Updated 1:20 000 Scale Geological Map for the Squall Lake–Snow Lake–Herblet Lake Area

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Manitoba

Project overview

Rocks of the Snow Lake - Squall Lake - Herblet Lake area include a panel of Snow Lake arc assemblage volcanic rocks imbricated between the McLeod Road thrust and the Birch Lake Fault. This panel is host to the most significant gold deposits, which together are responsible for production in excess of 1.4 million ounces of gold.

The rocks in the hangingwall of the McLeod Road thrust fault and farther north have only been mapped at 1:50 000 scale. In order to upgrade the geological map of the Snow Lake–Squall Lake–Herblet Lake area to a level comparable to that for the main panel of Snow Lake arc assemblage rocks to the south, the Manitoba Geological Survey is conducting new geological mapping. A particular emphasis of the project is the investigation of the geometry and stratigraphy of the New Britannia mine horizon in order to better understand the controls on gold mineralization.

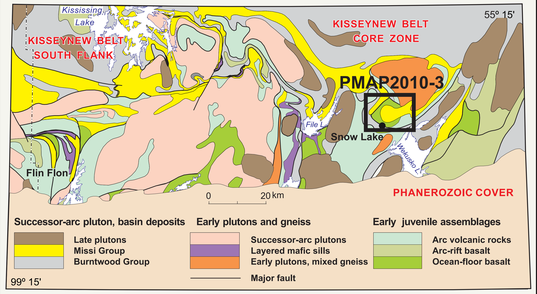
A new 1:20 000 geological map (**PMAP2010-3**) has been produced, integrating data from this latest field season with results from the previous years' mapping .

Geology

The New Britannia mine horizon is part of the McLeod Road - Birch Lake thrust panel (MBP) of Snow Lake arc assemblage volcanic rocks. The MBP comprises a 2-3 km thick sequence of bimodal arc-related volcanic and volcaniclastic rocks that form a thin arcuate package extending more than 10 km east and west of Snow Lake. The rocks were metamorphosed from lower to mid- amphibolite facies. Synvolcanic gabbro dikes and sills are common. The MBP is flanked to the north and south by younger metasedimentary rocks. The MBP is separated from the younger underlying Burntwood metaturbidites by the McLeod Road thrust. The Birch Lake fault, also interpreted as a thrust fault, marks the boundary between the MBP and the overlying younger Missi meta-arenite to the north. The western portion of the MBP comprises two panels of pillowed and massive mafic volcanic flows with ocean-floor signature.

The northeastern portion of the map area, north of Herblet Lake between Angus Bay and Northeast Bay, is characterized by the presence of a large domal structure, the Herblet gneiss dome, exposing granodioritic to tonalitic gneiss in its core. This gneiss dome is part of a series of domes that extends more than 80 km west from the Pulver gneiss dome, just east of Herblet Lake, to the Sherridon–Hutchinson Lake complex.

Project Location



Map showing the main geological subdivisions of the Flin Flon - Snow Lake greenstone belt. The project area is highlighted by the red box. The Snow Lake area is dominated by bimodal arc-related volcanic and volcaniclastic rocks. Younger Burntwood and Missi sediments are tectonically interleaved with the volcanics.

Structural Geology

The Snow Lake – Squall Lake –Herblet Lake area was affected by four deformations (Kraus, 1998; Kraus and Williams, 1999) but only three generations of fabric elements representing deformations D_1–D_3 have been identified.

The oldest deformation (D_1) for which fabric elements are preserved in rocks of the map area produced upright to moderately inclined isoclinal folds and an associated axial-planar slaty cleavage. The presence of F_1 folds is widespread but the penetrative development and preservation of S_1 is rare. The isoclinal geometry of F_1 folds resulted in the development of a layer-parallel foliation, which was either not penetratively developed or was developed but transposed during subsequent deformations. Layer-parallel foliation of the S_1 generation is also observed in the hinge zone of tight to open, mesoscopic F_2 folds where S_1 overprinting did not develop as strongly. Throughout the map area, there is no evidence for the presence of an S_1 foliation within the Missi Group clastic sedimentary rocks. Within the New Britannia mine horizon isoclinal F_1 fold intercalation of volcanic rocks was documented. The plunge of F_1 folds is poorly constrained but appears to be relatively shallow, based on the steep attitude of the L_1 stretching lineation, which is generally oriented perpendicular to the plunge of the associated folds, assuming the folding is cylindrical (Beaumont-Smith and Lavigne, 2008) .

The second deformation episode (D_2) is associated with the development of a prevalent S_2 foliation throughout the map area. D_2 deformation is characterized by shallowly inclined F_2 folds and D_2 thrust faulting. Mesoscopic F_2 folds form prominent structures in the map area: the McLeod Lake synform, the Whitefish bay synform, and another major F_2 synformal structure that can be traced from the Northeast Bay of Herblet Lake trending southwest to Southwest Bay where it wraps around the F_3 Threehouse synform.

