The Munroe Lake map sheet (NTS 640) lies on the south flank of the Hearne Province of the RaeHearne Archean craton that extends into Nunavut and Saskatchewan (see figure below). Hearne Province rocks in the map area consist largely of Archean continental crust and Paleoproterozoic cover strata that have been affected together by varying degrees of Paleoproterozoic plutonism and thermotectonism. These rocks, which are part of the Trans-Hudson Orogen (Hoffman, 1990), have been termed collectively the 'Cree Lake Ensialic Mobile Zone' by Lewry et al. (1978), Lewry and Sibbald (1980) and Lewry and Collerson (1990). Local domains are relatively unaffected by Hudsonian overprint. One of these, the Ennadai Block (Lewry et al., 1985), outcrops in the extreme northwest corner of Manitoba and extends north of the Munroe map sheet into Nunavut.

The Cree Lake Ensialic Mobile Zone, which dominates the map area, has been regionally subdivided into six geological domains in Saskatchewan and Manitoba: the Mudiatik Peter Lake (present only in Saskatchewan) Wollaston, Seal River, Great Island and Nejanilini domains. The domains are defined by their cover rocks, the proportion or absence of basement rocks, and their dominant structural trends. Two of these domains, the Nejanilini and Seal River, occur in the Munroe Lake map area. They are separated from accreted juvenile Paleoproterozoic terranes to the south by the WathamanChipewyan batholithic belt, the remnant of a continental magmatic arc.

In the Munroe Lake map sheet (NTS 64O), the Nejanilini Domain comprises mainly foliated Archean granitic and granitoid rocks. The Seal River Domain contains large areas of Paleoproterozoic Wollaston Group sedimentderived gneiss, with only local exposures of underlying Nejanilini-type Archean granitoid basement rocks. In both domains, the basement and cover rocks are intruded by Paleoproterozoic plutons, which increase in volume to the east and southeast, in inverse proportion to the volume of exposed Archean rocks. The basement and cover rocks both contain upper amphibolite facies Paleoproterozoic metamorphic mineral assemblages produced during Hudsonian thermotectonism.

The Nejanilini Domain occupies the northeast quarter of the Munroe Lake map area. It contains mainly Archean, grey, foliated tonalite and granodiorite (unit Tn) and lesser amounts of hypersthene-bearing tonalite (unit Tx). An east-trending belt of metasedimentary gneiss of uncertain age transects the centre of the domain at Askey Lake. Late Paleoproterozoic granitoid rocks (units T, G, Gn and Gp) intrude the gneiss.

The grey tonalitic to granodioritic gneiss (unit Tn) forms clusters of low, flat outcrops that are typically light grey to buff on weathered surface and greyish white to pink on fresh surface. The pink colour is due to high potassiumfeldspar content, either as porphyroblasts or granitic lits. Unit Tn has a characteristically low radiometric signature, except for areas of reddish pink hematitic alteration and granitization, which have higher levels of radioactivity. Hypersthene-bearing tonalite (unit Tx) is characterized by a green colour on the fresh surface.

Unit Tn extends into Nunavut, where it is considered to be equivalent to the Archean Kasba grey gneiss (Eade, 1973; Loveridge et al., 1988). It is also likely equivalent to the grey tonalitic gneiss (unit Tn) in the Mudjatik Domain of the Kasmere Lake map area (NTS 64N). The Kasba grey gneiss, which has yielded U-Pb zircon ages of 3274 ± 18 Ma and 2777 +95/-66 Ma (Loveridge et al., 1988), is likely of mixed origin. At Askey Lake an undated sequence of semipelitic biotite gneiss (unit N), calc-silicate and marble (unit K), and quartzite (unit Q) occurs within the basement tonalite gneiss (unit Tn). Contacts between this undated sequence and the surrounding Archean grey gneiss (unit Tn) are poorly exposed, but the similarity of the sequence to lower parts of the Wollaston Group suggests that it could be Paleoproterozoic in age and lie unconformably on the grey tonalite (unit Tn).

The boundary between the Nejanilini and Seal River domains dips northeasterly and trends southeasterly from Corbett Lake, in the Munroe Lake map area, to MacLeod Lake in the Nejanilini Lake map area (NTS 64P). The boundary coincides, in part, with the north flank of the Munroe Lake synform where it truncates stratigraphic units of the Wollaston Group. This suggests that the boundary may be tectonic, with the older Archean grey gneiss thrust over the Paleoproterozoic Wollaston Group rocks to the south.

