Stratigraphy and Structure of the Notigi–Wapisu Lakes Area

Manitoba

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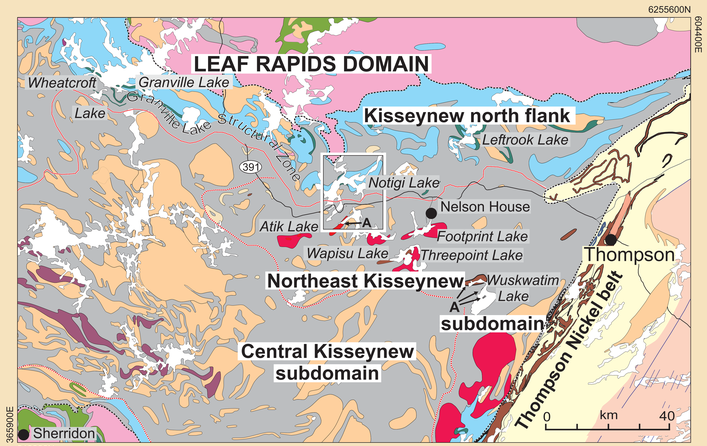
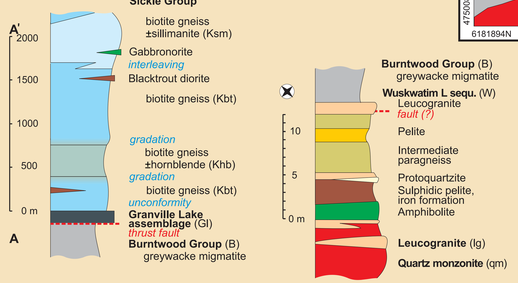
Introduction The Notigi-Wapisu lakes area (white outline below, and map on right) provides a transect from the south side of the Leaf Rapids Domain across the Kisseynew north flank into the Northeast Kisseynew subdomain. These areas represent, respectively, a 1.90–1.84 Ma volcano-plutonic arc terrane with VMS potential, a 1.85–1.83 Ga basin margin with sedimentary Cu potential but also containing a suture zone (Granville Lake structural zone) with Au potental, and 1.85–1.83 Ga basinal sedi-mentary rocks interleaved with prericontinental Archean basement with cover rocks that have potential for Thompson-type Ni deposits.

Mapping and geochronology in the Notigi-Wapisu lakes area helped to define these tectonic/metallogenic domains for mineral exploration. Geochronology has yielded ages of 1) arc magmatism for a pluton in the north, 2) younger magmatism at Notigi Lake, 3) Archean provenance of the older succession in the south with an early age of an associated pluton. Stereographic structural analysis and a down-plunge-projection technique were used to decipher the Notigi Lake structure. This was applied to determine the geometry and probable continuity at depth of the poorly exposed but economically promising older rocks to the south and southeast.

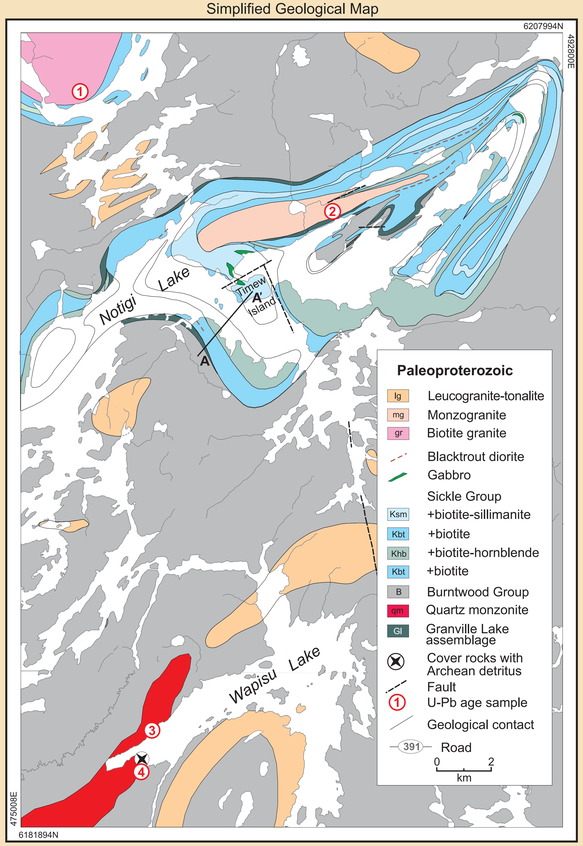


Tectonostratigraphy can be restored to an early stage of thrusting and folding using the regional relationships on the Kisseynew north flank. Sedimentary facies change from distal turbidite (Burntwood Group) to various proximal arkosic compositions (Sickle Group). A thin intervening structural package (Granville Lake assemblage) includes older metavolcanic and metasedimentary rocks thrust over the Burntwood Group with the Sickle Group lying unconformably on top (*see* column on right corresponding to section A–A′ on geologic map).

