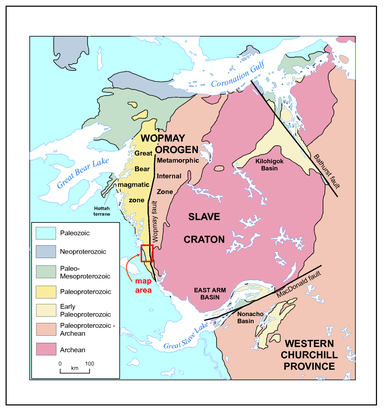

Figure 1. Generalized geology of the northwestern Canadian Shield and the location of the map area. (*Modified from* Gandhi, 1994, Figure 1)

MARGINAL NOTES

The Mazenod Lake – Lou Lake area is located in the southern part of the Wopmay Orogen, Northwest Territories, and is centred on the Great Bear magmatic zone (GBMZ). The Wopmay Orogen resulted from the collision of the Archean Slave craton with the Paleoproterozoic Hottah terrane (Hildebrand et al., 2010). The Wopmay fault zone along the east side of the area separates the GBMZ from the Metamorphic Internal Zone, which contains remnants of the Slave craton overlain by Coronation marginal platform metasedimentary rocks intruded by granitoid rocks. Cambrian strata of the Interior Platform overlie rocks of the Wopmay Orogen unconformably on the west side of the map area.

The GBMZ is an extensive, Late Middle Paleoproterozoic and predominantly calc-alkaline volcanic and intrusive terrane interpreted as a continental magmatic arc (Hildebrand et al., 1987; Gandhi et al., 2001) that developed on a metamorphosed and tilted sedimentary basin. Large, glacially polished outcrops are characteristic of the area. Volcanic tracts are so well exposed in the Mazenod Lake area that the volcanic stratigraphy can be mapped in detail and individual ignimbrite cooling units have been defined.

Superimposed on this orogenic collage and coeval with the magmatic activity are zones of intense iron oxide – alkali alteration ranging from sodic, to calcic and potassic alteration with or without iron oxides. Styles of alteration include minerals to whole rock-replacement, breccia formation and veining, with overprinting among alteration types and styles common (Corriveau et al., 2010; Potter et al., 2013). Replacive alteration is so intense in many areas that it has masked original lithologies, making field identification difficult.

This intense alteration culminated locally to produce diverse replacement, breccia, and vein styles of sulphide-poor polymetallic mineralization resulting as exemplified by the numerous mineral occurrences (NORMIN; Bretzlaff et al., 2013). These mineral occurrences are typically affiliated with a broad mineralization spectrum ranging from iron oxide copper-gold (IOCG) through porphyry to epithermal deposit types (Goad et al., 2000a, 2000b; Mumin et al., 2010), and have been reclassified accordingly. The NICO gold-cobalt-bismuth–copper deposit located near Lou Lake in the south part of the map area consists of largely stratabound lenses of mineralization hosted in brecciated clastic, hydrothermally altered metasedimentary rocks of the Treasure Lake Group. The Sue-Dianne copper-silver-gold deposit is hosted by brecciated and altered, felsic to intermediate volcanic and subvolcanic rocks of the Faber Group near Mazenod Lake in the northern part of the map area (Gandhi, 1994). Widespread occurrences of small metallic veins and replacements are related to this mineralization and alteration, but are not large enough to be classified as showings. Those shown on Gandhi (1999) have been transferred to this map and classified according to their metallic signature. New geochronology supported by the Geomapping for Energy and Minerals Program demonstrates that the IOCG and related mineralization took place over a very short period of time between 1873 and > 1866 Ma, within the time frame of the development of the GBMZ (Davis et al., 2011).

Quartz veins that occur along late-stage faults and fractures, and locally contain uranium and/or copper minerals, overprint IOCG mineralization and related alteration. These include the host to the Rayrock Mine (1957–1959: 159 metric tons uranium) emplaced along the Marion River Fault Zone (Gandhi, 1994) and the fault-hosted vein that hosts the Crowfoot showing within the Metamorphic Internal Zone.

