation with orogenic settings.

A pre-orogenic depositional environment must have had original permeability in the rocks and some structural deformation for the percolation of fluids. Stratabound permeability would be relatively high in fragmental rock units as opposed to massive flows. Wartman (2011) noted that in the Rainy River deposits “zones of higher permeability (i.e. flow tops and breccia related to dacitic lava flows) and areas of intense deformation have elevated gold values, up to 10,000 times greater than gold values in surrounding rocks”.

There is the possibility of pre-orogenic mineralizing events, commonly related to atypical greenstone belt gold model, existing at the three gold deposits.

Post orogenic mineralizing events at deposits

The term orogenic used in this recommendation is restricted to deposits composed of quartz-carbonate veins and associated wallrock replacement associated with compressional or transpressional geological structures such as reverse faults and folds. This mineralizing events overprint pre-existing deformation, alteration, metamorphism and especially any pre-orogenic mineralization (Robert et al. 2005, 2007). Two of the three gold deposits discussed in this article, the Cameron Lake Deposit (Ball, 2012) and Rainy River Deposit (Hardie et al., 2012 and Schandl, 2005) have overprinting post-orogenic mineralizing events, the typical setting of lode-gold greenstone belts models.

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Gold-Sulphide Association and Pre-Orogenic Model for Mineralization

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Recommendation

A key to success when examining the mineral potential is to understand and detect the different types of gold mineralizing events. Most gold occurrences consist of a single style of mineralization but Robert et al. (2007) indicates at several deposits that “the diversity of styles of mineralization, wall-rock alteration assemblages, and overprinting relationships require more than one episode of gold mineralization and more than one ore-forming process”.

The composition of the of the host rocks is important to the formation of sulphides. At the Cameron Lake gold zones Melling et al. (1988) noted “magnetite, although an abundant accessory mineral in the host rock of the deposit, is rarely present within the altered gold-bearing zones ... the fluid-wall rock reactions which led to gold deposition involved sulfidization of the Fe-bearing mineral, especially magnetite”. Sulphide-bearing rocks, which are overprinted by quartz veins, could have a pyrite-gold association. Scanning electron microscope analysis of gold-bearing rocks is a good method to determine if there is a gold-sulphide association.

Pre-orogenic atypical greenstone belt gold mineralization is nonetheless difficult to recognize due to the overprinting effects of subsequent orogenic-related metamorphism, deformation and alteration. Secord (2011) mentions stable isotope geochemistry is used “to investigate if the texturally distinct sulphide minerals and fluid phases represented separate isotopically distinct generations and to gain insight into the relationship between mineralizing fluids and ore forming minerals”. Oxygen isotope compositions of hydrothermal minerals can provide information on the temperature of mineralization and the source of ore-forming fluids. Sulphur isotope compositions can yield constraints on the source rocks from which these fluids were derived (McCuaig and Kerrich, 1998).

The application of specialized analytical techniques is not always available or practical. Examination of slab-cut rock samples could display unique sulphide – silica relations that could suggest the existence of an atypical mineralizing event. The fabric of the sulphide grains could illustrate evidence on multiple formation generations. The gold mineralizing event (s) could be associated with a specific formation of sulphide. If possible estimate the paragenesis of silica events, especially quartz veins and formation of sulphide – this could be also related to the introduction of mineralization.

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Gold-Sulphide Association and Pre-Orogenic Model for Mineralization

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HIGHLIGHTS



- **The western portion of the Caribou Lake greenstone belt represents an under explored belt with potential for significant iron formation-hosted gold as well as copper-lead-zinc mineralization**
- **Several key occurrences within areas of favourable geology for precious and base metal mineralization remain open for staking**

Targeting Gold and Base Metals in BIF and Ultramafic Volcanic Rocks; Western Caribou Lake Greenstone Belt

The Caribou Lake greenstone belt (CLGB) is located approximately 20 km north of Armstrong, Ontario and is bound by Caribou Lake to the west and the Summit Lake area to the east. The east-central portion of the CLGB is accessible by the Airport Road or Jackfish Logging Road east of Armstrong as well as a network of older logging roads. The western portion of the belt is accessible via Caribou Lake by boat, float-plane, helicopter or sled in winter.

The CLGB ranges from 3.5 to 15 km wide and extends from Caribou Lake, 80 to 100 km eastward where it merges with the Onaman-Tashota greenstone belt (MacDonald et al., 2009). The area recommended for exploration lies within the western portion of the belt around Caribou Lake proper. The supracrustal rocks in this part of the belt were mapped by Sutcliffe (1988) and consist of (1) ultramafic to mafic metavolcanic rocks; (2) clastic metasedimentary rocks ranging from argillite to metaconglomerate; (3) chert and ironstone with interbedded metavolcanic and metasedimentary rocks; and (4) metamorphosed subvolcanic to volcanic felsic rocks. The supracrustal rocks were intruded by several phases of intrusive rocks including (1) early felsic to intermediate plutonic rocks, dominantly biotite tonalite; (2) northeast trending amphibolite and gabbro dykes; (3) the gabbroic Caribou Lake Pluton; and (4) late felsic to intermediate plutonic rocks, dominantly granite.

In June of 2014, the staff of the Resident Geologist's Program visited the Caribou Lake greenstone belt focussing on the western portion of the belt around Caribou Lake. A traverse was conducted around the Fletcher Lake anticline which is host to the Bovin-Gilbert occurrence. The Fletcher Lake anticline is an iron formation unit composed of chert to magnetite-amphibole ironstone (Sutcliffe 1988). Outcrops in the area are generally small with several historical pits located towards the east end (fold nose) of the unit along a hillside. Quartz veining (up to 40 cm wide), sulphide mineralization and iron carbonate alteration are present throughout the unit suggesting the Fletcher Lake anticline is a favourable environment for iron formation-hosted gold mineralization. High grade lead and silver mineralization have been previously reported at three locations within the Fletcher Lake anticline with assay results yielding 47.3% Pb and 98.44 oz/ton Ag from a high grade galena vein (Thurston and Carter 1970). Samples were taken from one of these locations with material consisting of approximately 15-20% massive galena and 3-5% sphalerite within an iron formation host rock. Assay results for samples taken during this field work are pending.

The Cumaway Lake area, east of Caribou Lake hosts favourable geology for both gold and copper-lead-zinc mineralization. Ultramafic rocks in this area are associated with zones of deformation and alteration, likely related to two sets of intersecting faults as mapped by Sutcliffe (1988). Mineralization previously reported at the J.H. Forbes occurrence (Lett occurrence) is present within a 25 m wide fault breccia consisting of angular country rock fragments cemented by quartz-calcite with disseminated and/or massive chalcopyrite, sphalerite and galena (Sutcliffe 1988). Two grab samples (1105 and 1006) from this area taken in 1988 by the OGS yielded: Au = 0.05 oz/ton, Ag = 12.03 oz/ton, Cu = 2.0%, Zn = 11.05%, Pb = 2.10% and Au = 0.04 oz/ton, Ag = 0.46 oz/ton, Cu = 0.73%, Zn = 0.15%, Pb = 0.02%, respectively. Further work is warranted in this area to evaluate the potential for both precious and base metal mineralization within the fault-breccia zone described above as well as in the surrounding metamorphosed and altered ultramafic-mafic volcanic rocks.

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Targeting Gold and Base Metals in BIF and Ultramafic Volcanic Rocks; Western Caribou Lake Greenstone Belt

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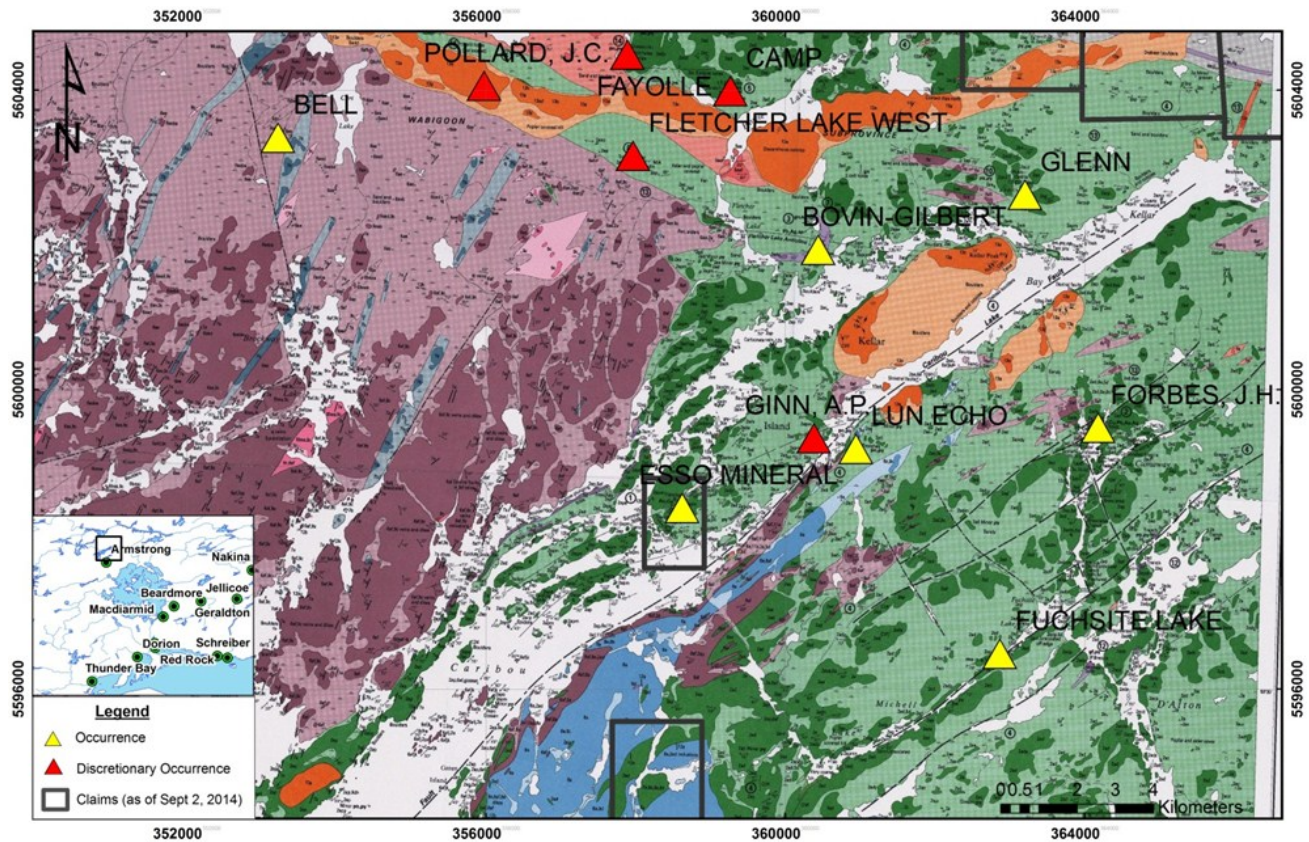


Figure: Geology of the northern section of Caribou Lake showing claim units as of September 2, 2014 (Caribou Lake greenstone belt; from Sutcliffe 1988).

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HIGHLIGHTS



- **The Badwater gabbro represents an easily accessible, layered mafic intrusive complex entirely open for staking**
- **The Badwater gabbro has potential to host Cu-Ni-PGE and/or Ti-V deposits**

Cu-Ni-PGE and Ti-V Potential in the Mesoproterozoic Badwater Intrusive Complex; Armstrong, Ontario

The Mesoproterozoic Badwater Intrusive Complex (a.k.a. Waweig Troctolite Complex; *cf.* Borradaile and Middleton 2006) intrudes Archean Wabigoon Subprovince country rocks, 13 km southwest of Armstrong, Ontario. The complex comprises the Badwater Gabbro (BG) and the Badwater Syenite (BS). It is believed to form a multi-phase, intrusive complex which is expressed by a circular magnetic anomaly 12 km in diameter (Middleton and Bennett 2008). Initial mapping by MacDonald (2004) identified a variety of intrusive rocks, ranging from gabbro to quartz monzonite and syenite. High-precision U-Pb dating of baddeleyite yielded an emplacement age of 1598.7 ± 1.1 Ma for the BG and a U-Pb zircon age of 1590.1 ± 0.8 Ma for the BS, which supports observed cross-cutting relationships (Heaman et al. 2007). They are unconformably overlain and largely obscured by Pillar Lake volcanic rocks which were possibly erupted at 1129 ± 4.6 Ma (U-Pb age from titanite; Heaman et al. 2007; Smyk et al. 2011).