The western boundary between the grey gneiss (unit Tn) of the Nejanilini Domain and Wollaston Group sedimentary gneiss of the Seal River Domain is well imaged and constrained by aeromagnetic data. It coincides with a zone of

northerly to northeasterly structures approximately 22 km east of Nueltin Lake.

In the Munroe Lake map area, the Seal River Domain is composed mainly of Wollaston Group rocks, including semipelitic paragneiss (unit wN), calc-silicate rocks (unit wK), impure quartzite (unit wQ), conglomerate (unit wC) and meta-arkose (units wSb and wSn). These sedimentary rocks are considered to be Paleoproterozoic in age (Patterson and Heaman, 1991; Annesley et al., 1997; Fossenier et al., 1995).

The basal unit is a psammitic to semipelitic biotite gneiss (unit wN) with sporadic interlayers of calc-silicate rocks and impure quartzite. It commonly contains accessory garnet and cordierite, with sillimanite as a minor component. The gneiss displays a well-developed metamorphic layering defined by alternating grey to dark grey, biotite-rich layers (1100 cm thick) and white to cream, medium-to coarse-grained granitic *lits*. The metamorphic layering is intruded by white, pegmatitic, boudinaged sills of granite. Areas underlain by psammitic to semipelitic gneiss of unit wN coincide with areas of low magnetic intensity (20002200 gammas).

A compositionally variable sequence of calc-silicate rocks (unit wK), interpreted to have been deposited in a platformal setting (Weber et al., 1975a) overlie garnet-biotite gneiss (unit wN). Regionally, in the Wollaston and Seal River domains, the calc-silicate rocks occur as bodies of variable size and varied lithological relationships (Schledewitz, 1986). They typically comprise amphibole-plagioclase-guartz layers with discontinuous diopside ± scapolite layers and carbonate lenses. Other common rock types in this unit are quartz ± tremolitebearing marble and an albite-pyroxene rock. The marble is interlayered with calc-silicate rocks at the southeast end of Munroe Lake where it forms layers 5 to 100 m thick between widely spaced laminae of more resistant, grey-green calc-silicate. The albite-pyroxene rock forms small, sparse outcrops that can rarely be traced for more than a kilometre along strike. They weather pale pink to white, with discontinuous, crudely aligned, green to dark green layers. Their principal minerals are albite and augite to aegirine-augite, with minor amounts of quartz, ilmenite and sphene. Unit wK calc-silicate rocks are of economic interest because of local high concentrations of uranium, rare occurrences of cobalt-nickelbearing minerals and trace amounts of gold to the west in the Kasmere Lake area and in Saskatchewan. Chalcopyrite and sphalerite occur in the calc-silicate rocks on the south edge of the Munroe Lake synform (Schledewitz, 1986).

Impure quartzite (unit wQ) is spatially associated with calc-silicate rocks (unit wK) in the Munroe Lake area. They consist of glassy quartzite to impure quartzite with discontinuous layers of calc-silicate rocks. The unit is interpreted to be part of a shallow-water facies that included calcareous sandstone with limey mud interlayers. It is a transitional facies into units wSb and wSn.

Biotite psammite gneiss (unit wSb) with local conglomerate lenses (unit wC), the latter not exposed in mappable units in the Munroe Lake area, is a regionally discontinuous unit overlying the calc-silicate rocks (unit wK). Units wSb and wC likely reflect a change from a platform stage to one of tectonic disturbance. They are interpreted to result from local areas of uplift coinciding with areas of subsidence.

The uppermost unit in the Wollaston Group is exposed most prominently on Munroe Lake and comprises an areally extensive, pink-weathering, magnetiferous, arkosic (± hornblende ± diopside) gneiss (unit wSn). Where least recrystallized, the meta-arkose displays discontinous alternating pink and grey layers, but normally this rock is coarsely recrystallized with numerous pink and white granitic lenses comprising up to 40% of many outcrops. Structural Geology

The Seal River Domain is characterized by large-scale, elongated dome structures cored by Archean and Proterozoic granitoid rocks and synformal basin structures occupied by arkosic rocks (unit wSn) or calc-silicate rocks (unit wK). These dome-and-basin structures have been interpreted (Schledewitz, 1989) to be due to the interference of early east-southeast-trending structures (F,) with superimposed narrow, northeast-trending