CREDITS

Field work that contributed to the Great Bear portion of this map was largely conducted by the Geological Survey of Canada between 1987 and 1996 (Gandhi, 1989; Gandhi, 1992; Gandhi and Lentz, 1990; Gandhi et al., 1996). Between 1987 and 1991 the research was part of the Canada-Northwest Territories Mineral Development Subsidiary Agreement. This geological synthesis map was then compiled privately under a two year confidentiality agreement for Hudson Bay Exploration Company Limited (Gandhi, 1999) to provide geological context for a government multi-parameter airborne geophysical survey (Hetu et al., 1994). Older map sources (Douglas et al., 1975; Lord, 1942; McGlynn, 1968) were also utilized to complete the compilation. Resources to update and convert this map into a GIS-ready cartographic product (this publication) were provided by the project Multiple Metals - Great Bear Region, Geomapping for Energy and Minerals Program (2009-2013), Geological Survey of Canada and the Northwest Territories Geoscience Office. Fieldwork in 2009 and 2010 was conducted under an Aurora Research Permit and letters of collaborative agreements with the Community Government of Gamèti and with Fortune Minerals Limited.

Mineral occurrences shown on the map were extracted from the Northwest Territories NORMIN database (NORMIN, 2009), enhanced with information from the unpublished Fe-oxide-copper-gold deposit database and Canadian U-Th database compiled by S. S. Gandhi and others under the joint industry and Geological Survey of Canada World Minerals Geoscience Database Project (Chorlton et al., 2007). They were spatially adjusted using georeferenced assessment report diagrams to improve locational accuracy (Bretzlaff et al., 2013), and were reclassified using the new knowledge gained during the GEM program. Newly discovered mineral occurrences, alteration mapping results, and new geological and geochemical alteration maps produced between 2009 and 2013 are being published separately.

The geochronological data were extracted from the Canadian Geochronology Knowledgebase (2013), and the sample locations were corrected to their locations on the scanned and georectified source map (Gandhi, 1999).

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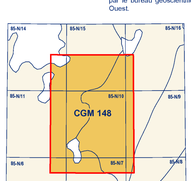
Abstract

The Mazenod Lake – Lou Lake area is centred in the southern Great Bear magmatic zone, Wopmay Orogen, Northwest Territories. The area comprises a 1.87–1.84 billion year old volcanic and plutonic terrane interpreted as a continental magmatic arc that developed on a locally exposed metamorphosed and tilted sedimentary basin. Intense alteration is superimposed on supracrustal rocks culminating in a diversity of mineral occurrences that range from iron-oxide-copper-gold (IOCG), including the NICO and Sue-Dianne deposits, to late vein-hosted uranium deposits, including the past-producing Rayrock Mine. This geological map was compiled in 1999 following Geological Survey of Canada fieldwork from 1987 until 1996, initially under the Canada-Northwest Territories Mineral Development Subsidiary Agreement (1987–1991). Updates and transformation of this map into a GIS-ready publication was supported by Multiple Metals - Great Bear Region, Geomapping for Energy and Minerals Program, Geological Survey of Canada and the Northwest Territories Geoscience Office.

Résumé

La région des lacs de Mazenod et de Lou est au coeur du secteur sud de la zone magmatique du Grand lac de l'Ours. Un terrain volcanique et plutonique de 1.87–1.84 milliard d'années, interprété comme un arc magmatique continental, y affleure sur un socle, un bassin sédimentaire basculé et métamorphisé. Des systèmes d'altération hydrothermale intense sont superposés sur les roches supracrustales, culminant en des zones minéralisées variées allant de la famille des gîtes à oxydes de fer cuivre-or dont les gisements de NICO et Sue Dianne, à des gîtes d'uranium en filons dont la mine historique de Rayrock. La compilation de cette carte a eu lieu en 1999 à partir de données de terrain acquises entre 1987 et 1996 par la Commission géologique du Canada, initialement sous l'accord Canada-Northwest Territories Mineral Development Subsidiary Agreement (1987–1991). La mise à jour de cette carte et ses modifications pour publication sur support informatique a été appuyée par le projet Métaux multiples, région du Grand lac de l'Ours du programme de Géocartographie de l'Énergie et des Minéraux, par la Commission géologique du Canada et par le bureau géoscientifique des Territoires du Nord-Ouest.