The poorly exposed BG was first recognized in 2000 by East West Resources Corp. (Middleton 2004) and was tested for PGE mineralization in drilling campaigns carried out in 2004 and 2008. The BG is described as a layered troctolite-gabbro complex consisting of olivine gabbro, anorthosite, troctolite, glomeroporphyritic rocks and layers of magnetite with sulphides (Middleton and Bennett 2008). Minor ultramafic mafic lithologies have also been reported from drill-core. Magmatic layering dips $\sim 45^\circ$ to $\sim 55^\circ$ southeast. Modal mineralogy for typical olivine gabbro is listed as: plagioclase (labradorite/bytownite) 55%; clinopyroxene (augite?) 25%; biotite 10%; olivine (partly relict) 3%; talc/sericite (after olivine) 2%; amphibole (secondary actinolite) 2%; opaque (magnetite? pyrrhotite?) 2%; clay?/sericite (after plagioclase) trace (Middleton and Bennett 2008). The BG is undeformed and displays generally fresh plagioclase and relatively unaltered olivine.

Although no appreciable assay results have been reported for the Badwater gabbro, potential for the unit to host significant Cu-Ni-PGE and/or Ti-V mineralization remains high. Several holes have been drilled into select parts of the layered gabbro complex (*see figure*) however several areas of the complex remaining untested. The Badwater gabbro is poorly understood and insights into the intrusive history and structural control of the unit should aid in developing targets for mineralization. Ground and bore-hole geophysical methods are recommended in addition to further drilling to test previously undrilled areas of the unit as well as any newly identified targets. The majority of drill-core recovered from previous campaigns is currently held at the MNDM's off-site core storage facility in Comnee Township west of Thunder Bay and is available for viewing.

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Cu-Ni-PGE and Ti-V Potential in the Mesoproterozoic Badwater Intrusive Complex; Armstrong, Ontario ...cont'd

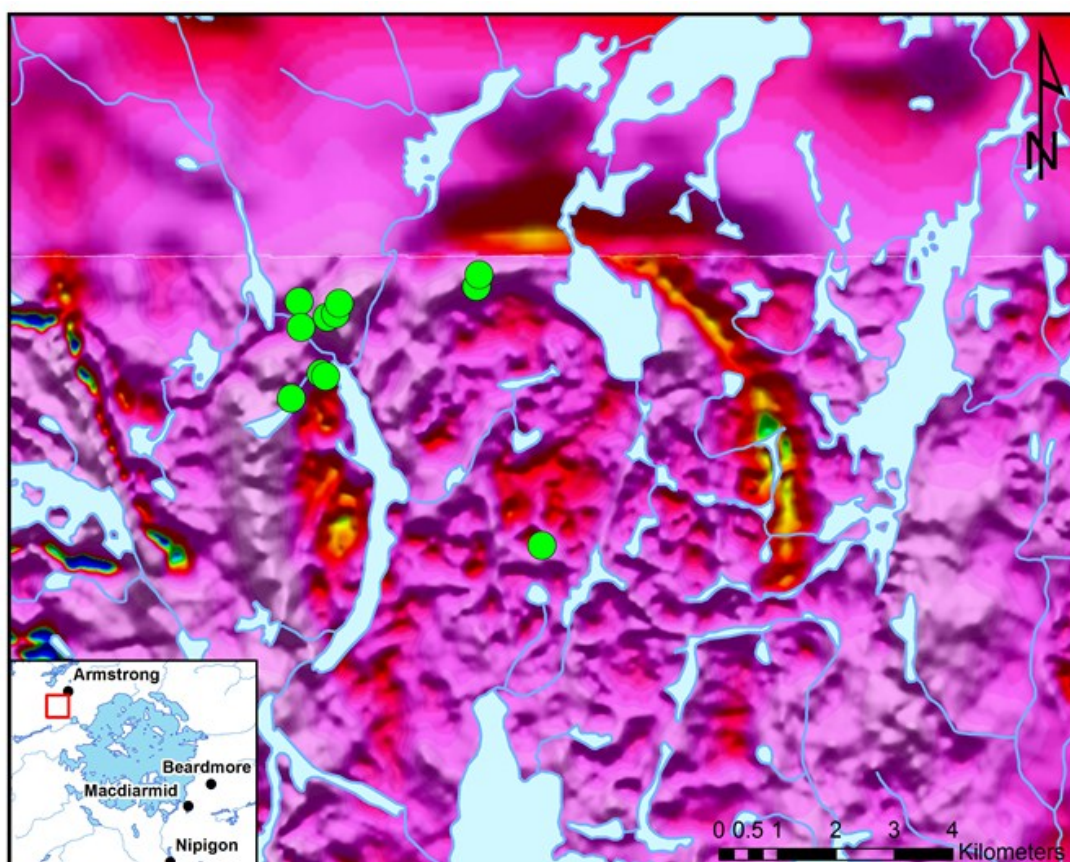


Figure: Total Field Magnetic map showing the circular magnetic expression of the Badwater Intrusive Complex with drill-holes marked as green dots.

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HIGHLIGHTS



- **The Garden Lake area has potential for the discovery of lode gold, volcanogenic massive sulphide (VMS)-type copper-zinc and mafic to ultramafic intrusion-hosted copper-nickel-PGE mineralization**
- **Historic gold occurrences near Kearns, Conick and Ruffo Lakes are open for staking**
- **A historic copper occurrence north of Garden Lake is also open for staking**

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Exploration Potential of the Garden Lake Area

The Garden Lake greenstone belt has seen sporadic mineral exploration activity since the initial discovery of gold on the east shore of Conick Lake in the late 1930s (Milne 1964). During the 1940s, Little Long Lac Gold Mines discovered additional gold showings along the shore of Garden Lake (Phelan 1947), and the majority of subsequent exploration activity in the belt (mostly between 1983 and 2000) has been focussed on gold in the immediate vicinity of Garden Lake (Hart 2000).

The Garden Lake belt has also seen periodic exploration for volcanogenic massive sulphide (VMS)-type zinc-copper deposits. VMS exploration commenced in the early 1960s, when Ruffo Lake Mines and Inco carried out geophysical surveys and diamond drilling programs (Hart 2000). Subsequent exploration programs were carried out by Weaver Lake Resources in the early 1990s (Pitman 1991) and in 2007 by Benton Resources Ltd. (Byrnes 2008).

Historic exploration programs and government surveys have resulted in the identification of eight significant mineral occurrences in the Garden Lake greenstone belt. The locations of these occurrences are shown on Figure 1. Note that three of the historic occurrences are now located within a Provincial Park. However, as of October 1, 2014, the Kearns Road, Bumbu, Conick Lake and Ruffo Lake occurrences are available for staking.

Gold Potential

The primary commodity of interest that has been identified at six of the historic occurrences in the Garden Lake greenstone belt is gold. Most of these gold occurrences are located in close proximity to the Garden Lake deformation zone (see Figure 1), which was previously identified as a favourable gold exploration target by Hart (2000). The Kearns Road gold occurrence is one example of a location where mineralization is believed to be associated with the Garden Lake deformation zone. Hart (2000) reported a grab sample assay of 0.69 oz/ton Au from the Kearns Road occurrence. The gold mineralization was hosted in sheared mafic metavolcanic rocks mineralized with 2 to 3% very fine grained pyrite. No significant exploration work is known to have occurred in the area of the Kearns Road occurrence since its discovery. As a result, this area is recommended for further exploration to follow-up upon the previously reported gold potential.

VMS-type Zinc-Copper Potential

Zinc and copper occurrences with characteristics consistent with the VMS-type mineralization model have been reported in the northern portions of the Garden Lake greenstone belt. These occurrences, known as the Bumbu and Gem, were discovered in extensively altered metavolcanic rocks that have a close spatial association with iron formation horizons (Pitman 1991, Hart 2000, Byrnes 2008).

Copper mineralization at the Bumbu showing was interpreted to be associated with a chloritized and brecciated VMS-type stringer sulphide zone at the contact between mafic and felsic metavolcanic rocks (Pitman 1991).

Exploration Potential of the Garden Lake Area

...cont'd

A felsic intrusion located to the northwest of Garden Lake was reported by Hart (2000) to have a trace element and rare earth element (REE) geochemical signature similar to intermediate and felsic metavolcanic rocks found in the central part of the greenstone belt. This geochemical similarity suggests the possibility that it is a subvolcanic intrusion that is genetically related to the VMS-type mineralization at the Bumbu and Gem occurrences, reinforcing the prospectivity of the Garden Lake greenstone belt for the discovery of a sizeable VMS-type Zn-Cu deposit.

Based on these observations, further exploration for VMS-type Zn-Cu mineralization is recommended in the northern portions of the Garden Lake belt where iron formations have been mapped and extensive hydrothermal alteration has been documented.

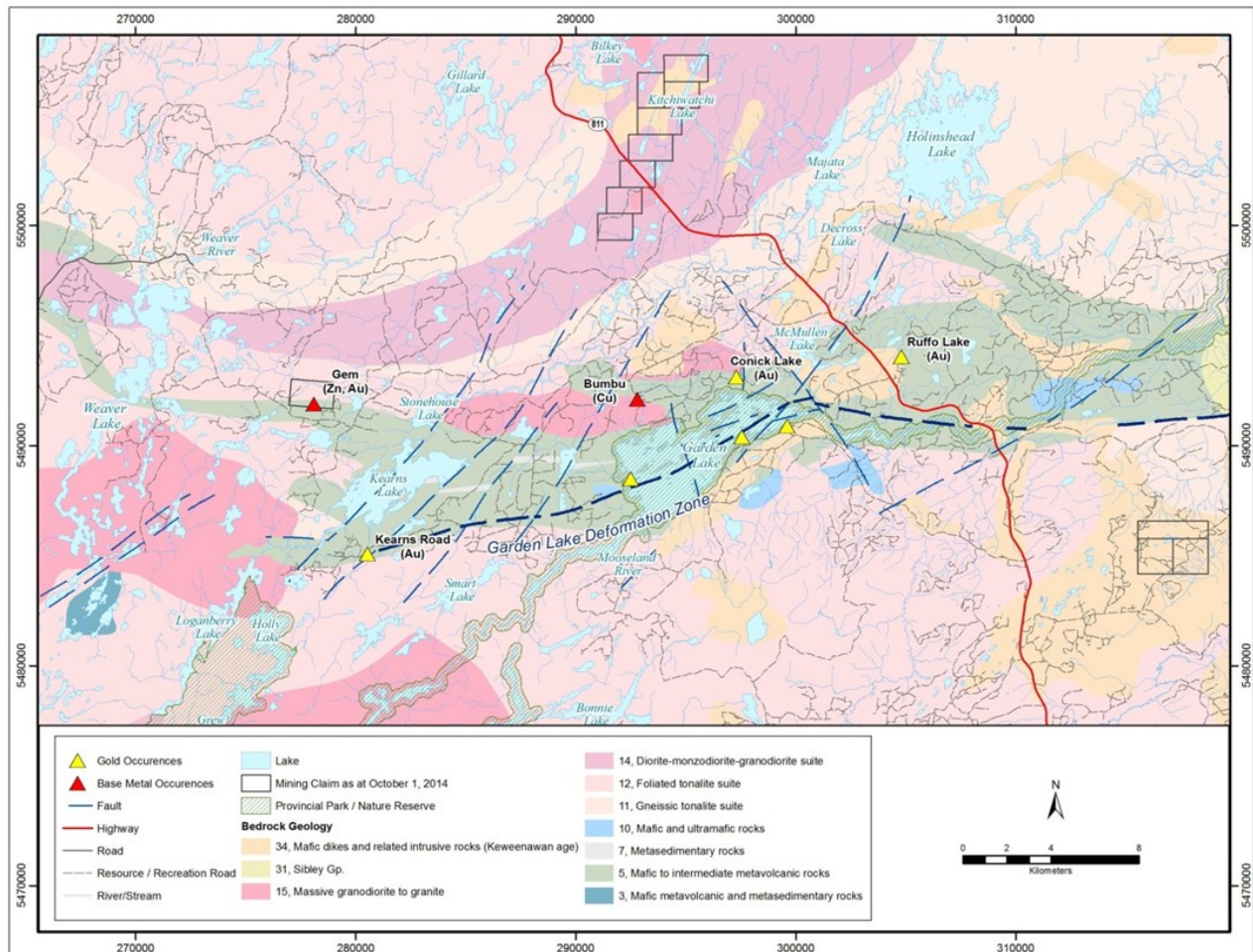


Figure 1: Geology and mineral occurrences of the Garden Lake greenstone belt.

