Geology of the Hook Lake Block, Flin Flon, Manitoba

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Hook Lake Block

The Hook Lake Block is one of several fault-bounded domains in the Flin Flon assemblage of the Paleoproterozoic Flin Flon Belt. It is bounded to the east and west by the Manistikwan Lake and Cliff Lake faults, respectively, and represents a comparatively unique volcanic and volcaniclastic stratigraphy with respect to the Flin Flon Block to the west.

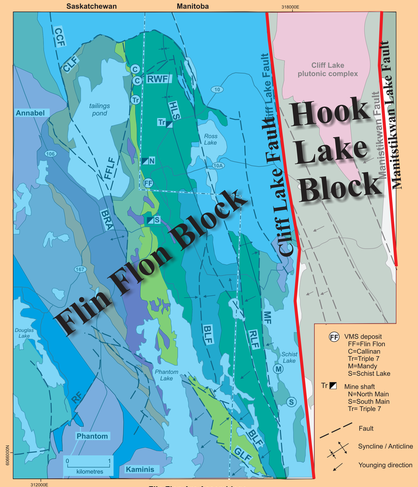
Two distinct sequences

Based on field mapping of the northern segment of the Hook Lake Block in the summer of 2007, the area has been subdivided into two distinct sequences:

1) ***Western Sequence*** consisting of aphyric to feldspar-phyric basaltic flows, associated volcaniclastic rocks with lesser felsic (quartz- and feldspar-phyric rhyolite) volcanic rocks, accompanied by a stratigraphically overlying sequence of reworked mafic and felsic proximal volcanic rocks interleaved with plagioclase- and pyroxene-phyric basaltic flows; and

2) ***Eastern Sequence*** consisting of massive to fragmental, quartz- and feldspar-phyric rhyolitic flows in a thick package of heterolithic mafic to mafic-felsic breccia. The western sequence is interpreted to be the product of proximal reworking of older mafic and felsic volcanic rocks accompanied by lesser mafic volcanism in a subsidence structure/basin. This is largely fragmental and also likely the product of infilling of a basinal domain by locally derived volcaniclastic detritus.

The boundary between the two sequences is marked, in places, by the Cliff Lake plutonic complex and, elsewhere, by the Hook Lake Fault. The latter is subparallel to, and has a similar kinematic history as, the block-bounding Manistikwan Lake and Cliff Lake faults.



Intrusive Rocks
- Phantom, Kaminis, Annabel, Cliff Lake plutons
- Boundary intrusions
- Myo felsic intrusion

Missi Group
- Fluvial sediments

Flin Flon Arc Assemblage

Louis formation
- Hidden formation
- Douglas formation

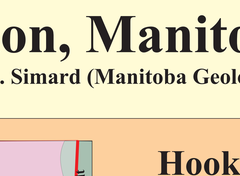
Hilary formation
- Key member undivided
- Newcor formation

Flin Flon formation
- Millrock member
- Creighton member
- Blue Lagoon member
- Club member
- Unassigned volcanic rocks

Hook Lake Block
- Unassigned volcanic rocks

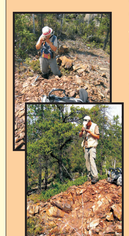
Economic potential

Sulphide mineralization was observed throughout the Hook Lake block, occurring as disseminations, stringers, or semi-massive pyrite and pyrrhotite +/- chalcopyrite and sphalerite. Many of the mineralized zones occur in spatial association with fragmental felsic volcanic rocks. Similar associations exist between the Flin Flon-Callinan-777 deposits and the Millrock member of the Flin Flon formation, as well as in the Schist Lake - Mandy mines area.



Gossaniferous felsic rocks just east of Grant Lake. Massive layered pyrrhotite ±pyrite ±chalcopyrite sulphide pieces were found in the rubbles surrounding this old trench.

Remobilized sulphide has been observed in and close to the Cliff Lake Fault and associated faults. One mineralizing event exposed in the Cliff Lake Fault by Highway 10 can be correlated with the second (sinistral) movement along the fault. If larger or more strongly developed structures related to this deformation event are present elsewhere in the region or even the belt, they could represent future exploration targets.

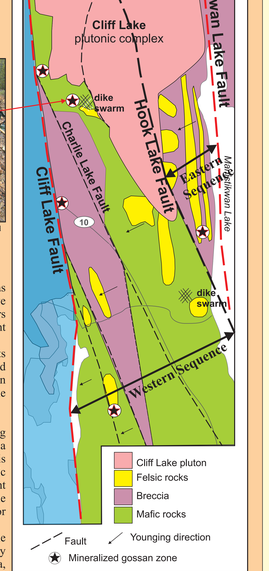


Primary sulphide associated with rhyolite flows occurs in the ***Eastern Sequence*** as discontinuous lenses and lobes of disseminated (<10%), stringer to locally semimassive (20-30%) pyrite±pyrrhotite, sphalerite and chalcopyrite. An example of the latter occurs just southeast of the Cliff Lake plutonic complex; parts of the zone have prominent sphalerite mineralization, with assays up to 12% Zn.