Rocks of the Wollaston Group at Munroe Lake are deformed by large, east- to southeast-trending, upright F, folds, the limbs of which are commonly truncated by shallow-dipping, east-trending faults. The F, Munroe Lake synform is 34 to 43 km wide and 55 km long, and trends southeasterly from Booth Lake to Munroe Lake. It is cored by arkosic gneiss (unit wSn), which is best exposed on the margins of the structure and poorly exposed in its centre. A corresponding F, antiform to the south is cored by hybridized, highly reworked and intruded Archean rocks (units Gh and Gn) and Hudsonian plutons (units G and Gp). Two east-trending, shallow north-dipping, annealed cataclastic zones in granitic rocks are possibly related to development of the Munroe Lake synform. The synform is offset by a system of northeast-trending shear zones. These northeast-trending structures are interpreted to be a part of the Fergus River Shear Zone that has been traced from the east side of Munroe Lake southwest for approximately 160 km. To the northwest, the Monroe Lake synform is truncated by the Topp Lake pluton (unit Gp). A northeast-trending fold, paralleling the northeast-plunging north contact of the Topp Lake pluton, crossfolds the F, Munroe Lake synform, forming a saddle-shaped structure that is cored by semipelitic to pelitic garnet-biotite gneiss (unit wN).

An east-trending synformal structure, south of Nueltin Lake, that lies on the northwest side of the saddle structure is also cored by basal Wollaston Group semipelitic to pelitic gneiss (unit wN). This strongly suggests that the Wollaston Group rocks were recumbently folded prior to formation of this east-trending synform. The south limb of the synform is underlain by magnetiferous arkosic gneiss (unit wSn), calc-silicate (unit wK) and biotite psammite gneiss (unit wSb). The north limb of this approximately 40 km wide synform coincides with a 50 km long magnetic lineament that is underlain by magnetiferous arkosic gneiss and calc-silicate rocks intruded by pyrrhotite-bearing amphibolite (unit B) after gabbro (Peck et al., 1994). The highly varied magnetic signature of the semipelitic to pelitic gneiss in the core of the synform is anomalous compared to semipelitic to pelitic gneiss units (unit wN) elsewhere in the area. The latter have characteristically low aeromagnetic signatures, suggesting that the semipelitic to pelitic gneiss, in the core of the synform, likely forms a thin cover overlying more magnetiferous arkosic gneiss. This would indicate that structural inversion of stratigraphy occurred prior to formation of the open synform, with older psammitic to semipelitic rocks overlying younger arkosic rocks. The relationship of this synform, with its inverted stratigraphy, to the Munroe Lake synform is unresolved.

Economic Geology

The Munroe Lake area was flown on a line spacing of 5 km, using a high-sensitivity gamma-ray spectrometer, as part of the federal-provincial Uranium Reconnaissance Program (URP). This survey was carried out in 1975 and 1976 by the Geological Survey of Canada, with participation from Manitoba. The survey included concurrent lakecentre sediment sampling, with an approximate density of one sample per 13 km². Lake sediment samples were analyzed for U, Zn, Cu, Pb, Ni, Co, Ag, Mn, Fe, Mo, As, Hg and loss-on-ignition.

The URP, which was intended to define broad regions containing higher-than-average uranium contents, delineated such zones of uranium enrichment in the Kasmere Lake map area (NTS 64N) and, to a lesser extent, the Munroe Lake map area (NTS 64O). Radiometric anomalies were observed within and on the margins of the Topp Lake pluton and along the southern edge of the Munroe Lake synform. The anomalies on the south edge of the Munroe Lake synform correspond to synmetamorphic Hudsonian tonalite (unit T) and small bodies of late tectonic, uranophane-bearing, Hudsonian granite pegmatite (unit Gn). Subsequent to the release of the URP data, ground follow-up was carried out by mining companies, the Manitoba Mineral Resources Division and the Geological Survey of Canada. This activity is summarized in Schledewitz (1986) and Soonawala (1980).