National Topographic System reference

Cover illustration
View looking west from Sue-Dianne Hill, Mazenod Lake area, Northwest Territories. Photograph by J.A. Kerswill June 16, 2009.
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GEOLOGICAL SURVEY OF CANADA
CANADIAN GEOSCIENCE MAP 148
NORTHWEST TERRITORIES GEOSCIENCE OFFICE
OPEN REPORT 2013-004

GEOLOGY AND MINERAL OCCURRENCES
MAZENOD LAKE-LOU LAKE AREA
Northwest Territories
1:50 000

Authors: S.S. Gandhi, J.-F. Montreuil, and L. Corriveau.

Geology based on fieldwork by S.S. Gandhi and N. Prasad between 1987 and 1996, supplemented with fieldwork during private consulting (Gandhi: 1998–1999) and regional compilation from Geological Survey of Canada map sources published in 1942, 1968 and 1975.

Additional geological data from the Multiple Metals - Great Bear Region, Geomapping for Energy and Minerals Program (2009–2013), Geological Survey of Canada and Northwest Territories Geoscience Office.

Geomatics by J.-F. Montreuil, A. Morin, K. Lauzière, G.S. Hanna, and L. Chorlton

Cartography by G.S. Hanna

Joint initiative of the Geological Survey of Canada and the Northwest Territories Geoscience Office, conducted under the auspices of the Iron-oxide Copper-Gold (IOCG) / Multiple Metals – Great Bear Lake (NWT) project as part of Natural Resources Canada's Geo-mapping for Energy and Minerals (GEM) program

Map projection Universal Transverse Mercator, zone 11. North American Datum 1983

Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications.

Elevations above mean sea level are expressed in metres (NTS 85-N/06, 85-N/11, 85-N/14) and feet (NTS 85-N/07, 85-N/08, 85-N/09, 85-N/10, 85-N/15, 85-N/16)

Magnetic declination 2014, 18°38'E, decreasing 27' annually.

The Geological Survey of Canada welcomes corrections or additional information from users.

Data may include additional observations not portrayed on this map. *See* documentation accompanying the data.

This publication is available for free download through GEOSCAN (http://geoscan.ess.nrcan.gc.ca/).

Preliminary publications in this series have not been scientifically edited.

Canada | Northwest Territories

GEOLOGICAL SURVEY OF CANADA
CANADIAN GEOSCIENCE MAP 148
NORTHWEST TERRITORIES GEOSCIENCE OFFICE
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GEOLOGY AND MINERAL OCCURRENCES
MAZENOD LAKE-LOU LAKE AREA
Northwest Territories

Canadian Geoscience Maps

Interior Platform: Cambrian platform strata (flat lying)

La Martre Falls Formation

- IL — **Shale member:** Green and red shale; thin bedded argillaceous and silty dolomite; salt crystal casts.
- ILM — **Mazenod member:** Basal polymict conglomerate; quartzose sandstone; nodular and oolitic brown dolomite.

Old Fort Island Formation

- IO — **Sandstone member:** White and grey sandstone, fine grained (may include basal La Martre Falls Formation in some places).

----------Unconformity----------

- qv — **Quartz veins:** Giant quartz veins and stockworks; related to brittle faults (mainly NE trending).

Great Bear magmatic zone (ca.1875–1840 Ma), Wopmay Orogen

Middle to Late Great Bear intrusions (pre-, syn-, and post-volcanic)

- GFrg — **Faber Lake rapakivi granite suite:** Porphyritic with coarse potassium feldspar phenocrysts; equigranular granitic and aplitic phases (1856 +2/-3 Ma[1]).
- Glg — **Leucogranite:** Epizonal plutons and sheets, medium to fine grained, seriate to porphyritic.
- Ggu — **Granitic plutons, undivided:** Granodioritic to more felsic; massive to foliated.
- GMggd — **Marian River granite-granodiorite batholith:** Coarsely feldspar phyric composite intrusion (local age 1866 +3/-2 Ma[1]), grades into gneissic (GMgn) and monzonitic phases (GMm) near Wopmay fault and Betty Ray Lake (1866 ± 2 Ma[1]).
- Gqm — **Quartz monzonite-monzodiorite:** Plutons and dykes (local age 1867 +1.6/-1.5 Ma[1]).
- Gd — **Diorite:** Irregular bodies and dykes (two generations or more; relative ages unknown).
- Grdp — **Rhyodacite to andesite porphyry:** Subvolcanic intrusions and dykes; feldspar-quartz-hornblende phyric, with aphanitic matrix (1867.9 +2.9/-2.4 Ma[1]).
- Gdp — **Plagioclase porphyry:** Andesitic to rhyodacitic; locally magnetite-rich where veined and hydrothermally altered.