During D_3 macroscopic northeast-trending broad, open F_3 folds formed in the Snow Lake area. Locally, an associated axial-planar fabric developed as a spaced cleavage. Decimetre-scale F_3 folds are well developed in Burntwood Group turbidite, whereas the volcanic rocks contain only a local, weak S_3 foliation.

East-trending F_4 folds overprint northeast-trending F_3 structures, resulting in a dome-and-basin configuration just north of the map area. No cleavage associated with the F_4 folding has been identified within the map area

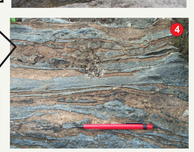
References:

Beaumont-Smith, C.J. and Lavigne, J. 2008: Structural geology and gold metallogenesis of the New Britannia mine area, Snow Lake, Manitoba (NTS 63K16); *in* Report of Activities 2008, Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, p. 7–17. **Kraus, J. 1998**: Structural and metamorphic studies in the Snow Lake area, Trans-Hudson Orogen, Manitoba, central Canada; Ph.D. thesis, University of New Brunswick, Fredericton, New Brunswick, 229 p. **Kraus, J. and Williams, P.F. 1999**: Structural development of the Snow Lake allochthon and its role in the evolution of the southeastern Trans-Hudson Orogen in Manitoba, central Canada; Canadian Journal of Earth Sciences, v. 36, no. 11, p. 1881–1899.

Northeast plunging streching lineation (L_1) developed as quartz rodding in Missi Group meta-arenite on S_2 surface.

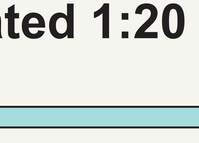
Isoclinal F_1 fold in felsic volcaniclastic rocks overprinted by a strong S_2 foliation. One limb (at bottom of photo) has been truncated.

Mafic tectonite from the Birch Lake fault zone displaying a strong carbonatization and mylonitic fabric. S_2 foliation is parallel to pencil.

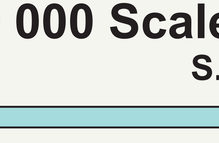


Tight F_2 folding in mafic tuff at Boundary zone.

Gold mineralization



Surface exposure of No. 3 zone which occurs along the contact between pillowed basalt and mafic volcaniclastics.



Narrow quartz veins in mineralized (arsenopyrite) and highly silicified gabbro sill at the Moon Gertie zone.

Thin late quartz vein cross-cutting strongly silicified and foliated rhyodacite, rock is mineralized with fine-grained arsenopyrite; Boundary zone.

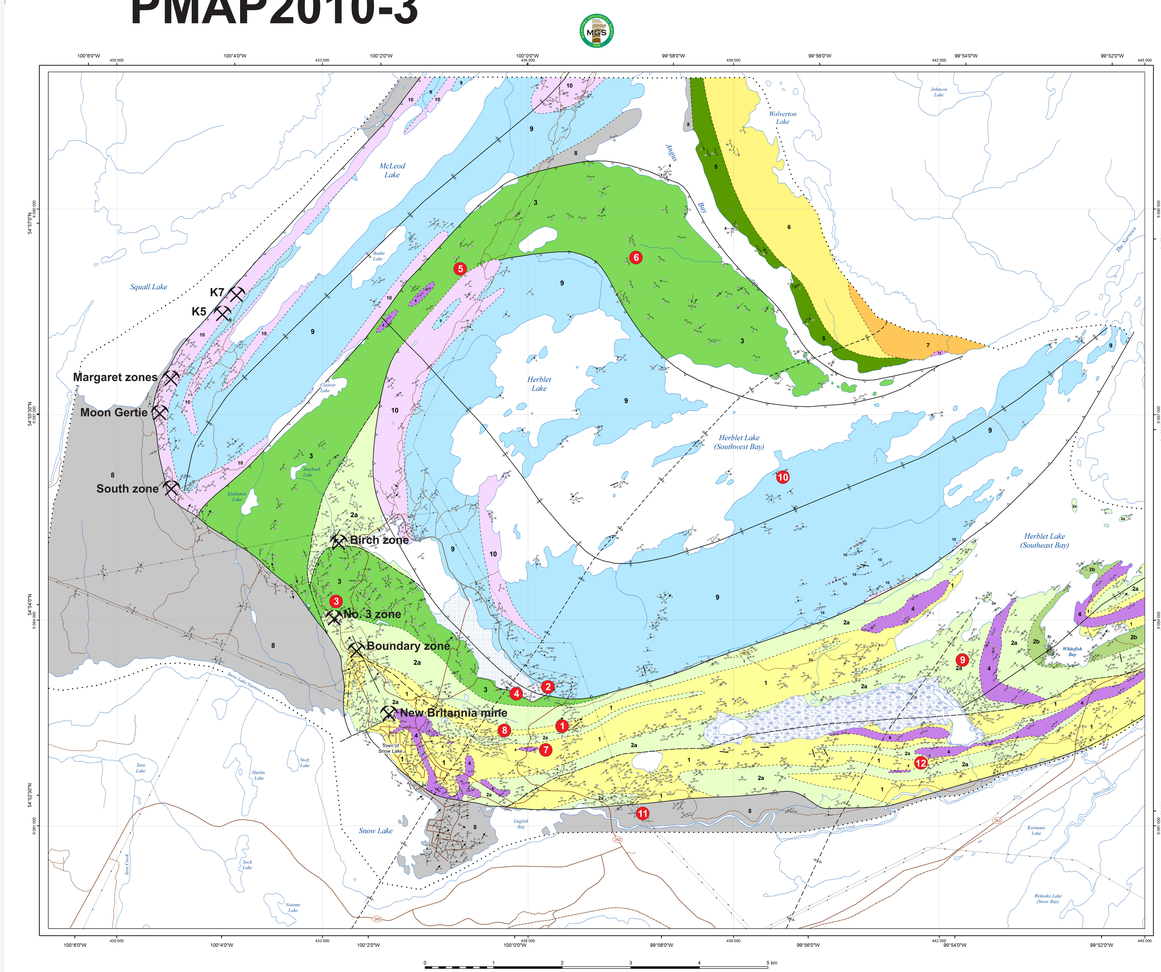
Late barren quartz veins infilling boundinaged and strongly silicified mineralized horizon (medium-grey), within a Bt-Ms-Carb altered host rock; New Britannia mine.

