The Mineral Potential of the Labrador Trough for Iron Oxide-Copper-Gold (IOCG) and Affiliated Deposits

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Overview

- IOCG-type mineralization and associated alteration
- General geology of the Labrador Trough
- IOCG-type mineralization and alteration in the Labrador trough
  - Romanet Horst
  - Montgomery Lake
- Exploration implications, conclusions and possible links to LIP’s in the Labrador Trough

IOCG and affiliated deposits in Canada (from Corriveau et al., in prep)
• Iron oxide copper gold (IOCG) deposits and various affiliated deposits are a major global source of Cu, Au and U (e.g. Olympic Dam, Prominent Hill, Ernest Henry)
  – also can contain Ag, Co, Bi, Fe, Mo, Ni, PGE, Pb, REE, V, Zn, etc.

• Found in many geological environments, classification of IOCG deposits based on a number of criteria (Groves et al, 2010; Corriveau and Mumin, 2010; Williams, 2010)
  – Abundant low-Ti Fe-oxides and characteristic alteration patterns
  – Strong structural control, associated with deep seated crustal structures
  – Close temporal (but not always spatial) association with magmatism

• Previous authors have linked generation of IOCG-type deposits and LIPs (Ernst and Jowett, 2013)
IOCG Mineralization

- IOCG and affiliated deposits form within distinctive, regional scale iron oxide and alkali-calcic alteration (IOAA) systems (Corriveau et al., 2016)
- When incorporated into ore genetic models and deposit classes may provide effective vectors towards mineralization

From Corriveau et al (in prep), adapted from Corriveau et al. (2016)
Geological Setting

- Labrador Trough located in western Labrador and northeastern Québec
- Forms part of the New Québec Orogeny (NQO)

From Corrigan et al (2018)
• Sequence of Paleoproterozoic (2.2 to 1.8 Ga) sedimentary and igneous rocks

• Record rifting of Superior Margin, development of a passive margin and subsequent collision of Superior with Core Zone (NQO)

• Major igneous events (LIPs) associated with initial rifting and collisions/orogenesis
Geological Setting

• Subdivided into series of lithotectonic zones (Clark and Wares, 2005)
  – Bounded by major crustal structures and with distinct stratigraphy
• Superior-type iron formations deposited close to continental margin
• Other deposit types present in eastern Labrador Trough (e.g. magmatic sulphides, VMS, orogenic Au etc.)
• IOCG-type mineralization and associated alteration reported from two main areas
  – Romanet Horst
  – Montgomery Lake
Romanet Horst: Geology

- Romanet Horst forms anticlinal structure bounded by major crustal faults (Konstantinovskaya et al., 2019)
- Surrounded by dominantly 2.17 LIP magmatism
- Diversified metallic assemblages in the property showings;
  - e.g. Cu-Co-Au-Ag±REE and Au-U±Mo-Co-Cu-Ni-REE

*Faults
Mineral Occurrences*

- Copper
- Gold
- Uranium
- Zinc
- Lead

IOCG-type mineralization with albitionization (Clark and Wares, 2004; McLaughlan et al., 2016)
Romanet Horst: Geology

- Regional sodic and sodic-calcic-iron alteration
- Convergence and intersection of numerous and deeply rooted regional structures
- Mineralization zones hosted in albitites
Romanet Horst: Mineralization

- Delhi Pacific – Chibtown Prospects
  - Polymetallic Cu-Ag-Au-(Co-Zn) mineralization
  - Structurally controlled, hosted in albitized shales
  - Recent drilling results include 0.54% Cu over 45 m, 0.38% Cu, 0.2 g/t Au, 0.8 g/t Ag over 30.9 m (DP) and 0.46% Cu over 42 m (CB)

- Taché-Saarberg showings
  - Comprises a series of Co+Cu anomalies (Co > 500 ppm) over 750m along strike
  - Up to 30.8% Cu, 21.2% Cu, 11.3% Cu, 1.92 g/T Au, 0.27% Co, 0.81% Co in grab samples

- Other prospects include
  - Eagle (up to 213 g/t Au, 2.9% U, 368 ppm La, 0.5% Cu in grab samples).
  - Kish (up to 1% U and 136 g/t Au in grab samples).
  - Viking (up to 0.1% U, 6.1% Cu, 1.6% Ni, 5.7% Se and 223 g/t Au in grab samples).
  - Lac Mistamik (up to 43 g/t Au, 601 ppm La, 20.7 g/t Ag, 1.8% U, 0.1% Cu in grab samples)
Corriveau et al. (2014) recognized alteration facies typical of IOCG style mineralization

- Regional Na±Ca alteration (albitite)
- High temperature Ca-Fe (amphibole-dominant)
- High temperature K-Fe alteration (magnetite and biotite dominant)
- Low temperature K-Fe (hematite and sericite dominant); distinctive of IOCG deposits and locally host copper-sulphide mineralization
Montgomery Lake: Geology

- Structurally complex area, with numerous large crustal scale faults and exposed basement in core of north plunging anticline (similar to Romanet Horst?)