Faber Group (volcanic assemblages; ca. 1875 –1860 Ma).

Bea Lake volcanic assemblage

- GFB2 — **Andesite to rhyodacite:** Quartz and feldspar phyric, massive, grey aphanitic matrix; in part intrusive.
- GFB1 cg, GFB1 vc — **Volcaniclastic rocks:** GFB1cg - Conglomerate, volcaniclastic, clasts cobble to pebble size; GFB1vc - Tuff, siltstone, rhyolite.

Mazenod Lake volcanic assemblage

- GFM13 — **Rhyodacite ignimbrite:** Flow textured to massive; unit of sub-assemblage extending to the north.
- GFM12 — **Rhyodacite ignimbrite:** Flow textured to massive (1861.5 +8.7/-1.3 Ma[1]); GM12S - Lithologically comparable outlier near Sarah Lake.

Rhyodacite ignimbrite cooling units; lower part of each characterized by well developed flow foliation; gradation to massive zone above; top part commonly contains abundant lithic fragments; volcaniclastic siltstone lenses and inclusions occur in some places

- GFM11 — **Rhyodacite ignimbrite cooling unit:** 5.
- GFM10 — **Rhyodacite ignimbrite cooling unit:** 4.
- GFM9 — **Rhyodacite ignimbrite cooling unit:** 3.
- GFM8 — **Rhyodacite ignimbrite cooling unit:** 2.
- GFM7 — **Rhyodacite ignimbrite cooling unit:** 1.
- GFM6 — **Rhyodacite:** Coarsely feldspar phyric, massive; flow foliation at base.
- GFM5 — **Volcaniclastic unit:** Basal heterolithic fragmental zone overlain by conglomerate and lapilli tuff.
- GFM4 — **Rhyodacite ignimbrite:** Flow textured to massive (1868.6 +1.3/ -1.2Ma[1]).
- GFM3 — **Rhyodacite ignimbrite:** Massive to flow textured.
- GFM2 — **Rhyodacite to andesitic ignimbrite:** Flow textured to massive; GFM2s – associated volcaniclastic siltstone lenses.
- GFM1 — **Rhyodacite to andesitic ignimbrite:** Flow textured to massive; GFM1s – associated volcaniclastic siltstone lenses.

Cole Lake volcanic assemblage

- GFC — **Andesitic to rhyolitic volcanic and volcaniclastic rocks:** GFCs – Andesitic to rhyolitic volcanic rocks and siltstone; GFCcg – Conglomerate-agglomerate, with sandstone lenses; GFCr – Rhyolite, subporphyritic; GFCbx – Breccia, heterolithic, hydrothermal and tectonic.

Dianne Lake volcanic assemblage

- GFD — **Andesitic to rhyolitic volcanic and volcaniclastic rocks:** GFDv: Andesite, dacite and rhyolite; coarsely porphyritic, massive; GFDs – Siltstone, volcaniclastic; GFDri – Rhyolite ignimbrite; GFDvc – Volcaniclastic siltstone and rhyolite.

Unnamed volcano-plutonic units

- GFH — **Dacitic to basaltic porphyry west of Hump Lake:** Highly foliated, plagioclase-phyric.

Lou Lake volcanic assemblage

- GFL8 — **Rhyolitic rocks, undivided:** Commonly aphanitic; massive to subporphyritic.
- GFL7 — **Rhyolite to andesite:** Massive, quartz-feldspar porphyritic, in places showing ignimbritic flow texture.
- GFL6 — **Rhyolitic:** Aphanitic to subporphyritic.
- GFL5 — **Rhyolite to andesite:** Flow banded to massive, grey; porphyritic to subporphyritic.
- GFL4 — **Rhyolitic:** Flow banded, subporphyritic, in places lithophysae-bearing; buff white to light grey
- GFL3 — **Volcaniclastic rocks:** Tuff, volcaniclastic siltstone and agglomerate, with thin rhyolite flows; commonly bedded or layered.
- GFL2 — **Rhyolitic:** Massive to flow banded, subporphyritic, buff white to pink.
- GA — **Breccia to agglomerate-lithic tuff:** Heterolithic, in part thinly bedded with angular to lensoid fragments; basal conglomerate lenses contain quartzite clasts.