Both base-metal and uranium occurrences are present in Wollaston Group calc-silicate rocks. Copper-sulphide minerals (chalcopyrite and bornite) were observed in these rocks in the Seal River Domain on the south edge of the Munroe Lake synform (Schledewitz, 1986). A sedimentary origin is the preferred interpretation for the base-metal occurrences (Weber et al., 1975a). Rocks of the Courtenay LakeCairns Lake fold belt that lie along the eastern edge of the Wollaston Group in Saskatchewan also contain a number of base-metal occurrences interpreted to fit a sedimentary exhalative origin (Delaney et al., 1997). These mineral showings and deposits occur sporadically over a distance of 280 km.

Regional Tectonic Synthesis

Rocks of the Munroe Lake map area are part of the Trans-Hudson Orogen and were involved in the Paleoproterozoic tectonics and thermotectonism that dominated this orogen. Rocks of the area evolved as a terrane of Archean basement rocks and Paleoproterozoic sedimentary basins comprising the foreland zone of the

The Trans-Hudson Orogen extends for approximately 5000 km from the north-central United States, through the Churchill Province in Canada and ultimately to Greenland (Lewry and Collerson, 1990). In Manitoba and Saskatchewan, two major elements of the Trans-Hudson Orogen, the Cree Lake Ensialic Mobile Zone of the Archean Hearne Province and the juvenile Paleoproterozoic arc-related terranes, are separated by the Andeantype Wathaman Chipewyan continental magmatic arc. The latter has a minimum strike length of 900 km and a width

Radiomentric Dating of Pre-Hudsonian Rocks

1. Pre-Hudsonian sedimentation:

Radiometric dating has allowed delineation of Archean to Paleoproterozoic pre-Hudsonian sedimentary and igneous rocks that were subsequently involved in several discrete tectonic events resulting from multistage subduction and collision processes:

> - Montgomery Group and Hurwitz Group Kinga and Padlei formations, and the overlying Ameto Formation (Nunavut), range in age from 2400 to 2100 Ma (Patterson and Heaman, 1991), and possibly represent cratonic-basin sedimentation (Aspler and Bursey, 1990). - Wollaston Group Courtenay Lake Formation (Saskatchewan), with a minimum age of 2100 Ma (Annesley et al., 1997), unconformably overlies garnet-biotite gneiss (age uncertain).

Wollaston Group calc-silicate rocks (Manitoba) overlie garnet-biotite gneiss (age uncertain). Pre-Hudsonian mafic igneous and volcanic rocks with geochemistry that favours a continental-rift setting: Mafic sills and flows, dated at 2094 +26/-17 Ma (Patterson and Heaman, 1991), intrude Hurwitz Group lower Ameto Formation and underlying Kinga Formation (Nunavut). - Mafic pillowed and massive flows in the Courtenay Lake Formation (Saskatchewan) have a minimum age of

2100 Ma (Fossenier et al., 1995; Annesley et al., 1997). This mafic igneous activity at ca. 2100 Ma may be related to opening of the Manikwan Sea (Patterson and Heaman, 1991; Aspler and Bursey, 1990). 3. Synorogenic magmatism related to the Trans-Hudson Orogen was reported by Baldwin et al. (1987) in felsic volcanic rocks at Lynn Lake as early as 1.91 Ga. In the Munroe Lake area, units deposited within the Trans-Hudson Orogen are likely limited to postCourtenay Lake formation (Wollaston Group), postAmeto formation (Hurwitz Group) and the overlying Kiyuk Group.

Hudsonian Collisional Tectonics

The entire Paleoproterozoic cover sequence, juvenile synorogenic volcanic and intrusive rocks, and the Archean 'basement' were incorporated into the Trans-Hudson Orogen as follows:

1. Possible early arc-continent collision at 1888 to 1860 Ma (Bickford et al., 1990): - Deformation of cratonic basin and (?)passive margin successions into fold and thrust belts, overthrusting of - Deformation and metamorphism in the Rottenstone Domain (Saskatchewan; minimum age 1867 ± 8 Ma on synkinematic tonalitic gneiss that postdates some phases of deformation [Lewry et al., 1987]); - Accretion of a complex collage of Paleoproterozoic volcanic island arc, back-arc to ocean-floor rocks and

intrusive rocks (the Rottenstone Domain and La Ronge belt in Saskatchewan and the Southern Indian, Lynn Lake and Leaf Rapids domains in Manitoba) to the RaeHearne craton, possibly via southeast-directed subduction (Bickford et al., 1990). 2. Emplacement of the WathamanChipewyan plutonic complex between 1865 and 1855 Ma (Van Schmus and Schledewitz, 1986; Meyer et al., 1992), possibly as a continental-margin magmatic arc related to a northerly subduction flip. This magmatic arc lies between the Archean RaeHearne craton and an accreted terrane consisting