Exploration Potential of the Garden Lake Area

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Copper-Nickel-PGE Potential

Although significant mafic intrusion-hosted Cu-Ni-PGE occurrences have yet to be documented in the Garden Lake greenstone belt, the possibility of locating such a deposit should not be overlooked. As noted by Hart (2000), the late gabbroic intrusions located along the Mooseland River in the eastern portion of the belt, and the pyroxenite intrusion west of Garden Lake require additional prospecting and sampling to properly establish their Cu-Ni-PGE potential.

Additionally, the Garden Lake greenstone belt is located near the western margin of the Mesoproterozoic Nipigon Embayment, which forms part of the Midcontinent Rift igneous province. Recent Cu-Ni-PGE exploration in the Thunder Bay area has resulted in the discovery of a number of mineralized mafic-ultramafic intrusive complexes (e.g., Thunder Bay North, Steepledge Lake and Sunday Lake igneous complexes) that formed during the development of the Midcontinent Rift. These and other mafic-ultramafic intrusions in the Nipigon Embayment typically occur at or near the intersections of major deep-seated fault structures (Hart and MacDonald 2007), with pre-existing Archean faults playing a major role in their emplacement (Hollings et al. 2010; Heggie et al. 2012). The area in the vicinity of the intersection between the Archean Garden Lake Deformation Zone and a northwest-striking fault immediately east of Garden Lake is considered to be an especially favourable location to prospect for Cu-Ni-PGE mineralized Midcontinent Rift-related mafic-ultramafic intrusions (Puumala et al. 2012).

Byrnes, K. 2008. Assessment report on the 2007 trenching and prospecting program at the Gem property; Thunder Bay South District, Assessment Files, AFRI report number 20000003878.

Hart, T.R. and MacDonald, C.A. 2007. Proterozoic and Archean geology of the Nipigon Embayment: Implications for emplacement of the Mesoproterozoic Nipigon diabase sills and mafic to ultramafic intrusions; *Canadian Journal of Earth Sciences* v.44, p.1021-1040.

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Heggie, G., MacTavish, A., Johnson, J., Weston, R. And Leon, M.A. 2012. Structural control on the emplacement of the TBN-Igneous Complex; *in* Proceedings and Abstracts, Part 1, 58th Institute on Lake Superior Geology, Annual Meeting, Thunder Bay, Ontario, v.58, pt.1, p.37-38.

Hollings, P., Smyk, M., Heaman, L.M., and Halls, H. 2010. The geochemistry, geochronology, and paleomagnetism of dikes and sills associated with the Mesoproterozoic Midcontinent Rift near Thunder Bay, Ontario, Canada; *Precambrian Research*, v.183, issues 3, p.553-571.

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Phelan, L.G. 1947. Report on the Garden Lake property for Little Long Lac Gold Mines Ltd.; Thunder Bay South District, Assessment Files, AFRI report number 52H12SE0011.

Pitman P. 1991. A Geological Appraisal, Weaver Lake Resources Corporation Mineral Properties, Garden Lake Area; Thunder Bay South District, Assessment Files, AFRI report number 52H12SE0002.

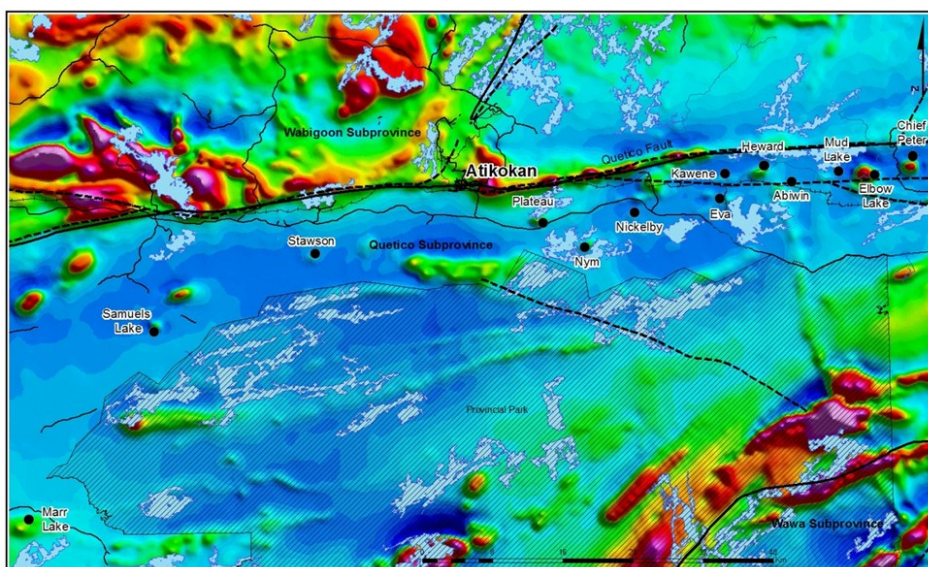
Puumala, M.A., Campbell, D.A., Cundari, R.M., Zurevinski, S.E., Tuomi, R.D., Lockwood, H.C., Debicki, R.L., Moses, P., Brunelle, M.R. and Pelaia, R. 2012. Report of Activities 2012, Resident Geologist Program, Thunder Bay South Regional Resident Geologist Report: Thunder Bay South District; Ontario Geological Survey, Open File Report 6285, 67p.

HIGHLIGHTS

- **Mafic-ultramafic Quetico intrusions have potential to host Cu-Ni-PGE mineralization**
- **Almost all of the Quetico mafic-ultramafic intrusions are available for option from local Thunder Bay-Atikokan area prospectors and several are open for staking**

Copper, Nickel and Platinum Group Element Potential in the Atikokan—Quetico Area

Copper-nickel sulphide mineralization and platinum group elements (PGEs) are known to occur within a series of mafic-ultramafic igneous rocks known as the Quetico Intrusions. The Quetico Intrusions are located in the vicinity of Atikokan, approximately 200 km west of Thunder Bay. These intrusions occur near the northern boundary of the Quetico Subprovince and/or near the margins of the Quetico Batholithic Complex (McTavish, 1999). Pettigrew & Hattori (2006) propose that the late Archean Quetico Intrusions display many similarities with Alaskan/Ural-type zoned mafic-ultramafic intrusions and likely formed in a similar tectonic setting; along major sutures of orogenic belts. The intrusions are related to an east-west trending, deep seated, linear feature referred to as the Quetico Fault marking the boundary between the Wabigoon and Quetico Subprovinces. This right lateral transcurrent fault zone is traceable for over 400 kilometres and ranges in width from 10-300 metres with several associated splay faults (McTavish, 1999). The intrusions are easily interpreted by their high magnetic signature and extend over a distance of 125 km (see map below).



Almost all of the Quetico mafic-ultramafic intrusions are available for option from local Thunder Bay-Atikokan area prospectors and several are open for staking as of October 15, 2014. The following table highlights Cu-Ni-PGE results from previous exploration on the Quetico Intrusions.

Name	Owner(s)	Highlights	Reference
Chief Peter	K. Fenwick K. Bjorkman	DDH CP13-01: 1.06g/t Pt, 1.27g/t Pd, 0.22% Ni & 0.55% Cu over 4 m DDH CP13-02: 1.2g/t Pt, 1.08g/t Pd, 0.14% Ni & 0.61% Cu over 5 m (Gabbro/peridotite*)	Minifocus Exploration Corp., news release, March 26, 2013*).

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Copper, Nickel and Platinum Group Element Potential in the Atikokan—Quetico Area

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Name	Owner(s)	Highlights	Reference
Elbow Lake (North and South)	DLK Minerals Ltd.	Grab - JR Showing: 5.0g/t Pt, 1.1g/t Pd, 3.73% Cu, 0.61% Ni. 25 Grab samples over an area of 25 m x 25 m returning an average grade of 1.61g/t Pt + Pd. (Hornblende gabbro, hornblendite, gabbro, pyroxenite, leucogabbro, hornblende-pyroxenite and diorite ³)	1349563 Ontario Limited/ P. Gagne 2001 Assessment Report AFRO# 2.20942 AFRI# 52B14SE2008
Mud Lake North	W. Moorehouse	Grab Samples ranging 0.21-5.12% Cu, 0.07% Ni, 33-3430 ppb Pt, 50-525 ppb Pd, 8g/t Ag (Clinopyroxenite, feldspathic hornblendite, hornblendite, and clinopyroxene hornblendite ²)	McTavish, 1999 OFR 5997
Mud Lake South	M. Frymire J. Brown	No known results	
Abiwin	M. Frymire J. Brown	Grab samples ranging 387-7,946 ppm Cu, 51-1,940 ppm Ni, <10-298 ppb Pt, <15-198 ppb Pd, <5 to 28 ppb Au (Pyroxenite, hornblendite, werhlite and monzodiorite/diorite ³)	Donnybrook Resources Inc. Starcro Resources Ltd. 1999 Assessment Report AFRO# 2.19850 AFRI # 52B14SE2004
Heward Lake	Open	Trench samples 487 ppm Cu, 90 ppm Ni 222 ppm Cu, 233 ppm Ni (Hornblendite/gabbro*)	Fleck Resources Ltd. 1988 Assessment Report AFRO# 2.10726 AFRI# 52B14SE0007*
Kawene Lake	K. Fenwick K. Bjorkman	DDH KW08-05: 0.10% Ni, 0.25% Cu, 0.45g/t Pt & 0.51g/t Pd over 11.7 m (Hornblende gabbro, hornblendite, hornblende clinopyroxenite and hornblende, werhlite ³)	Canadian Arrow Mines Ltd., news release, November 12, 2008)
Eva Lake	K. Fenwick K. Bjorkman	DDH EL-08-09: 0.19% Ni, 0.46% Cu, 0.24g/t Pt, 0.31g/t Pd & 0.26g/t Au over 12 m (Hornblende peridotite, olivine-clinopyroxene hornblendite ³)	Canadian Arrow Mines Ltd. news release, November 12, 2008)
Nym Lake (Bergman Intrusion)	B. Kuzmich	DDH NL-99-1: 609 ppb Pt + Pd (321 ppb Pd + 288 ppb Pt) over 1.1 m DDH NL-99-2: 655 ppb Pt +Pd (355 ppb Pd + 300 ppb Pt) over 1.3 m (Hornblendite, feldspathic hornblendite ³)	Band Ore Resources Ltd., 2001 Assessment Report AFRO# 2.20985 AFRI# 52B11NW2003

Copper, Nickel and Platinum Group Element Potential in the Atikokan—Quetico Area

...cont'd

Name	Owner(s)	Highlights	Reference
Nickelby	Open	6 DDHs No assays reported (Sheared gabbro*)	E. Corrigan 1957 Assessment Report MEI# 52B11NW003*
Plateau Lake	M. Frymire	DDH-1 Sample yielded >2% Cu, 7,688ppm Ni (Pyroxenite*)	OPAP 1992 Report by C. Hicks, Project# OP92-481 AFRO# 52B14SE0019*
Stawson (Bill Lake, McQuat Lake)	Open	Grab samples: 2.0g/t Pt + Pd (Clinopyroxenite ³)	East West Resources Ltd. 2001 Assessment Report AFRO# 2.22321 AFRI# 52B12NW2003
Samuels Lake	Pro Am Explorations Corp.	DDH SL-08-13: 0.39% Ni, 0.85% Cu over 14.3m DDH SL-08-14 : 0.21% Ni, 0.30% Cu over 33.5m DDH SL-08-15: 0.23% Ni, 0.52% Cu over 15.2m (Gabbro, clinopyroxenite, hornblendite, werhlite and monzodiorite/diorite ²)	Teck Cominco Limited 2008 Assessment Report AFRO# 2.40694 AFRI# 20000003942
Marr Lake	A. Onchulenko B. Kuzmich P. Gehrels	3 Grab Samples Averaging 1.2% Cu, 0.2% Ni, 1.3g/t Pt, 1.3g/t Pd, 6g/t Ag, 0.4g/t Au (Pyroxenite*)	W.C. Hood 2005 Assessment Report AFRO# 2.35117 AFRI# 20000002182*

¹MacTavish, A.D. 1999. The mafic-ultramafic intrusion of the Atikokan-Quetico area, northwestern Ontario; Ontario Geological Survey. Open File Report 5997, 154p.