The association of mineralization with the fragmental rhyolite flows suggests potential for volcanogenic massive sulphidetype mineralization in the area. Unpublished geochemical data point towards a potential link between the rocks of the Eastern Sequence and those found to the north in the Trout Lake area, where the Trout Lake mine has been in operation since 1982.

The thick ***Western Sequence*** composed of mixed heterolithic breccia overlying basaltic flows is interpreted to represent proximal volcanic resedimentation into a subsidence structure/basin within the Hook Lake block. One mappable margin of this preserved basin seems to be marked by a dike swarm stratigraphically beneath rhyolitic flow and breccia, and is associated with gossaniferous mineralized zones and significant alteration in the surrounding volcanic rocks. Grab samples from an old trench in the mineralized zone contain massive, thinly layered pyrrhotite and pyrite with minor chalcopyrite.

The abundant heterolithic breccia, containing both mafic and felsic clasts, and the association of VMS type mineralization and alteration with felsic magmatism are very similar characteristics to what has been observed in the Schist Lake - Mandy mines area, as well as in the Flin Flon-Callinan-777 footwall rocks.



Western Sequence

The thick ***Western Sequence*** composed of mixed heterolithic breccia, both felsic and mafic, overlying the aphyric to sparsely feldspar-phyric basaltic flows is interpreted to represent proximal resedimentation of pre-existing mafic and felsic volcanic rocks into a subsidence structure/basin within the Hook Lake block.

The northern margin of this preserved basin seems to be marked by the mafic dike swarm with associated felsic dikes east of Grant Lake. This dike swarm, which traces eastward into the underlying mafic volcanic rocks stratigraphically beneath a large quartz-feldsparphyric rhyolitic flow and breccia, is associated with gossaniferous mineralized zones. Grab samples from an old trench in the mineralized zone contain massive, thinly layered pyrrhotite and pyrite with minor chalcopyrite. Assay results are pending. Mafic flows immediately surrounding the trench show noteworthy quartz-epidote alteration patches, which are interpreted to have resulted from paleo-hydrothermal activity in this area.

Mafic volcanic rocks

The stratigraphic base of the western sequence is marked by a thick package of aphyric to feldspar-phyric basalts. Flows are primarily pillowed with lesser massive basalt, capped by amoeboid breccia. Primary features are generally well-preserved, and include concentric zoning and syn-genetic quartz-epidote alteration. Younging criteria show consistent tops to the west.

Aphyric pillowed basalt and amoeboidal pillow breccia. Pillow cores show primary epidote-quartz alteration patches. Hammer for scale.

Centimetre-scale concentric zoning in aphyric pillows.

Silicified and altered (quartz-epidote) aphyric pillowed basalt. Pencil for scale.

Felsic volcanic rocks

Discontinuous flows and domes of feldspar +/- quartz-phyric rhyolite occur throughout the western sequence. Associated lenses of weakly- to well-developed autoclastic breccia occur at the top or on the lateral margins of the massive rhyolite flows/domes.

Sulphide mineralization has been observed in close spatial association with brecciated felsic volcanic rocks.

Quartz-phyric felsic breccia. Pencil for scale.

Sheared aphyric massive felsic intrusion.

Volcaniclastic rocks

Bedded, matrix-supported, heterolithic mafic and felsic breccia.

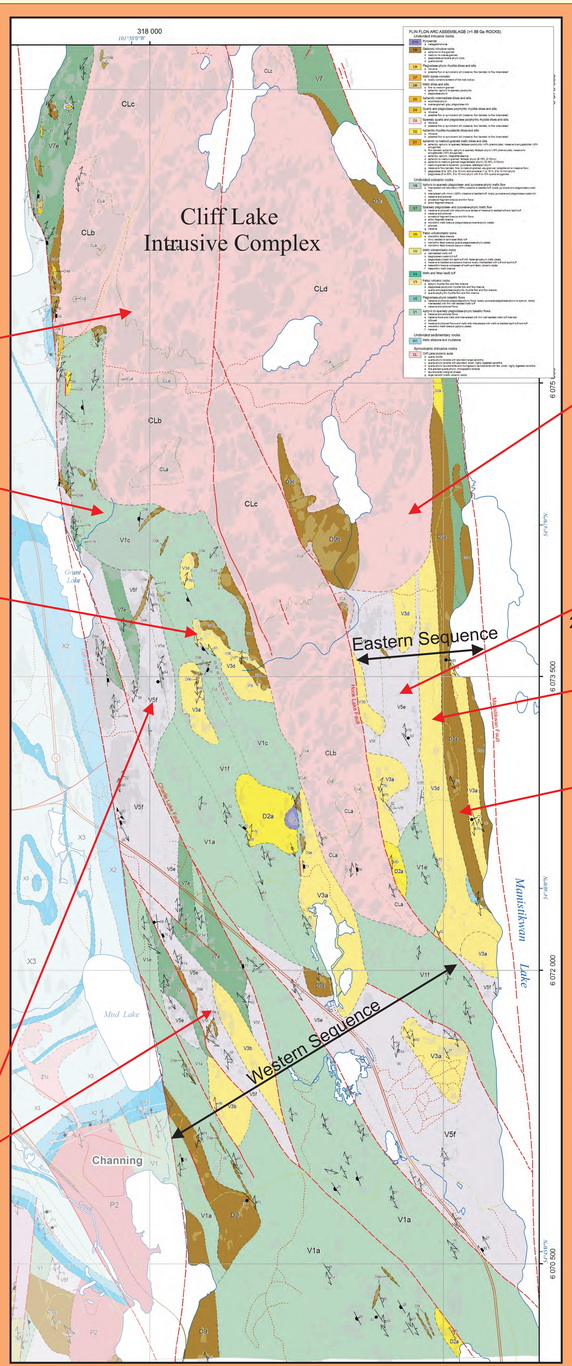
Massive, clast-supported, heterolithic mafic and felsic breccia. Pencil for scale.