The older rocks on Wapisu Lake (Wuskwatim Lake sequence) include a 1.5 m layer and a 3.5 m layer of dark grey intermediate paragneiss separated by 1.6 m of semipelitic gneiss and followed by a 2 m section of sulphidic semipelite and silicate facies iron formation (hornblende-garnet bearing) and 2 m of amphibolite. Local protoquartzite establishes an Archean provenance for the sequence (*see* **Geochronology**). Contacts with the Burntwood Group are interpreted as faults and with pre-Burntwood quartz monzonite as intrusive but obscured by younger leucogranite (*see* column at far right).



Simplified Geological Map



Structure at Notigi Lake was interpreted using map patterns and changes in plunge produced during polyphase folding (map on right). The geometry was analyzed in 3-D using subareas with similar plunge to construct down-plunge sections with views that are nearly orthogonal to three different sets of folds (figures on far right).

The Notigi (main) dome was formed by the interference of a late upright antiform (F_3) with complex midcrustal recumbent structures (F_2) that refolded major early folds (F_1) and a thrust. Applying this history to the economically important rocks in the Northeast Kisseynew subdomain indicates that this area, although not widely underlain by thick Archean basement at depth, hosts narrow structural inliers many kilometres long similar to rocks in the Thompson Nickel Belt that host the nickel deposits.

Uranium-lead geochronology was carried out using the LA-MC-ICMS at the University of Alberta **(1)** and the SHRIMP at the Geological Survey of Canada in Ottawa **(2–4)**. Previously obtained ages are on **(5)**.

The Rat pluton **(1)** is a foliated to gneissic, medium-grained biotite granite. It forms an asymmetric dome or sheath fold surrounded by the Sickle Group at the south margin of the Leaf Rapids Domain. Its crystallization age of 1838 ±4 Ma is similar to granodiorite at the same margin 50 km farther east. The age is considered as syndepostional with the Sickle Group, the lower part of which is apparently intruded. With plutons of known ages of 1.86 and 1.89 Ga also at the south margin, the Rat granite indicates that arc magmatism there spanned the same time period as throughout the internal (volcanoplutonic) zone of Trans-Hudson orogen.

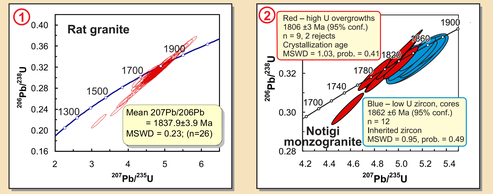
The Notigi granite **(2)** is a uniform foliated monzogranite near the core of the Notigi dome where it is interpreted to intrude the Sickle Group. Its zircons have distinct 1862 ±6 Ma cores and 1806 ±9 Ma rims **(2a, 2b)** but its field relationship indicates an age of emplacement younger than the 1850 Ma maximum age of deposition of the Sickle Group. Consequently, the cores are interpreted to be inherited or else the pluton was remobilized during high-grade metamorphism.

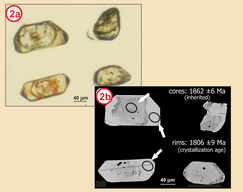
The Wapisu quartz monzonite to quartz syenite **(3)** forms an elong-ate pluton assigned to the Footprint Lake plutonic suite of Whalen et al. (2008)[1]. Because of its better exposure but close relationship to the economically important Wuskwatim Lake sequence *(see* below), an early age would make this pluton another important probe for Archean rocks and their cover similar to bodies toward the east and west. This interpretation is confirmed by the crystallization age of 1872 ±9 Ma .