²Pettigrew, N.T., Hattori, K.H. 2006. The Quetico Intrusions of Western Superior Province: Neo-Archean examples of Alaskan/Ural-type mafic-ultramafic intrusions. Precambrian Research. 149, 21- 428.

³Vaillancourt, C., Sproule, R.A., MacDonald, C.A. and Leshner, C.M. 2003. Investigation of mafic-ultramafic intrusions in Ontario and implications for platinum group element mineralization: Operation treasure Hunt; Ontario Geological Survey, Open File Report 6102, 335p.

HIGHLIGHTS



- **Amethyst deposits near the north shore of Lake Superior occur in close proximity to the Archean/Proterozoic unconformity and northeast-striking fault zones**
- **Prospecting potential exists in an area extending from the Ontario-Minnesota border to Marathon where several known amethyst occurrences are open for staking**

Amethyst Potential Near the North Shore of Lake Superior

The Thunder Bay area has long been known for its amethyst deposits. Currently, there are a number of small-scale amethyst quarries operating immediately east of the City of Thunder Bay in the Tartan Lake Area and McTavish Township. These quarries are largely focused on the supply of mineral specimens and ornamental stone, with much of this material marketed to tourists. Although current production is occurring in a relatively small area covering only two geographic townships, amethyst is known to occur across a much wider area extending from the international border southwest of Thunder Bay and across the north shore of Lake Superior almost to Marathon. The locations of known amethyst occurrences in the Thunder Bay South Resident Geologist District, including the current producing quarries, are shown on Figure 1.

Amethyst in the Thunder Bay area most commonly occurs in veins and/or breccia zones that occur within northeast-striking fault zones that were active during the Mesoproterozoic (ca. 1100 Ma) Midcontinent Rift event. The most significant amethyst deposits tend to occur where two fault systems intersect. This is due to the interaction between multiple faults allowing for the development of more open spaces (i.e., vugs) for amethyst crystals to grow (Garland 1994).

Amethyst occurs in a variety of rock types. However, all deposits are located in close proximity to the unconformity between Archean age granitic rocks and Proterozoic age sedimentary rocks of the Animike and Sibley Groups. The location of the Archean/Proterozoic unconformity is shown on Figure 2. Note that major northeast striking fault zones have also been mapped in close proximity to the unconformity. Therefore, it is recommended that prospecting for amethyst focus on areas that are in close proximity to both the unconformity and northeast-striking fault zones.

Figure 2 also shows the locations of a number of known amethyst occurrences that were open for staking as of October 1, 2014. Table 1 provides a listing of Ontario Geological Survey (OGS) information sources for these occurrences, including Mineral Deposit Inventory records (MDI), mineral exploration Assessment Files (AFRI), and the Resident Geologist's files. The MDI and AMIS records can be accessed on-line through Geology Ontario, while the Resident Geologist's files are only available in hard copy at the Thunder Bay Office. Geological descriptions of the Mount Baldy, Little Bear Quarry and Walkinshaw occurrences are also provided in Garland (1994).

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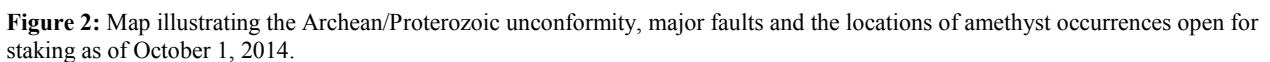
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Amethyst Potential Near the North Shore of Lake Superior

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Occurrence Name	MDI File No.	AFRI File Nos.	Resident Geologist's File
Holzem	NA	NA	52B07SE, Holzem Occurrence
Marks Township	NA	52A05SW2003	NA
Silver Valley	MDI52A05SW00009	NA	52A05SW, Silver Valley Occurrence
Mount Baldy	NA	52A11SE2002 52A11SE2005 52A11SE0001	52A11SE, Mount Baldy Occurrence
Walkinshaw 02	MDI000000001234	52A11NE0004 20002132	NA
Belletini	MDI000000001238	52A10NW2003	NA
Stenlund	MDI52H01SE00008	NA	52H01SE, Stenlund Occurrence
Little Bear Amethyst Quarry	MDI42E04NE00003	42E04NE0009 42E04NE0008	42E04NE, Little Bear Amethyst Quarry
Vos	MDI42E04NE00008	NA	NA
Kilometre 23	MDI42D15NE00005	NA	42D15NE, Km 23 Occurrence
Bayco	MDI52A15SE00023	52A15SE0019	NA

Table 1: Amethyst occurrences open for staking as of October 1, 2014.

Garland, M.I., 1994. Amethyst in the Thunder Bay area; Ontario Geological Survey, Open File Report 5891, 197 p.

HIGHLIGHTS

- The survey revealed significant anomalies in Zn, Cd, and Cu, suggesting the underlying stratigraphy is consistent with metal association typical of Archean volcanic-associated massive sulphide deposits
- The adjacent host rocks display variable chlorite, biotite, sericite and silica alteration that is consistent with a VMS setting

Cu-Zn-Pb-Cd Mineralization; A Possible VMS-Deposit Setting in the Batchawana Greenstone Belt?

Over the last several years, exploration for new gold deposits has dominated the work done in greenstone belt terrains. There has been little focus on exploring for volcanogenic massive sulphide (VMS) deposits. The Batchawana Greenstone Belt has historically been underexplored. To date, there have been no VMS deposits delineated in it, but numerous base metal showings have been discovered (Grunsky, 1991). The Batchawana Greenstone Belt should therefore be considered an exploration target for VMS deposits.

The Percy Lake area is situated within the Dismal Lake Assemblage, in the northeast section of the Batchawana Greenstone Belt. It underlies the central portion of Moggy Township (Figure 1). The Dismal Lake metavolcanic sequence (2700 to 2698 Ma) consists of a calc-alkalic mafic to felsic metavolcanic sequence of rocks (Grunsky, 1991).

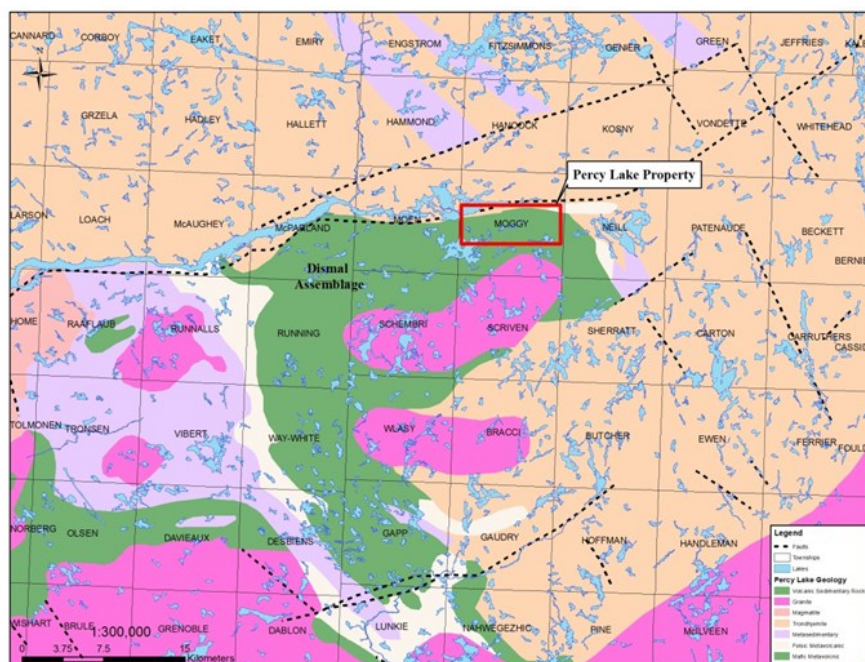


Figure 1: Location of the Percy Lake property in the Dismal Assemblage of the Batchawana Greenstone Belt

The Percy Lake property is underlain by interbedded tholeiitic to calc-alkalic mafic volcanic flows and volcanoclastics. The mafic flows are locally interbedded with intermediate to felsic flows and synvolcanic intrusions that vary from aphanitic to quartz-feldspar porphyry. The volcanoclastic units include tuff breccia, lapilli tuff, amphibole crystal tuff, and ash tuff. Minor argillaceous, silty, and lean oxide iron formation units are locally interbedded with the mafic flows.

A regional-scale east-northeast-trending syncline has been identified west of the Percy Lake area (Wilson, 1983). It may have attributed to the small-scale folding ranging from crenulation cleavage over a few centimetres to larger folds with amplitudes of a few metres in the metavolcanic rocks.

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Cu-Zn-Pb-Cd Mineralization; A Possible VMS-Deposit Setting in the Batchawana Greenstone Belt? ...cont'd

A drilling program completed by Vault Minerals Inc. in 2006 intersected numerous quartz-calcite-feldspar fracture veins containing sphalerite, chalcopyrite and galena (Vault Minerals Inc., 2006). These fracture veins may reflect a structural control that developed as a result of the surrounding synvolcanic intrusions. Finely disseminated pyrite and pyrrhotite were also found in semi-massive sulphides hosted in contorted and brecciated siliceous graphitic iron formation (Avalon Ventures Inc., Sault Ste. Marie Assessment File, 1996).

The Dismal Lake Assemblage underlies some strong base metal lake sediment geochemical anomalies, particularly within the Percy Lake area. These anomalies were identified in a survey of the Batchawana greenstone belt done by the Ontario Geological Survey (Hamilton, Forescue and Hardy 1995). The survey revealed significant anomalies in Zn, Cd, and Cu, suggesting that the underlying stratigraphy is consistent with metal associations typical of Archean VMS deposits (Figure 2).

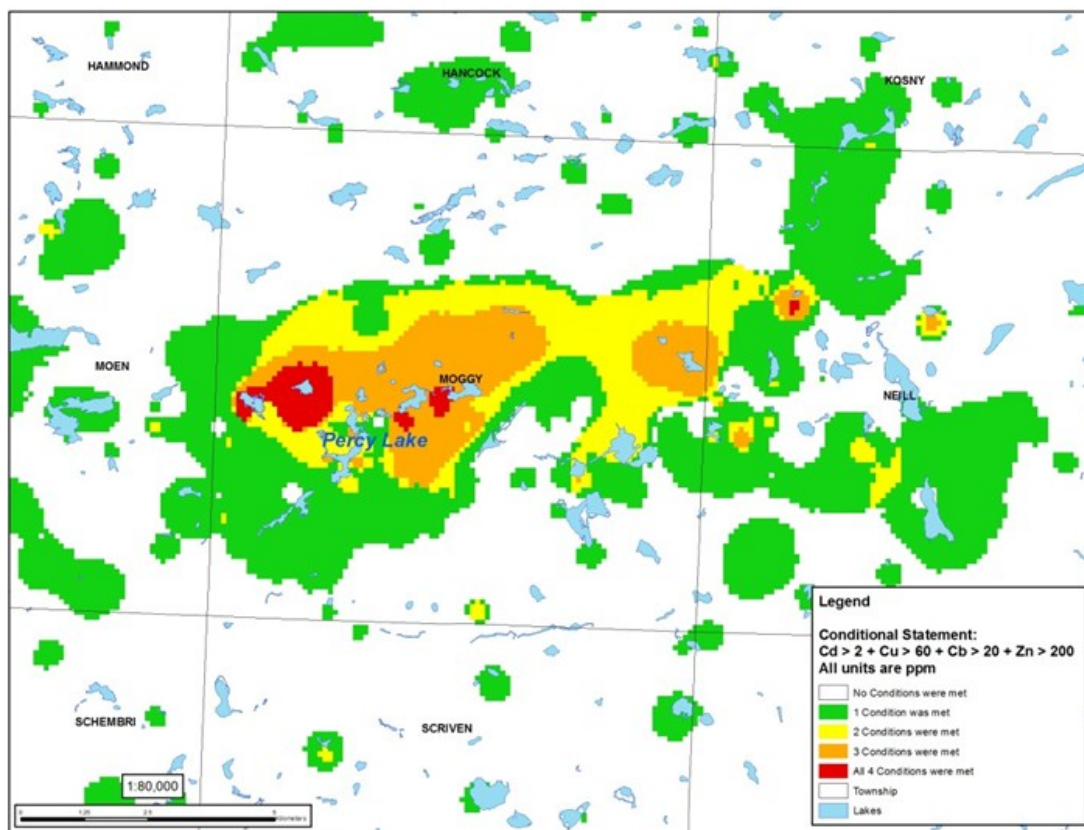


Figure 2: Lake sediment geochemical anomalies of Cu-Zn-Pb-Cd in the Percy Lake area identified in a survey of the Batchawana Greenstone Belt by the Ontario Geological Survey.