of the Rottenstone Domain, the Southern Indian Domain, and the La Ronge and Lynn LakeLeaf Rapids greenstone belts. The magmatic arc effectively stitches the craton and the Paleoproterozoic accreted-arc terranes. 3. Continent-continent collision, deformation and emplacement of nappe sheets (18301800 Ma; Bickford et al., - At 1855 to 1800 Ma (Stauffer and Lewry, 1993), the northwest margin of the Wathaman Chipewyan magmatic arc was deformed along the Needle Falls Shear Zone (an oblique collision structure), along its boundary with

the Wollaston Domain and along shear zones at the boundary with the Peter Lake Complex (Reindeer Lake, - At ca. 1820 to 1812 Ma, the Wollaston Group, the underlying Archean basement and early-formed

Hudsonian intrusions were affected by peak thermal metamorphism (Annesley et al., 1997) that was synchronous with the age of peak metamorphism in the internal juvenile zone of the Trans-Hudson Orogen. 4. Late to postcollisional deformation: - Ductile/brittle deformation continued along the Needle Falls Shear Zone and the mostly sheared boundary

- Folds tightened and ductile/brittle shearing occurred in the Wollaston and Mudjatik domains. - Northeast-, north- and east-trending ductile/brittle shear zones were superimposed on the east-trending structures of the WathamanChipewyan magmatic arc, Seal River Domain and Nejanilini Domain.

of the Peter Lake Complex (Ray and Wanless, 1980; Van Schmus et al., 1987).

5. Postcollisional granite bodies (1753 +3/-2 Ma; Loveridge et al., 1987), characteristically fluorite-bearing and with rapakivi texture and high uranium background, occur most commonly in parts of the Hearne Province where negative gravity anomalies exceed -60 mGal (Schledewitz, 1986).

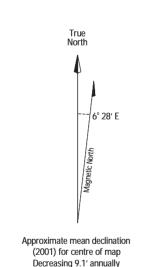
> Synoptic geology by D.C.P. Schledewitz Compilation by D. Lindal and D.C.P. Schledewitz

Digital CAD drafting by M. McFarlane GIS cartography by L. Chackowsky

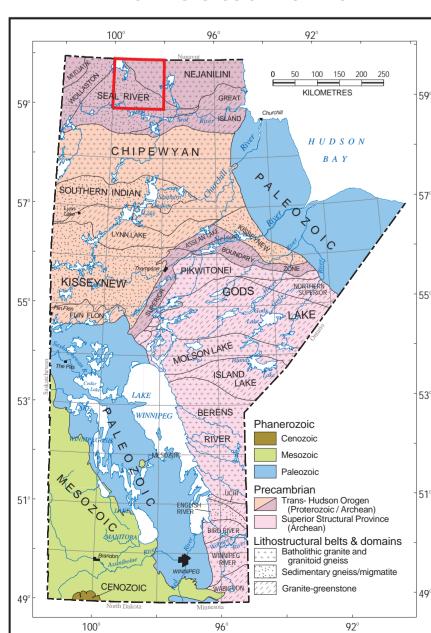
Suggested reference:

Manitoba Industry, Trade and Mines 2001: Munroe Lake; Manitoba Industry, Trade and Mines, Geological Survey, Bedrock Geology Compilation Map, NTS 64O, scale 1: 250 000.

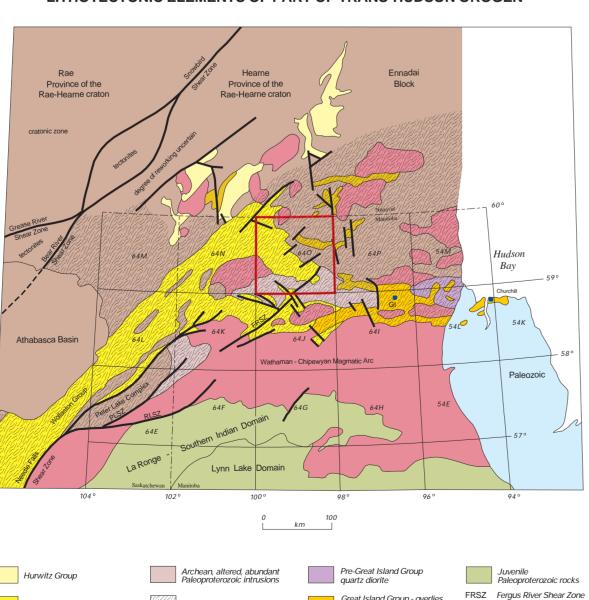
Every possible effort has been made to ensure that the information presented on this map is accurate. However, the Province of Manitoba and Industry, Trade and Mines do not assume liability for any errors that may occur. References are included for users wishing to verify