There is a strong spatial association between gold mineralization and the McLeod Road Thrust. Gold mineralization is located in the hangingwall of the thrust and is hosted by a wide variety of rock types. Two common characteristics are the hosting of mineralization within high-strain zones and the location of gold mineralization along or adjacent to lithological contacts.

The quartz-vein–hosted gold mineralization and its alteration are overprinted by F_2 folding, which constrains the age of gold emplacement to pre- to syn-D_2. However, there are also textural relationships that suggest later gold mineralization stages during D_2. Our current interpretation constrain the initial gold mineralization to syn-D_2 or older accompanied by significant local remobilization during D_2.

Gold mineralization in the New Britannia mine horizon is hosted by quartz and quartz-carbonate replacements and veins. There appears to be a systematic change in the style of mineralization from east to west. The New Britannia deposit is characterized by massive quartz-carbonate replacement of potassium-altered mafic volcaniclastic rocks adjacent to the contact with felsic volcanic rocks. To the west, the deposits become more closely associated with quartz veins. The Boundary zone contains both quartz replacement and quartz-vein–associated gold mineralization focused at the contact of felsic volcanic and mafic volcaniclastic rocks. Farther west, the No. 3 zone comprise mineralization associated with quartz veins while the Birch zone consists of a fine quartz stockwork.

PMAP2010-3



Preliminary Map PMAP2010-3

Geology of the Snow Lake–Squall Lake–Herblet Lake area, Manitoba (parts of NTS 63K16, 63J13)

Legend

Post-Missi intrusive rocks

- 11 — Granitic pegmatite: homogeneous, massive, microcline-plagioclase-quartz-biotite-muscovite
- 10 — Gabbro dikes and sills: massive to foliated, equigranular, locally plagioclase porphyritic

Missi Group

- 9 — Arenite: trough crossbedded; biotite-garnet; biotite-garnet-sillimanite

Burntwood Group

- 8 — Greywacke, mudstone: staurolite-garnet-biotite schist; garnet-biotite schist; biotite-garnet-sillimanite

Herblet gneiss dome

- 7 — Tonalitic to granodioritic gneiss: fine to medium grained, foliated, quartz-oligoclase-microcline-biotite±hornblende
- 6 — Felsic gneiss: fine- to medium-grained garnet±ferrous quartzofeldspathic gneiss, foliated
- 5 — Amphibolite: strongly foliated, medium grained, compositionally layered hornblende-plagioclase gneiss, commonly garnet±ferrous