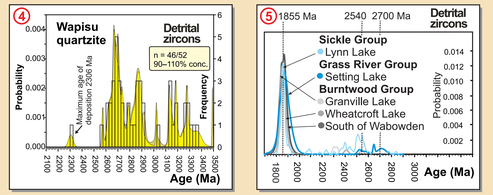
The Wapisu quartzite **(4)** is interpreted as part of the Wuskwatim Lake sequence which is related to the Ospwagan Group in the Thompson Nickel Belt where those rocks cover Archean basement and host all the nickel deposits. The 2.7 Ga peak is a common age in the Superior craton and the Mesoarchean peaks are interpreted to be derived from Assean-type crust at the north margin of the craton.

All the Kisseynew sediments, in contrast, have detrital zircon ages that peak at 1855 Ma **(5)**. They are clearly distinguished by their predominantly Proterozoic arc provenance from similar looking rocks in the Wuskwatim Lake sequence *(compare* plots on right).

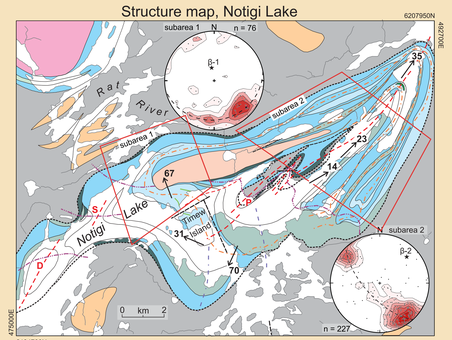
[1] MGS Report of Activities



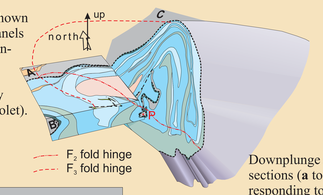




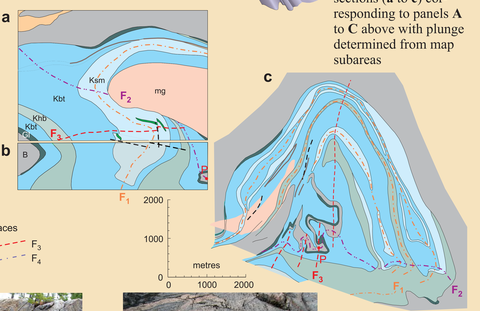
Structure map, Notigi Lake



3-D geometry shown in three tilted panels **A** to **C** corresponding to sections **a** to **c** (below), also folded early fault surface (violet).

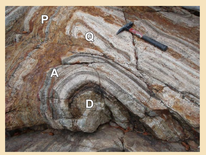


Downplunge structure sections (**a** to **c**) corresponding to panels **A** to **C** above with plunge determined from map subareas



Foliations: Contoured poles, all ages; ★ β- Foliation girdle axis
Local plunge: 14 β axes, all foliations; D, P Western and main domes; S Saddle
Faults: Early, Late
Axial surfaces: F_1, F_2, F_3, F_4

Wuskwatim Lake sequence sulphidic semipelite. Note that similar looking rock in the Granville Lake assemblage (photo to right) is juvenile (Paleo-proterozoic arc-derived).

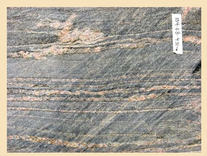


Granville Lake assemblage with interlayered sulphidic pelite (P), quartzofeldspathic to calcsilicate gneiss (Q), amphibolite (A) and diopside rich rock (D), interpreted to have been derived from mafic volcanic and sedimentary rocks. The fold is F_3, showing a flexural style with a small thrust.

Burntwood Group garnetiferous metagreywacke-mudstone–derived metatexite.

Note: Tape shown in all photos is 10 cm long and the arrow points north.

Burntwood Group metaturbidite grading from greywacke (pale) to mudstone (darker) with tops shown as arrows.



Sickle Group magnetite-bearing biotite gneiss probably derived from nonmarine lithic arenite (redbeds).

Sickle Group hornblende-biotite gneiss (hornblende indicated by arrows) derived from arenite with probable calcite cement.

Sickle Group sillimanite-biotite gneiss (meta-arkose) with quartz-sillimanite knots; tape is along the axial plane of an F_1 fold and fabric elements are interpreted as labelled; note overprinting of F_2 by S_3

Isoclinal fold in greywacke (lighter coloured out-lined eye shape) interpreted as F_1 affected by later folds and pinch-and-swell structure; synkinematic granitoid veins show F_2 folding and injection into the axial plane.

Recumbent F_2 folds of bedding, early foliation and granitoid veins as seen on a steep rock face.

F_2-F_3 interference structures near the hinge zone of a major F_2 anticline. Note similar map-scale pattern at Notigi Lake.