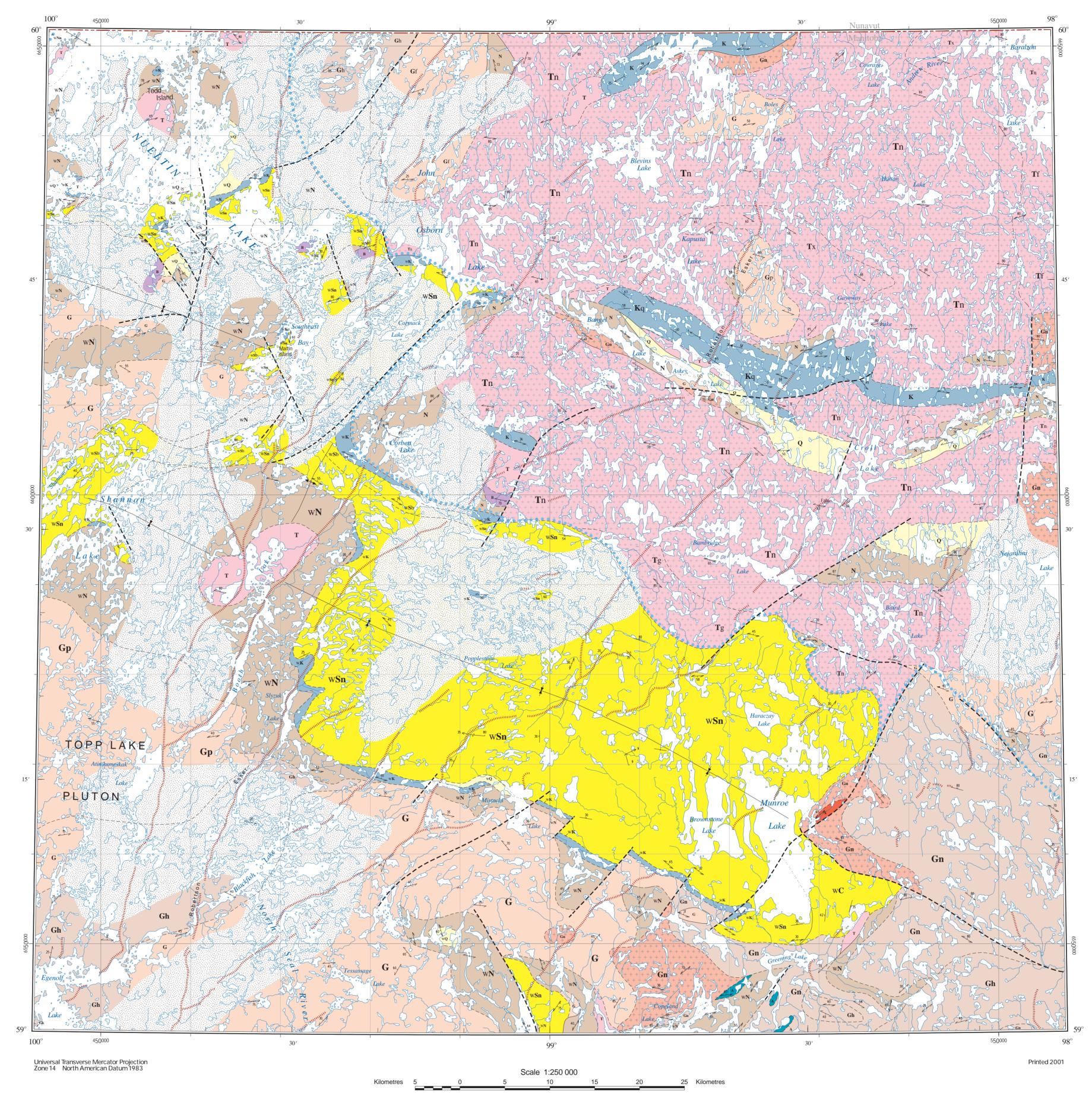






LITHOTECTONIC ELEMENTS OF PART OF TRANS-HUDSON OROGEN





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Lewry, J.F. and Collerson, K.D.