- Numerous gabbro sills and possible Paleoproterozoic granite at margin of basement complex (Wardle, 1979; Butler, 2019)

- Strong alteration zone parallel to Walsh Lake Fault traced for more than 1.5 km
Montgomery Lake: Mineralization

- Intensely altered units, commonly brecciated with rounded to sub-angular clasts in fine-grained grey matrix
- Historical exploration from 1942 to 1966 includes trenching, diamond drilling, geophysical (EM, mag, gravity) and geochemical surveys
  - 0.31% Cu over 14.5m, 0.17% Cu over 25.5m, 0.12% Cu over 36.1m, 1.0g/t Au over 1.5m, 9.2 g/t Ag over 1.5m
  - Grab samples from main trench up to 5.48% Cu, 424 ppb Au
- Anomalous Cu (> 0.1% Cu) and Au (> 100 ppb) grades in grab samples over 1.4 km strike length
- Also enrichment in LREE and Ag (up to 1.7 g/t Ag)
Montgomery Lake: Genetic Model

• Two main phases of alteration
  – Early Na alteration consisting primarily of albite and quartz with < 10% carbonate – “Albitite”
  – Later Ca-Na-Fe brecciation (hydraulic breccia) associated with chalcopyrite, minor pyrrhotite and pyrite

• IOCG affiliated deposit (Iron Sulphide Copper Gold deposit)
  – Strong structural control near major crustal structure
  – Hosted in graphitic sedimentary sequence (reducing) under conditions too reduced to stabilize Fe-oxides
  – Early sodic alteration (regional)
  – Late chalcopyrite and pyrrhotite mineralization and brecciation (minor magnetite, apatite)
  – Presence of hypersaline fluids (preliminary fluid inclusion study)

• Similar global examples include Eloise, Lady Clayre (Cloncurry), Delhi-Pacific (Romanet Horst, Labrador Trough)
Montgomery Lake: Regional Implications

- Potential for further exploration in eastern Labrador Trough using IOCG exploration model
  - Similar tectonic setting to Romanet Horst
  - Prospecting has identified anomalous Cu over > 23 km strike length (Labonte et al., 2009; this study)
  - Possible similar alteration to Montgomery Lake reported from southern end of Andre Lake (Kozela, 1960)
  - Numerous unexplained magnetic and radiometric anomalies in Andre Lake area (Labonte and Kieley, 2009)
  - Diamond drilling on Andre Island area in 1960s encountered potassic (biotite) alteration, brecciation and intervals of pyrrhotite and magnetite rich units with trace chalcopyrite

- Future work planned following up on previous prospecting results and magnetic anomalies, and aims to place alteration in framework developed by Corriveau et al. (2010, 2016)
IOCG in the Labrador Trough: Overview

- Similarities in tectonic setting of Romanet Horst and Montgomery Lake areas
  - Strong structural control, located close to major crustal structures
  - Proximal to basement domes (Superior affinity)
  - Importance of early (rift related) sediments and former evaporite horizons (brines?)

- Regional sodic alteration associated with polymetallic mineral occurrences (Cu, Au, Ag, U, REE, Co)
  - Common brecciation, evidence of hypersaline fluids (Montgomery Lake)

- Alteration studies in Romanet Horst indicate other IOAA facies typical of IOCG and affiliated deposits
Potential of a region to host IOCG-type mineralization can be determined using mineral systems based approach (Skirrow et al., 2019)

Focusses on critical geological processes necessary to form mineral deposits, especially important in greenfield exploration

Areas of the Labrador Trough displays many mappable criteria indicative of IOCG potential
  - More baseline geological, geochemical and geophysical studies required
IOCG in the Labrador Trough: Possible links to LIPs

(mappable criteria from Skirrow et al., 2019)

Drivers and source of energy

- IOCG and affiliated deposits commonly have temporal links to large scale I- and A-type magmatism
  - Possible energy sources in Labrador Trough include 1.85 Ga De Pas Batholith (bimodal) and other potential Paleoproterozoic granites and carbonatite complexes

Sources of metals, fluids, ligands and sulphur

- Possible magmatic or mixed magmatic hydrothermal fluid sources for IOCG and affiliated deposits
  - ~1.85 Ga magmatism in Labrador Trough
- Metals may be leached along fluid flow path
  - Leaching of metals from ~2.17-2.14 Ga LIP
IOCG in the Labrador Trough: Conclusions and Exploration Potential

- IOCG and affiliated deposits (including albitite hosted U and ISCG Cu-Au deposits) have been recorded in the Romanet Horst and Montgomery Lake areas

- Significant exploration potential remains, with poor outcrop and limited previous work in most areas
  - Evidence of extensive albite alteration associated with the De Pas batholith (Lafrance et al., 2015)

- Further geological (e.g. bedrock mapping, structural), geochemical (e.g. alteration mapping, isotope studies) and geophysical (e.g. gravity, magneto-telluric data) studies required to fully assess the mineral potential of the Labrador Trough
References


Ernst R E, and Jowett, S (2013) Large Igneous Provinces (LIPs) and Metallogeny. Society of Economic Geologists Special Publication Volume 17, pages 17–51.


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