Although only limited exploration work has been reported in the Percy Lake area, two exploration programs completed in 1995 and 2006 make reference to the Cu-Zn-Cd-Pb anomalies in the area. Grab samples collected by Avalon Ventures Inc. in 1995 returned values of up to 2.86% Cu, 11.04% Zn, 1.98% Pb and 33.7 g/t Ag (Avalon Ventures Ltd., Sault Ste. Marie Assessment File, 1996). Geophysical surveys completed by the company indicated that the Cu-Zn-Cd-Pb anomalies were associated with weak to strong EM and magnetic conductors and, in several cases, with a felsic volcanic–mafic volcanic contact.

Cu-Zn-Pb-Cd Mineralization; A Possible VMS-Deposit Setting in the Batchawana Greenstone Belt? ...cont'd

In 2006, as follow up to the work completed by Avalon Ventures Ltd., Vault Minerals Inc., completed the only diamond drilling program in the area. It intersected several exhalite-bearing horizons containing anomalous Zn, Pb, Cu, and Cd values. The adjacent host rocks display variable chlorite, biotite, sericite and silica alteration that is consistent with a VMS setting (Vault Minerals Inc., Sault Ste. Marie Assessment Files, 2006).

The Percy Lake area contains key geological, geophysical, and geochemical features that indicate the potential for volcanogenic massive sulphide style mineralization.

Bain, D., 1996. Report on the Economic Potential for Cu-Pb-Zn carried out on the Percy Lake Property. Avalon Ventures Ltd., Assessment File, SSMP Moggy-06.

Grunsky, C.E. 1991. Geology of the Batchawana Area, District of Algoma; Ontario Geological Survey, Open File Report 5791.

Hamilton, S.M., Fortescue, J.A.C. and Hardy, A.S. 1995. A Zinc-Cadmium-Copper Anomaly: Preliminary Results of the Cow River Geochemical Mapping Project, Batchawana Greenstone Belt; Ontario Geological Survey, Open File Report 5917.

Lengyel, P.W.J., 2006. Report on the 2006 Diamond Drilling Program carried out on the Percy Lake Property. Vault Minerals Inc., Assessment File SSMP Moggy-05.

Wilson, B.C., 1983. Geology of the Rotunda Lake–Percy Lake Area. Districts of Algoma and Sudbury; Ontario Geological Survey, Report 229.

HIGHLIGHTS

- **Porcupine Destor Fault Zone, one of the most prolific gold bearing faults in Ontario**

The Westward Continuation of the Porcupine Destor Fault Through the Northern Swayze Greenstone Belt, Abitibi Subprovince

The Porcupine Destor Fault Zone (PDFZ) is one of the most important crustal structures controlling gold mineralization in the Abitibi subprovince. In Ontario, over 70 million ounces of gold have been mined along the fault from Timmins to the Quebec border. As such, it presents one of the most obvious exploration targets for Archean lode gold deposits. The PDFZ is in part delineated by the presence of syn-orogenic clastic sediments that are locally referred to as “Timiskaming sediments.” Such sediments include distinctive clast-supported polymictic conglomerates and these rock types are readily identifiable in the field by the Prospector. (See Photo 1 as an example).



Photo 1: Interbedded clastic metasediments of possible Timiskaming affinity in Penhorwood Township. Note the development of the strong deformational fabric that has transposed bedding.

Many attempts have been made to trace the PDFZ westward beyond the Timmins West Mine in Bristol Township where supracrustal rocks of the Abitibi greenstone belt are intruded and interrupted by the Kenogamissi Batholith. Discontinuous septa of greenstone in Denton and Keefer townships retain possible vestiges of the PDFZ, and link the structure to a west-trending structure in the northern Swayze greenstone belt.

Rocks, including polymictic cobble conglomerate with well-preserved cross-bedding and fining upward, south facing sequences, occur in Penhorwood Township (Milne, 1972, Ayer, 1995, Bleeker et al 2014). These rocks are possibly correlative with Timiskaming sediments at Timmins and may be used to delineate the PDFZ through the northern Swayze greenstone belt (See Figure 1). In the Timmins area, Timiskaming sediments are prolific gold hosts. Elsewhere in Archean greenstone belts throughout the Superior Province, similar rocks both define crustal scale structures that are prerequisite to large gold deposits and often comprise gold ore.

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The Westward Continuation of the Porcupine Destor Fault Through the Northern Swayze Greenstone Belt, Abitibi Subprovince

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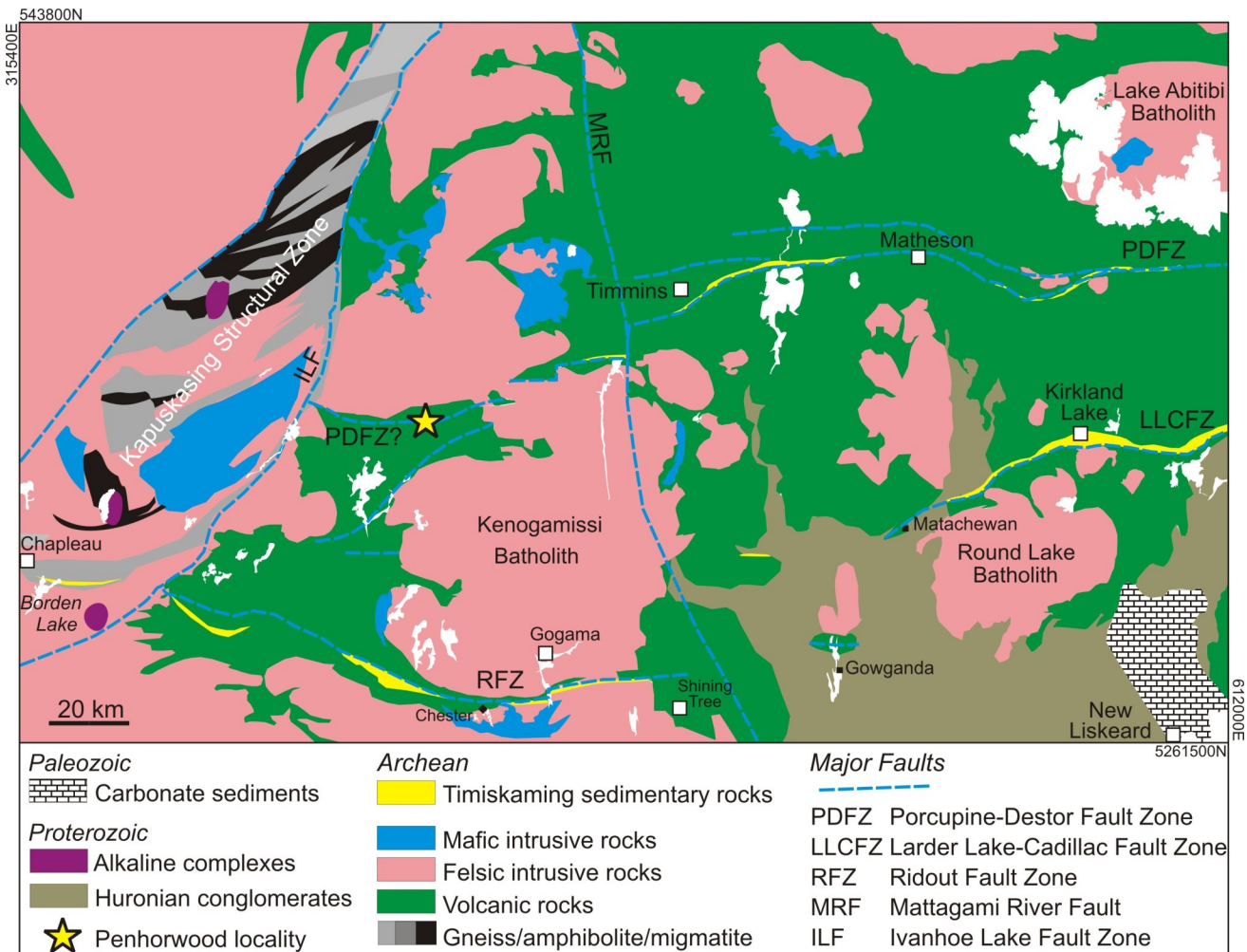


Figure 1: General geology of the western Abitibi greenstone belt showing the westward projection of the Porcupine Destor Fault Zone through the northern Swayze greenstone belt to the Ivanhoe Lake Fault that marks the east boundary of the Kapuskasing Structural Zone. The yellow star identifies the location of possible Timiskaming clastic sediments in Penhorwood Township depicted in Photo 1. (Figure from Bleeker et al 2014).

Evidence that the PDFZ might continue westward on the north side of the Kenogamissi Batholith and into the northern Swayze greenstone belt include strongly deformed clastic, syn-orogenic sediments that are tentatively correlated with Timiskaming sediments in Timmins. In Penhorwood township, the presence of talc+magnesite+chlorite+carbonate schists at the Penhorwood Mine may be part of a large-scale hydrothermal alteration event that exploited the PDFZ as a fluid conduit. Consequently, the area extending westward through Penhorwood, Keith, Foleyet and Ivanhoe townships to the Ivanhoe Lake Fault Zone that delimits the east boundary of the Kapuskasing Structural Zone warrant careful examination for Archean lode gold deposits.

The Westward Continuation of the Porcupine Destor Fault Through the Northern Swayze Greenstone Belt, Abitibi Subprovince

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Bleeker, W., Atkinson, B.T. and Stalker, M. 2014 (in press) Summary of Field Work: 43. A “New” Occurrence of Timiskaming Sedimentary Rocks in the Northern Swayze Greenstone Belt, Abitibi Subprovince—With Implications for the Western Continuation of the PDFZ and Nearby Gold Mineralization. Ontario Geological Survey, Open File Report.

Milne, V.G., 1972a. Geology of the Kukatush-Sewell Lake area District of Sudbury; Ontario Division of Mines, Geological Report 97, 116p.

HIGHLIGHTS



- **Past producing iron, copper-nickel and copper mines**
- **Numerous gold deposits**
- **Little recent exploration**

Temagami – An Area with Past Producing Mines but Little Recent Exploration

The discovery of mineralized rocks, claim staking and exploration has been going on in the Temagami area since the early 1900s. Prospectors came to the area when it was opened up for lumbering and the development of the railway from North Bay to Cochrane. The area has also had its share of producing mines, both large and small, and a variety of commodities. These included iron ore from the Sherman Mine (MDI31M04SW00025), copper, gold silver and nickel from the Temagami Copper Mine (MDI411I16NE00004), copper, nickel, gold and PGE from the Kanichee Mine (MDI31M04SW00022). The area also contains a number of properties with historic resources. These include the Diadem (MDI31M04SW00077), a Cu-Ni deposit, the Cominco South (MDI31M04SW00021) gold deposit, the Leckie (MDI31M04SW00090) gold deposit and the Kokoko (MDI31M04SW00096) iron deposit.

Exploration in the area has challenges, past and present. Not all of the land is open to exploration and other parts have special requirements for exploration. Temagami Lake is an attractive tourist region resulting in the potential for stakeholder conflict. Portions of the area are overlain by thick sequences of Huronian Supergroup sedimentary rocks, creating exploration challenges and the area of the Temagami greenstone belt that is exposed is relatively small. Over the past 15 years only about \$5 million of assessment work has been approved for the Temagami Lake region.