PLSZ Parker Lake Shear Zone

RLSZ Reilly Lake Shear Zone

GI Great Island

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SYMBOLS

———— — Fault (defined, interpreted) Axial trace of major fold (antiform, symform) Bedding, tops known (inclined, vertical, overturned)

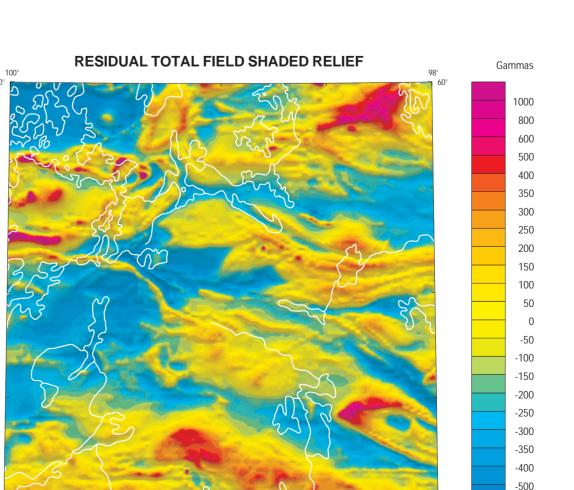
Bedding, tops unknown (inclined, vertical, dip unknown) Layering and foliation (inclined, vertical, dip unknown) Pillows, inclined (tops known, tops unknown)

Schistosity (inclined, vertical, dip unknown) Cataclastic foliation (inclined) Fracture cleavage-strain slip cleavage (inclined) Mineral lineation

Minor fold axis (inclined)

Minor fold axial plane (inclined) Minor fold symmetry (asymmetrical Z-shaped, S-shaped; symmetrical)

Domain boundary



BEDROCK GEOLOGY COMPILATION MAP SERIES

WOLLASTON DOMAIN

Wollaston Group

SEAL RIVER DOMAIN

Post-Hudsonian

Wollaston Group

Conglomerate

Calc-silicate rocks

WQ Impure quartzite to quartzite

Proterozoic and/or Archean

NEJANILINI DOMAIN

Archean

Proterozoic

Archean

granodioritic gneiss

Semipelitic paragneiss to metatexite + garnet with tonalite

Pink and/or white granite pegmatite with grey tonalitic to

 \pm pegmatite; **Gp** – pink porphyritic granite

Hybrid granite; **Gn** – hybrid granite gneiss

biotite psammite gneiss \pm calc-silicate lenses

Metagabbro, in part noritic; metabasic rocks

Semipelitic paragneiss to metatexite + garnet

Foliated alaskite with hybrid granite and pink aplite \pm

Granite; Gp – porphyritic granite; Gf – pink fluorite bearing

gneiss; Gn – granite \pm aplite \pm pegmatite, hybrid granite with

Calc-silicate rocks; $\mathbf{K}q$ - with marble \pm quartz \pm tremolite;

Granite, massive to foliated with grey tonalitic to granodioritic

older grey tonalitic to granodioritic gneiss and foliated to

lineated biotite granodiorite to tonalite

Impure quartite to quartzite

Tonalite, cordierite bearing ± tourmaline

Metagabbro, in part noritic; metabasic rocks

Foliated to lineated biotite granodiorite to tonalite

GEOLOGICAL DOMAINS

Grey tonalitic to granodioritic gneiss; Tx - hypersthene

with foliated to lineated biotite granodiorite to tonalite

tonalite; Tg – grey tonalitic to granodioritic gneiss with younger granites; Tf – grey tonalitic to granodioritic gneiss

NEJANILINI DOMAIN

SEAL RIVER DOMAIN

Foliated to lineated biotite granodiorite to tonalite

Tonalite, cordierite bearing ± tourmaline

Granite, medium to coarse grained, massive to foliated \pm aplite

Meta-arkose; derived arkosic gneiss with metatexite; wSb -

Proterozoic

Proterozoic

Munroe Lake NTS 640

INDEX MAP AND MAJOR TECTONIC DIVISIONS