The stratigraphic top of the western sequence is composed of monolithic to heterolithic mafic to mafic-felsic breccia that represents proximal reworking of existing/underlying volcanic rocks into a basin/subsidence structure.

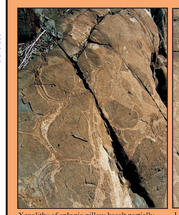
The stratigraphy in northern portion of the basin is relatively intact. To the south, it has been dismembered by a series of faults that splay off of the Cliff Lake fault.

Monolithic plagioclase- and pyroxene-phyric mafic volcanic breccia.

Lenses of pyroxene- and plagioclase-phyric basalt and associated volcaniclastics occur in the basin stratigraphy and represent minor episodes of volcanism during (re)sedimentation. The presence of up to 20% pyroxene phenocrysts (2-6 mm) makes these basalts quite distinct from the underlying aphyric to feldspar-phyric varieties.



Cliff Lake Plutonic complex



Xenoliths of aphyric pillow basalt partially digested by quartz-phyric tonalite of the Cliff Lake plutonic complex. Pencil for scale.

Large screen of pillow basalt intruded by quartz-phyric tonalite of the Cliff Lake plutonic complex. Pencil for scale.

The Cliff Lake plutonic complex separates, in part, the western and eastern sequences of the Hook Lake block. It is composed primarily of medium- to coarse-grained quartz-phyric tonalite, however, quartz diorite and diorite phases are occur towards the margins. Xenoliths of mafic volcanic rocks are common on the western and southern margin of the complex and show baked and/or partially resorbed margins. In larger xenoliths, primary volcanic features may be preserved. The volcanic rocks immediately surrounding the pluton have been homogenized by the effects of contact metamorphism.

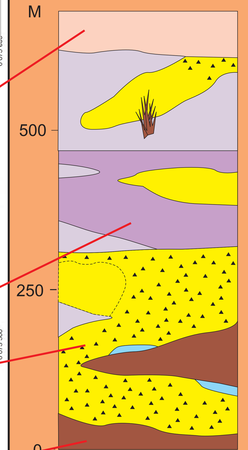
Eastern Sequence

Rocks of the ***Eastern Sequence*** are composed mainly of laterally continuous breccia layers with subordinate mafic flows. A significant proportion of the breccia is felsic in composition, or contains felsic as well as mafic clasts. The abundance of breccia, combined with a lack of flows, suggest that these rocks, similar to those of the western sequence, could represent proximal resedimentation of pre-existing felsic and mafic volcanic rocks into a subsidence structure/basin.

Felsic volcanic rocks

Aphyric and quartz- and feldspar-phyric rhyolite flows are laterally more continuous in the eastern sequence. As with rhyolite in the western sequence, the top of the flows is often marked by variably developed monolithic felsic breccia, and is locally overlain by fine- to very fine-grained felsic tuff.

The spatial association between sulphide mineralization and felsic breccia is again observed in multiple locations in the eastern sequence.

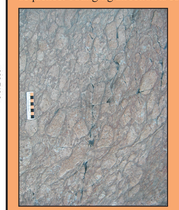


Felsic breccia showing a chloritized matrix.

Volcaniclastic rocks

Heterolithic mafic-felsic breccia is the dominant volcaniclastic facies in the eastern sequence, and is again interpreted to represent proximal reworking of volcanic rocks into a subsidence structure/basin.

Primary features such as bedding and graded beds are more readily identifiable in the eastern sequence. Younging direction is consistently to the west.



Massive, clast-supported heterolithic mafic breccia.

Massive, matrix-supported heterolithic mafic breccia. Hammer for scale.

Bedded, mafic lapilli-tuff.

Mafic intrusive rocks

Intrusive contact between pyroxene-phyric (right) and oikocrystic gabbro (left), pen magnet for scale

Knobby-textured melagabbro norite west of the Cliff Lake pluton

Several generations of mafic intrusive rocks crosscut all lithologies within the stratigraphy of the Hook Lake block. These intrusions range from narrow dikes to small plugs to large sills, and include very fine-grained, equigranular, ophitic, porphyritic, and glomeroporphyritic phases. In some instances, mafic dike swarms comprise more than 80% of outcrop.

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