Fyon and Crocket (1986) published a report on the mineral potential in the Strathy Township portion of the area. They identified volcanogenic massive sulphide (VMS) potential of copper-zinc mineralization based on felsic vents, sulphide rich clasts in subaqueous pyroclastic rocks, low base metal values in stratabound zones near the vents and distinctive rare-earth element patterns in felsic pyroclastic rocks. A subsequent discovery of mineralization with VMS characteristics (Hook property) was made in northern Strathy and Best townships (Guindon et al. 2012). Many of the gold occurrences display a strong structural control. The linear and apparent structural control of the gold occurrences and deposits was also noted by Bennett (1978). A vein copper-gold mineral occurrence was discovered in northern Strathy Township (Owaissa property). Mineralization is related to Nipissing Diabase dikes.

The Northeast Arm Deformation Zone and a band of volcanic and mafic intrusive rocks underlie and parallel the Northeast Arm of the lake. The volcanic rocks host the Temagami Copper Mine that contain elevated gold and PGE levels in the high grade copper ore. The mafic intrusive rocks contain copper-nickel mineralization with elevated PGE values (Meyer et al. 2000, Meyer et al. 2001, Guindon et al. 2010).

The Sherman Mine was an iron ore producer for close to 30 years. About 1 million tons of pellets were produced yearly and shipped to Hamilton by rail. The mine closed about 1991 due to the drop in iron prices and declining reserves. The Kokoko (MDI31M04SW00096) property is located west of the mine in Cynthia Township. An in-house estimate in 1964 placed the resources at 93.7 million tons of 25% iron or 37 million tons of concentrate at 64% iron.

Diamond exploration has taken place in the area over the past 30 years since the discovery of diamondiferous kimberlite pipes in the New Liskeard area, with only limited exploration in the past 5 or so years. In January 2005, both Temex Resources Corp. and Tres-Or Resources Ltd. reported the recovery of an alluvial diamond in the Temagami area (Temex Resources Corp., press release, January 17, 2005 and Tres-Or Resources Ltd., press release, January 31, 2005).

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Temagami – An Area with Past Producing Mines but Little Recent Exploration

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The area contains favourable geology, past producing mines, deposits with resources and limited modern exploration, it deserves another look.

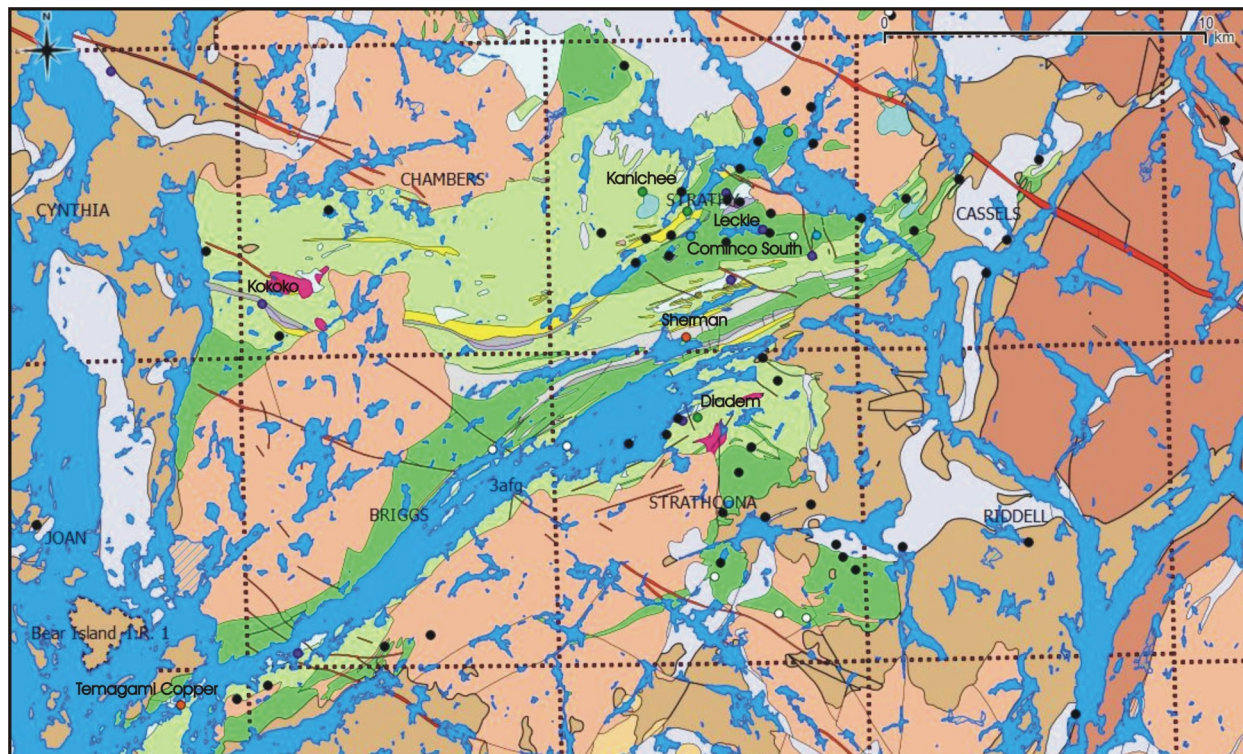


Figure: Temagami area showing Mineral Deposit Inventory (MDI) points on a geology background from MRD 214.

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HIGHLIGHTS



- **Areas of Offset Dikes in the North Range available for exploration**
- **Areas of Cu-Ni-PGE potential away from the Sudbury Igneous Complex**
- **New veneer stone production methods may offer new opportunities**

Offset Dikes – PGM, Nickel, Copper – Building Stone in the Sudbury Area

Nickel, Copper and Platinum Group Elements in Offset Dikes

Several producing mines in the Sudbury camp have been established in offset dikes, essentially Sublayer intrusive rocks penetrating the footwall of the Sudbury Igneous Complex (SIC), and accordingly these dikes have been popular exploration targets since the earliest days of mining in Sudbury. Offset dikes either radiate outward from the base of the SIC or occur in footwall rocks parallel to the SIC contact.

Sudbury Breccia, a pseudotachylite of varying composition, occurs around the Sudbury Basin in both radial and concentric patterns as well, and has been identified as far as 80 km from the basin in the northeast. Many offset dikes are associated with Sudbury Breccia. Radial offsets project outward from embayments along fractures which are often filled with Sudbury Breccia, and the Froid-Stobie offset is entirely within Sudbury Breccia.

In the highly-staked ground surrounding the Sudbury Basin, one of the last areas affording unstaked Crown Land is found in the north range and townships northeast of the basin. Proximal to the prolific Foy offset, these areas contain little-documented occurrences of Sudbury Breccia which warrant further examination for possible offset dikes of both radial and concentric nature.

Platinum Group Metals (PGM), Nickel and/or Copper Potential

Exploration for platinum group metals has been the dominant activity in the Sudbury District for the past several seasons. The majority of exploration is being conducted on differentiated mafic intrusive rocks of the East Bull Lake suite (2.45 Ga) of rocks that include the River Valley, Agnew, and East Bull Lake complexes. Work has also been carried out on Nipissing gabbro intrusive rocks (2.22 Ga), both east and west of Sudbury.

Much of this ground is held in good standing under the Mining Act as claims, leases, and patents, with a substantial amount of assessment work yet to be applied. As such, opportunities for land acquisition on ground underlain by these mafic intrusive rocks are limited. However, several marginal areas of mafic intrusive rocks may also be prospective for platinum group metals. These include, but are not restricted to the following:

- Mafic intrusive rocks north of the East Bull Lake complex. Prospective areas for PGE exist outside currently explored ground and areas explored only for Ni-Cu mineralization. Exploration for offset dikes is recommended. Flagstone being economically mined in the district warrants further development work in Lockyer and Mandamin townships.
- Mafic intrusive rocks, particularly those currently considered as Nipissing gabbro west of Sudbury to Elliot Lake and hosted in Huronian Supergroup metasedimentary rocks of the Penokean Fold Belt.
- Archean mafic intrusive rocks hosted within the Benny greenstone belt.

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Offset Dikes – PGM, Nickel, Copper – Building Stone in the Sudbury Area

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- Mafic intrusive complexes hosted within the Central Gneiss Belt (i.e. the towns of Arnstein, Whitestone and Eau Claire; and in Mattawan and McConkey townships).
- Areas within the Grenville Front Tectonic Zone east of the River Valley complex (Flett, Angus, and Parkman townships). Targets to consider include known Ni-Cu occurrences, previously considered uneconomic, with emphasis on platinum group metals.

Dimension Stone

Changes in the dimension stone industry have increased the potential for the development of new deposits in the Sudbury District. Trends in the residential construction market toward the use of resin-stone composites and thin stone veneer (TSV), which do not require large quarry blocks for production, have increased the economic potential of a wide variety of limestone, dolostone, granite, gneiss and marble deposits found in the Sudbury District.

Many occurrences of marble and gneiss previously considered to be unsuitable for dimension stone production, based upon low potential for large quarry block extraction, may be suitable for the production of thin stone veneer and decorative stone. Such deposits, including granites, should be re-examined as potential sources of stone for cultured marble and granite, which may contain approximately 80% stone particles in a polyester resin matrix.

Thin stone veneer is natural, split-face stone cut to a thickness of 2 to 4 cm that gives the appearance of rough-cut stone at a much lower cost and weight than standard 10 to 15 cm thick ashlar. It can be applied to an existing wall using a standard mortar mix over a metal mesh backing, and does not require extra footings and wall ties as do conventional, full-thickness veneer products. The ideal stone for TSV fabrication is 4 to 8 cm thick with 2 split faces. The slab is fed into a veneer saw and sliced into 2 pieces, each 2 to 4 cm thick with a sawn back and split face. Limestone, dolostone, and granitic gneiss, all of which have been quarried in Sudbury District, are well suited to the production of TSV. The following areas are recommended for further research:

- Gneissic rocks in the Parry Sound–Muskoka area are quarried in several locations for flagstone. Fouts and Marmont (1989) describe the quarries and the potential of the area for flagstone production. Easton and Fyon (1992) suggest that domain and terrane boundaries in the Central Gneiss Belt are primary target areas for flagstone deposits.
- Limestone and dolostone-derived marble of the Proterozoic Espanola Formation has been quarried northwest of Wanapitei Lake. The formation also occurs north and east of Wanapitei Lake in Clary, Demorest, Grigg and Fraleck townships and west of the Sudbury Basin north of Agnew Lake.

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HIGHLIGHTS



- **Carbonatite and Alkalic complexes are potential sources of rare earth elements**
- **Brucite is a potentially important source of magnesium**
- **Critical infrastructure renewal requires local sources of aggregate and other structural minerals**

Critical Minerals: A Southern Ontario Perspective

Existing and emerging technologies are generating unprecedented demand for lesser known minerals bearing elements such as lithium (Li), indium (In), tellurium (Te), gallium (Ga), antimony (Sb), beryllium (Be), rare earth elements (REE) and high-purity silica. Many jurisdictions including the United States, the European Union, India and Japan have each developed a listing of minerals they consider to be “Critical”.

To determine which minerals are critical to a specific jurisdiction, the importance of that mineral to a given economy is considered relative to the risk that the supply of that mineral will be disrupted. Of particular concern are those commodities for which a jurisdiction has no domestic supply, particularly if the supply is from a single offshore source.

Some of the commodities identified include antimony, beryllium, cobalt, fluorspar, gallium, germanium, graphite, indium, lithium, magnesium, niobium, platinum group metals, rare earth elements, rhenium, tantalum, tellurium and tungsten.

Historically, there has been limited exploration for sources of minerals bearing these elements. Until the burgeoning development of new technologies and analytical methods, many elements had limited applications or were seen as scientific curiosities. There are resulting gaps in our knowledge of the occurrence, resource inventory, methods of extraction, and environmental behavior and management of these elements.

Ontario potential for new discoveries of many of these critical minerals is documented in Ontario Geological Survey publications, in the Mineral Deposit Inventory database and in donated and unique information available through the Resident Geologist Offices.

Ontario Potential – Rare Earth Elements

Carbonatite and alkaline intrusive complexes have the highest potential for hosting many of these critical elements including rare earth elements. From 1982 to 1987, the Ontario Geological Survey mapped, researched and published 25 reports on these occurrences across the province (See Map Below). In the intervening decades since these studies were completed, there have been new discoveries made and new analytical methods developed that have resulted in a better understanding of this type of deposit. There are new demands and markets for the minerals they potentially contain. Further examination of Ontario carbonatite and alkaline intrusive complexes as potential sources of rare earth elements and other critical minerals is recommended.