Snow Lake arc assemblage

- 4 — Gabbro: fine grained, equigranular; weakly foliated with granoblastic texture
- 3 — Mafic volcanic rocks: aphyric to plagioclase-phyric pillowed basalt; massive basalt; minor volcaniclastic rocks
- 2c — Felsic- and intermediate- dominated heterolithic volcanic conglomerate
- 2b — Epiclastic volcanic sandstone: predominantly feldspathic volcanic sandstone; also contains pyroxene-phyric mafic tuff, heterolithic lapilli tuff and tuff breccia and heterolithic volcanic conglomerate
- 2a — Mafic volcanic and volcaniclastic rocks: pyroxene- and plagioclase-pyroxene-phyric mafic tuff; monolithic to heterolithic lapilli tuff and tuff breccia; local pyroxene-phyric pillowed basalt and basalt flows; contains locally abundant pyroxenite dikes
- 1 — Felsic volcanic and volcaniclastic rocks: amygdaloidal dacite; aphyric to K-feldspar-phyric tuff; heterolithic lapilli tuff and tuff breccia; minor quartz-phyric lapilli tuff; contains locally abundant pyroxenite dikes (unit 2a)

Symbols

Planar structures

- Bedding: tops unknown, upright, overturned
- Foliation: generation unknown,1, 2, 3, 4
- Flow contact: top unknown, known
- Crenulation cleavage: generation unknown
- Shear zone: sinistral
- Fault: sense unknown
- Shear band: generation 2, dextral
- Dike
- Vein
- Fold axial plane: generation unknown, 2, 3

Linear structures

- Fold axis: generation unknown, 2, 3, 4
- Fold axis: Z symmetry, generation 1, 2, 3
- Fold axis: S symmetry, generation 1, 2
- Fold axis: symmetric, generation 1
- Intersection lineation: generation unknown, 1, 2, 3
- L-fabric: generation unknown, 1, 2
- L-fabric: mineral lineation
- Slicken striae

- Fault
- Thrust
- Antiform: F_2,F_3
- Synform: F_1, F_2, F_3
- Approximate contact
- Limit of mapping
- Road
- Limited use road
- Trail
- Powerline
- Mine (past producing)
- Tower
- Swamp
- Tailings pond

Geology by: S. Gagné, and C.J. Beaumont-Smith

Includes compiled geology by Beaumont-Smith and Gagné (2008), Gagné (2008), Schledewitz (1987) and Galley, et al. (1998).

Cartography by: M.E. McFarlane

Published by:
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Manitoba Geological Survey, 2010

This map is a provisional summary of work carried out during the summer field season and is produced directly from the geologist's manuscript. It is not to be regarded as a final interpretation of the geology of the area.

SUGGESTED REFERENCE:
Gagné, S. and Beaumont-Smith, C.J. 2010: Geology of the Snow Lake–Squall Lake–Herblet Lake area, Manitoba (parts of NTS 63K16, 63J13); Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, Preliminary Map PMAP2010-3, scale 1:20 000.

REFERENCES
Gagné, S. 2009: Geology of the McLeod Road–Birch Lake allochthon, Herblet Lake (Southwest Bay), Snow Lake area, Manitoba (part of NTS 63J13); Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, Preliminary Map PMAP2009-1, scale 1:20 000.

Galley, A.G., Ames, D.E. and Franklin, J.M. 1998: Geological setting of gold mineralization, Snow Lake, Manitoba; Geological Survey of Canada, Open File 1700, scale 1:5000.

Schledewitz, D.C.P. 1987: Compilation of the geology of the Squall Lake area, Manitoba; Manitoba Energy and Mines, Preliminary Map 1987F-2, scale 1:20 000.

Beaumont-Smith, C.J. and Gagné, S. 2008: Structural geology of the Snow Lake–Squall Lake area, Manitoba (parts of NTS 63K16, 63J13); Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, Preliminary Map PMAP2008-1, scale 1:20 000.

Index map

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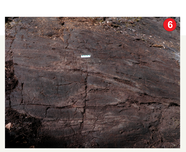
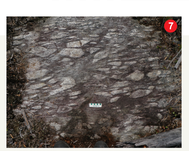
5 — Aphyric, pillowed Birch Lake basalt with thin selvages and rare interstitial material.



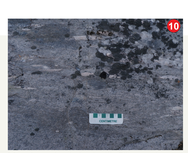
6 — Pillowed basalt with moderate garnet-hornblende alteration along pillow selvages and between pillows.



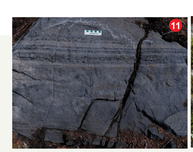
7 — Matrix-supported felsic lapilli tuff with matrix of intermediate composition.

8 — Clast-supported felsic lapilli tuff.

9 — Mafic lapilli tuff with amygdaloidal plagioclase-phyric cm-size clasts.



10 — Massive arkosic bed with 5% cm-size felsic clasts of uncertain origin; Missi Group.



11 — Normally graded Burntwood metaturbidites with alternating pelitic (staurolite-rich) and psammitic beds.

12 — Well-bedded fine-grained felsic tuff and crystal tuff.