----------Unconformity----------

Early Great Bear intrusions

- Gge — **Granite-leucogranite:** (1873 ± 2 Ma[1])

Treasure Lake Group

- GT4 — **Upper metasiltstone member:** Metasiltstone with variable magnetite content; including beds and lenses of arkosic quartzite, calc-silicate, argillite and biotite-garnetcordierite gneiss; may contain undivided rhyolitic and granitic sills.
- GT3 — **Quartz arenite member:** Quartzite (< 1886 ± 8 Ma[2]), interbedded with metasiltstone (GT4) and calc-silicate beds, including skarn and other hydrothermally altered rocks (GT2); may contain undivided rhyolitic and granitic sills.
- GT2 — **Calc-silicate member:** Calc-silicate and marble with sandy and silty beds, commonly affected by severe alteration including albitization and magnetite replacement; may contain undivided rhyolitic and granitic sills.
- GT1 — **Lower metasiltstone member:** Metasiltstone with black argillite beds; variable magnetite content largely as a consequence of hydrothermal alteration; may grade into quartzo-feldspathic paragneiss, cortorted, with local amphibolite replacement; may contain undivided rhyolitic and granitic sills.

----------Fault contact----------

Internal Metamorphic Zone and Coronation Margin, Wopmay Orogen, east of Wopmay fault zone.

- Mg — **Intrusive rocks east of the Wopmay Fault:** Granite, granodiorite and related rocks; gneissic intrusions, undivided.

Snare Group, Coronation Margin

- CS2 — **Carbonate member:** Dolomite, limestone; thin to thick bedded.
- CS1 — **Siliciclastic membe:** Conglomerate, arkose, quartzite, shale, argillite, cherty argillite and phyllite.

----------Unconformity----------

Archean rocks of the Slave Craton (> 2500 Ma) east of Wopmay fault zone

- Sg — **Archean intrusive rocks:** Granite, granodiorite; undivided Archean and early Proterozoic plutons.

Yellowknife Supergroup

- SY — **Metasedimentary rocks:** Metagreywacke, slate, phyllite, quartzite, quartz-mica schist and paragneiss.

Age determinations[3]

- U-Pb zircon age

Showings ☐ **and deposits** ☐[4,5]

- Quartz veins - polymetallic + U
- Quartz veins - polymetallic
- IOCG[7] - localized veins
- IOCG - hematite group
- IOCG - skarn
- IOCG - magnetite-hematite group
- IOCG - magnetite group
- IOA[8] - polymetallic
- IOA
- Albitite-hosted U

Observed mineralization[6]

- U-Cu fracture fillings
- Pb-ZnCu veins
- MoS PyZnCuTur
- Au-Bi-Cu-Co-W-As disseminations and veins
- CuSPbZnAsCoSNiBi
- CuSPbZnAsCoSBi
- MagSApSActCuSU veins
- Fe - stratabound to discordant in metasedimentary rocks

Structural measurements

- Bedding, inclined
- Bedding, vertical
- Bedding, tops known, inclined
- Foliation or gneissosity, inclined
- Foliation or gneissosity, vertical
- Foliation or gneissosity, dip unknown
- Minor fold, plunge indicated

Geological discontinuities

- Contact, defined
- Contact, approximate
- Contact, inferred
- Contact, unconformable, defined
- Contact, unconformable, approximate
- Fault, approximate
- Fold hinge, synformal

Footnotes

1. Gandhi et al., 2001
2. Gandhi and van Breemen, 2005
3. Canadian Geochronology Knowledgebase, 2013
4. NORMIN, 2009
5. Bretzlaff et al., (in press)
6. Mineral abbreviations from Whitney and Evans, 2010
7. Iron oxide ± copper ± gold mineralization
8. Iron oxide - apatite mineralization

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