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Critical Minerals: A Southern Ontario Perspective

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Figure: Carbonatite-alkalic complexes in Ontario and mafic complexes in the James Bay Lowlands (*modified from Sage 1987*).

Ontario Potential – Magnesium

Global consumption of magnesium metal reached a new high in 2012 at 1.2 Mt, with demand growing 5.5% a year over the past decade. Increases in auto sales, particularly in China, and the trend toward producing lightweight vehicles has led Roskill Information Services to predict an annual 5% growth in magnesium metal consumption through 2017 (Topf 2013).

Brucite, $\text{Mg}(\text{OH})_2$, has a much higher content of MgO (69.1 weight %) or Mg (41.6 weight %) than any other naturally occurring magnesium compound, except the high-temperature metamorphic mineral periclase (MgO), which is rare in nature as it retrogrades to brucite in the presence of water. In comparison, the main currently exploited magnesium-bearing minerals—magnesite and dolomite—contain 28.8 and 12.6 weight % Mg , respectively. Brucite has the additional advantage, in both energy consumption and environmental considerations, of producing no CO_2 during the calcining process and, therefore, is a mineral of considerable

interest as an alternative raw material for production of MgO and elemental magnesium.

As an industrial mineral, brucite can be used for magnesia production, in flame retardants, electric wire insulation, carpet backing, agricultural feed, specialty cements and as a functional filler in plastic compounds (Simandl, Paradis and Irvine 2007). There has been no production of magnesium metal in Canada since the closure of the Timminco Metals dolomite-based magnesium plant (Haley Station, southeastern Ontario) in 2007.

Southern Ontario Brucite

Most brucite deposits of economic interest are associated with shallow-level, low-quartz, igneous intrusions into high-purity dolomite or magnesite-bearing sedimentary rocks. In southeastern Ontario, brucite occurrences have been documented within high-purity dolomitic marble adjacent to syenitic intrusive rocks in Hinchinbrooke and Marmora townships (See Map Below).

The Hinchinbrooke occurrences, described by Harding (1951), are hosted by a series of narrow marble units surrounded by granite and syenite. These occurrences consist of up to 20% brucite disseminated within white, calcitic marble, and were discovered about 1940 by the Consolidated Mining and Smelting Company during exploration of the marble belt for lead-zinc mineralization. The company did minor surface exploration, including trenching, but considered the brucite zones to be too small and too low grade for development.

Critical Minerals: A Southern Ontario Perspective

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The Marmora occurrence, is a brucitic marble that is currently being quarried for decorative aggregate. The quarry exposes a 150 by 250 m zone in white, dolomitic marble containing pervasive brucite mineralization, which on the weathered surface, has been altered to white, chalky hydromagnesite. Brucite content appears to be between 20 and 30%. Detailed geological mapping by MacKinnon (1990) indicates that the zone extends along strike to the north and south of the quarry for a total length of about 1 km.

A sample from the Marmora quarry, analyzed by X-ray diffraction for mineral identification and semi-quantitative analysis, was estimated to contain 57% calcite, 12% dolomite and 27% brucite by weight.

Brucite has not been the focus of any significant exploration in southeastern Ontario and may have been overlooked during previous mapping and sampling of the marble belts. Dolomitic marble near the margins of syenitic, dioritic and gabbroic intrusive rocks may host additional deposits of brucite. The presence of wollastonite-bearing skarns associated with calcitic marble adjacent to intrusive rocks may indicate favourable conditions for the formation of brucite if dolomitic marble is also present. Both periclase and wollastonite can form in relatively high-temperature, low-pressure, inner-contact metamorphic zones of high-level intrusions. The Marmora brucite occurrence is located less than 5 km north of the Platinova–Cominco wollastonite deposit.

The geology and geochemistry of Grenville marble belts and specific prospects are documented in the following Ontario Geological Survey reports:

- *Geochemistry of Grenville Marble in Southeastern Ontario* (Grant, Papertian and Kingston 1989)
- *Precambrian Dolomite Resources in Southeastern Ontario* (LeBaron and MacKinnon 1990)
- *High-Purity Calcite and Dolomite Resources of Ontario* (Kelly 1996)

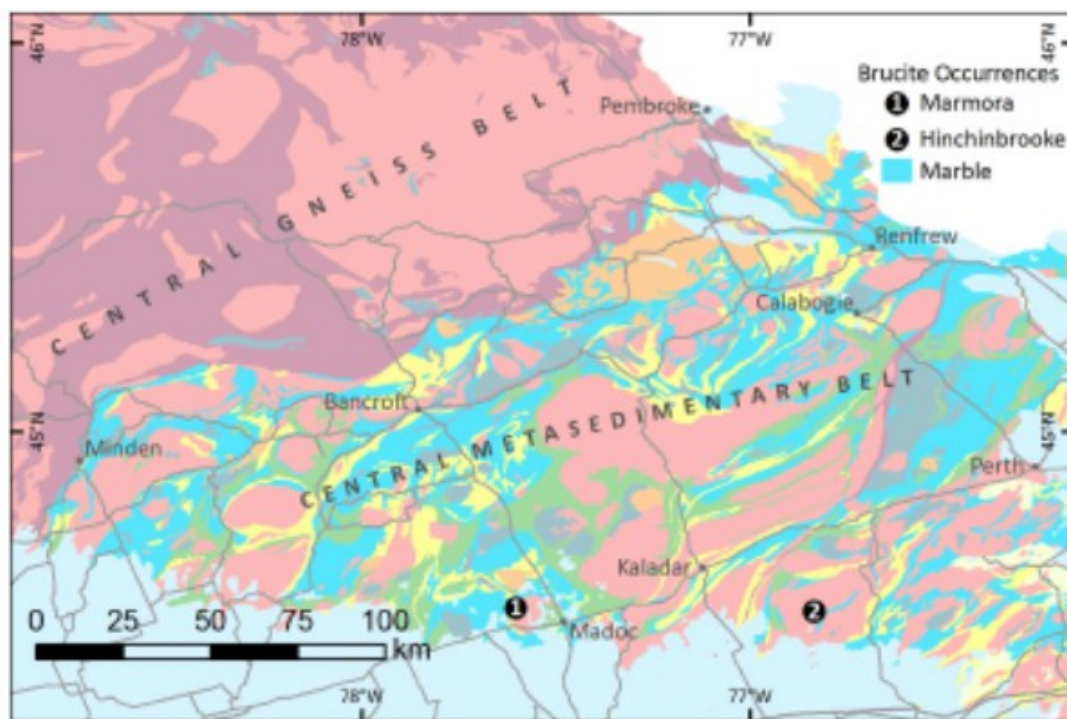


Figure 11. Brucite occurrences and marble belts, southeastern Ontario. Geology from Ontario Geological Survey (2006).

Figure: Brucite occurrences and marble belts, southeastern Ontario. Geology from Ontario Geological Survey (2006).

Critical Minerals: A Southern Ontario Perspective

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Minerals for Infrastructure

Although not generally considered as “Critical Minerals”, a domestic supply of a wide range of structural commodities including sand, gravel, crushed stone aggregate, cement, clay and lime is essential. By their nature, these high volume–low value raw materials cannot economically be transported over long distances or from offshore sources. In 2013, Ontario production of these commodities was valued at over \$1.8 billion.

Roads, bridges, water and waste-water systems are assets owned by the public and require constant attention and reinvestment. Federal, provincial and municipal governments are the largest consumers of these commodities.

For example, in April 2013, Toronto announced that the city would spend \$155 million on roads and bridges, as part of \$2.9 billion program over the next 10 years. In addition, the City could invest another \$17 million on repairing the Gardiner Expressway. To complete these and other projects, a reliable supply of raw materials is required. The supply of aggregate for the Greater Toronto Area is at capacity. Further exploration of new Ontario sources of these minerals for infrastructure is recommended.

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HIGHLIGHTS



- **Ti and V demand expected to increase 5% per year, used in high-strength steel**
- **Grenville Province contains most of Canada's titanium- and vanadium-bearing iron deposits**
- **Target magnetite/ilmenite deposits hosted by anorthositic gabbro intrusions**

Titanium and Vanadium in Southeastern Ontario – Metals of the Future

Titanium and vanadium are important components of high-strength steel alloys. With the trend to creating lighter weight, fuel efficient vehicles and lowering costs by improving the strength to weight ratio of material used in construction projects, the demand for both metals is forecast to increase by 5% to 6% per year to 2018. Titanium is used primarily in the aircraft and aerospace industries, while 40% of global steel production is now high-strength, low-alloy vanadium (HSLA-V) steel (www.chcfcapital.com).

The use of vanadium flow batteries is also expected to rise as intermittent energy producers such as solar and wind farms seek ways to store energy for use during times of low production ("Vanadium battery technology could transform power grids", CBC news, Sept 1, 2014, www.cbc.ca).

Titanium dioxide represents around 94% of the total demand for titanium. TiO₂ pigment is used in the paint, coatings, paper, plastics, automobile, and consumer packaging industries, and its demand is also forecast to grow at 5% per year for the next 2 years (www.chcfcapital.com).

E.R. Rose of the Geological Survey of Canada, in his report "Geology of Titanium and Titaniferous Deposits of Canada", stated that "most of Canada's titaniferous deposits lie in the immense anorthositic massifs of the Grenville structural province in Quebec and Ontario" (Rose 1969). In a subsequent report on vanadium occurrences in Canada, he stated that "Vanadium is a notable constituent of titaniferous magnetite in which it occurs in solid solution. Large deposits of vanadium-bearing titaniferous magnetite are distributed in the Canadian Shield, particularly in the Grenville Province, associated with the gabbroic phase of anorthositic intrusions" (Rose 1973).

Carter (1984) lists 26 documented iron-titanium occurrences in the Grenville Province of southeastern Ontario, all of which are hosted by gabbroic to syenitic intrusive rocks. The highest titanium content is associated with magnetite/ilmenite mineralization within anorthositic phases of gabbroic intrusions of the 1250-1240 Ma Lavant suite (Easton 1992). Two of the most significant prospects are the Newboro iron deposit in North Crosby and South Crosby townships and the Trigan Resources ilmenite deposit in Methuen Township, described below.

The Newboro deposit consists of two separate zones, known as the Matthews and Chaffey iron mines, which produced a total of about 20,000 tonnes of iron ore between 1858 and 1871. Total estimated reserves (non-NI-43-101-compliant) within the two deposits are 45 million tonnes averaging 26% Fe and 6.6% TiO₂ (Carter 1984). Samples of ore material from rock dumps were reported to contain 0.1% V₂O₅ (Robinson 1922).

The Methuen township deposit, formerly known as the Twin Lakes ilmenite deposit and currently owned by Trigan Resources Ltd., consists of a zone of massive ilmenite within the cumulate zone of an anorthositic gabbro body about 4km x 2km in surface area. Exploration of the deposit in the 1980s by the Canadian Nickel Company defined reserves of 13.2 million tonnes averaging 21.7% TiO₂ to a depth of 165m (Sangster et al 1999). A sample of massive ilmenite collected by staff of the Tweed Resident Geologist Office in 2011 contained greater than 1000 ppm V₂O₅.

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Titanium and Vanadium in Southeastern Ontario – Metals of the Future

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Of the many iron and iron-titanium occurrences in southeastern Ontario, shown in Figure 1, there are few with documented reports of vanadium analyses. However, Wilson (1994) identified two additional occurrences with highly anomalous vanadium content: the Pine Lake occurrence in Glamorgan Township (up to 0.52% V_2O_5), a magnetite deposit within anorthositic gabbro; and the Orton occurrence in Tudor Township (up to 0.34% V_2O_5), a magnetite zone at the margin of the Tudor Gabbro. The average grade of current producers is less than 0.5% V_2O_5 (“Largo ships first vanadium”, article in *Northern Miner*, September 15-21, 2014, vol. 100, no. 31).

Exploration for Ti- and V-bearing iron oxide deposits is recommended in southeastern Ontario, particularly in association with gabbroic/anorthositic intrusions of the Lavant Suite. In addition, many of the known magnetite deposits in the vicinity of similar intrusions should be sampled and analysed for Ti and V.

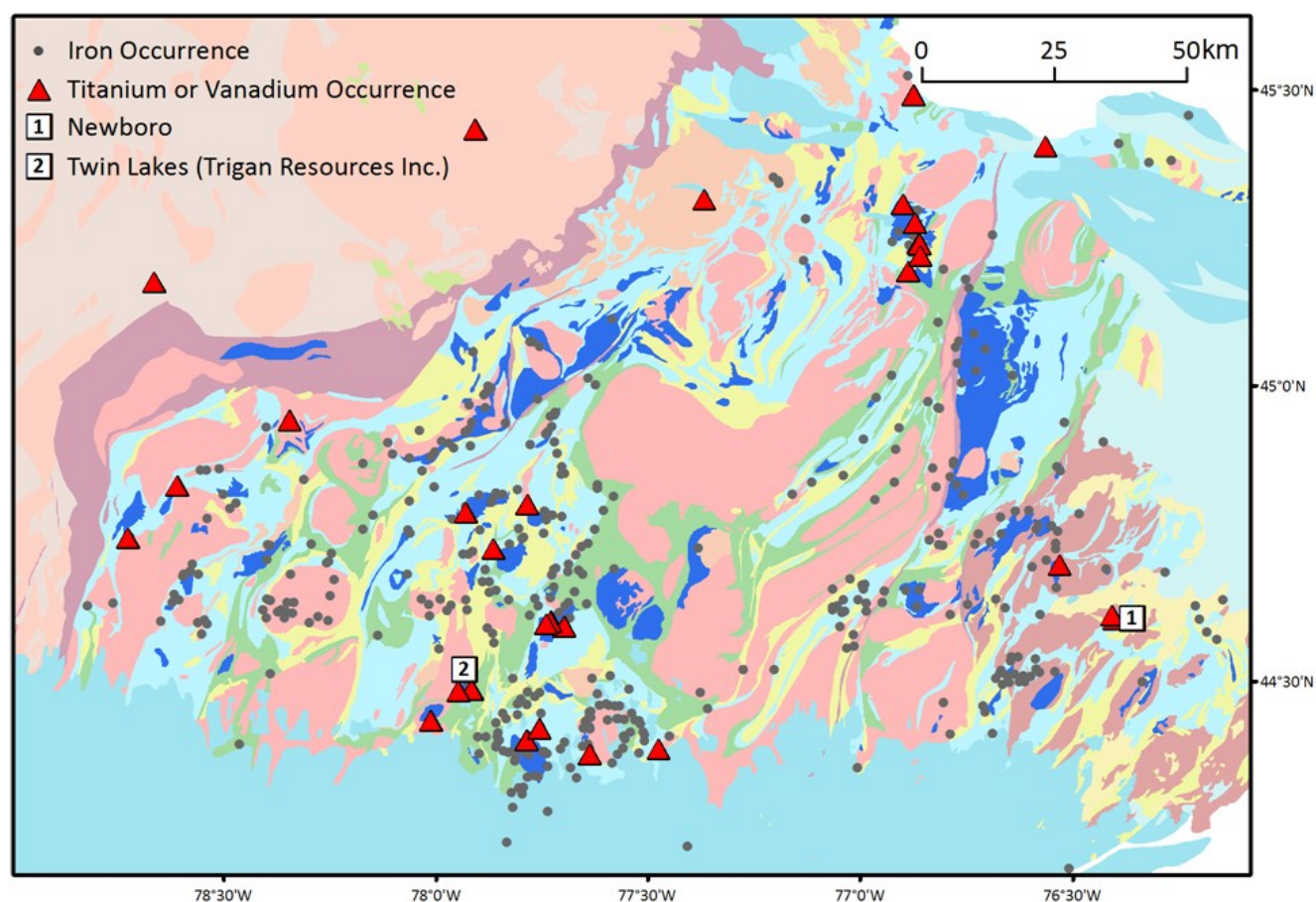


Figure 1: Iron, titanium and vanadium occurrences in southeastern Ontario. Geology from Ontario Geological Survey (2006).

Titanium and Vanadium in Southeastern Ontario – Metals of the Future

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HIGHLIGHTS



- **Ontario's first gold mining area (1866). New deposits were discovered more than 100 years later**
- **New discoveries contain more than 10 times the total past production of gold in S. Ontario**
- **3 distinct settings for gold mineralization, spatially related to a significant volcanic-sedimentary contact**

Gold Mineralization in the Marmora-Madoc-Harlowe Area, Southeastern Ontario

Exploration for gold in southeastern Ontario began with the discovery of Ontario's first gold mine, the Richardson mine at Eldorado, in August of 1866 and the subsequent increase in prospecting activity in the area resulted in new discoveries in the following years. Between 1895 and 1908, 12 gold mines operated, the most important of which were the Deloro mine producing about 10,000 ounces of gold from 40,000 tons of ore, and the Cordova mine producing 23,000 ounces of gold from 120,000 tons of ore. A Provincial Assay Office was opened in the city of Belleville in 1898 to service the new mining area. The total past production of all southern Ontario gold mines is about 40,000 ounces.

With the discovery of the rich deposits of gold and silver in northern Ontario in the early 1900s, the focus of exploration shifted away from southern Ontario. However, as the price of gold increased to over \$800 per ounce in 1980, interest in the old gold mines of southern Ontario was renewed and a significant amount of exploration was done throughout the 1980s. That work resulted in two new discoveries in 1985 – the Mono Gold Mines property near Bannockburn in Madoc Township and the Dingman deposit near Malone in Marmora Township. Based on diamond drilling to date, the Mono deposit contains about 135,000 ounces of gold and the Dingman deposit contains about 360,000 ounces. Both properties have changed ownership several times and continue to be active projects.

The gold exploration programs of the 1980s on 23 properties are documented in LeBaron (1991). Since that time, significant exploration has been done on a few of the prospects and is described in Sangster *et al* (2014).

Figure 1 shows the geology and gold occurrences of the Marmora-Madoc-Harlowe area and the general location of the favourable contact between metavolcanics of the Tudor Formation and overlying metasedimentary rocks of the Dungannon Formation, in addition to intrusive contacts that host many of the occurrences.

Three distinct styles of gold mineralization can be identified.

1. Intrusive margin

The mines at Cordova and Deloro are quartz vein-type deposits that formed along the margins of the Cordova gabbro and the Deloro granite. Gold that was present in rocks near the volcanic-sedimentary contact may have been remobilized and deposited in fractures associated with shearing and faulting along the edges of the intrusions. The veins include other minerals typical of lode gold deposits such as pyrite, chalcopyrite, arsenopyrite, tourmaline, and iron-bearing carbonates.

2. Volcanic-sedimentary contact

The Sophia, Mono and Tudor gold deposits occur in both volcanic and sedimentary rocks associated with fault and/or fold-related shear zones. These probably represent a concentration of gold that occurred from a combination of hydrothermal activity and erosion of the volcanic pile during the final stages of volcanic activity, followed by remobilization during Grenvillian deformation and deposition into structural traps. Mineralization appears to be restricted to quartz veins containing various assemblages of sulphides, arsenopyrite, ankerite and rare native gold.

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Gold Mineralization in the Marmora-Madoc-Harlowe Area, Southeastern Ontario

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3 Flinton Group Unconformity

The Addington and Ore Chimney mines and the Harlowe area occurrences represent concentrations of gold near the base of the Flinton Group (conglomerates, quartzites and pelitic schists) which unconformably overlie the older metavolcanic and metasedimentary rocks along the along the northern margin of the Northbrook granodioritic pluton.

A spatial association of gold mineralization with the basal Flinton Group unconformity in Kaladar, Barrie and Kennebec townships has been recognized by Moore and Morton (1986) and others. The occurrences are hosted by either: 1) mafic schist of the Ore Chimney Formation, interpreted as a paleoregolith that locally lies at the unconformity between underlying mafic metavolcanic rocks and overlying conglomerates and quartzites of the Flinton Group. Examples are the Ore Chimney and Addington deposits to the west of the Harlowe area in Barrie and Kaladar townships, respectively, which host gold mineralization in quartz veins with tourmaline, pyrite, chalcopyrite, galena and sphalerite; or 2) narrow bands of dolomitic marble below the unconformity, as at the Dome, Pay Rock and Gold Base occurrences in the Harlowe area, which host auriferous quartz veins, generally with minor sulphides (pyrite, chalcopyrite, tetrahedrite).

Outlook

Since the late 1980s, sporadic exploration for gold in southeastern Ontario has continued by a few local prospectors. The current downturn in mineral exploration and difficulties in raising exploration funding by junior mining companies has resulted in a generally low level of gold exploration activity in southern Ontario in recent years. However, as the discoveries of the mid-1980s proved, despite over 150 years of prospecting, there is potential for the discovery of new gold deposits in southeastern Ontario.

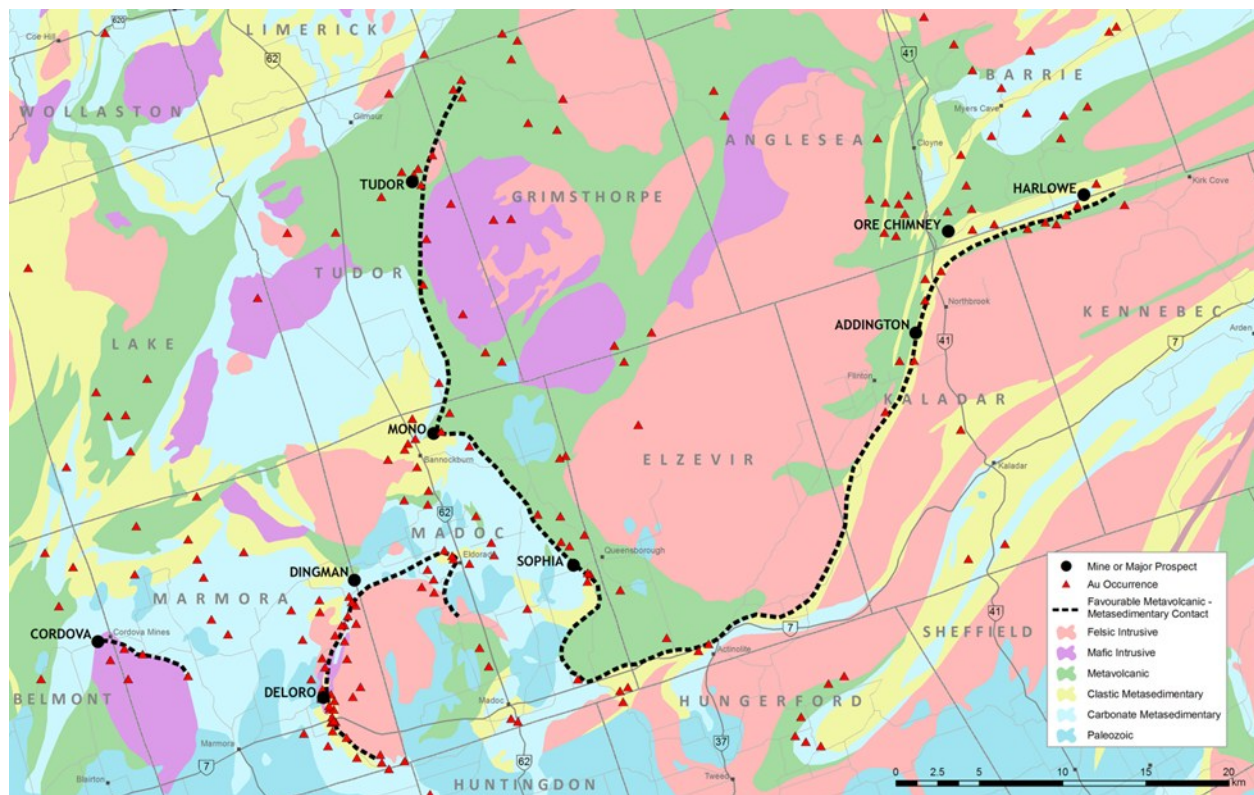


Figure 1: Geology and gold occurrences in the Marmora-Madoc-Harlowe area, southeastern Ontario. Geology from Ontario Geological Survey (2006).

Gold Mineralization in the Marmora-Madoc-Harlowe Area, Southeastern Ontario

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