The Cross Lake area (NTS 63I) is underlain by rocks of the Archean Superior Province. The area is subdivided into the Molson Lake domain, in the southern half of the map area, and the Gods Lake and Pikwitonei domains in the northern half and northwestern corner, respectively.

The Molson Lake domain comprises dominantly granitoid metaplutonic rocks and minor amphibolite grade supracrustal rocks. The northern boundary of the Molson Lake domain is defined by the southern margin of the narrow greenstone belt that extends from Aswapiswanan Lake (in NTS 53L) through Logan Lake, Robinson Lake, Butterfly Lake and along the southern margin of the Cross Lake belt. Grey to pink tonalite to granodiorite (T) makes up much of the central and southern part of the

Molson Lake domain in 63I. Porphyritic and medium- to coarse-grained granodiorite (G) is the dominant rock type in the northern part of the Molson Lake domain in NTS 63I. Granodiorite and tonalite likely represent Granitic rocks (G) are widespread in the Molson Lake domain and are similar to 2663 Ma Kenoran

granites (Turek et al., 1989) and pegmatites in the English River Subprovince of southeastern Manitoba and pegmatitic granites in the Bird River belt. The granitic rocks and associated metasomatic rocks (alaskites) and pegmatites, likely represent partial melts generated during high grade metamorphism. One sample of granite from the western part of Molson Lake has yielded a U-Pb age of 2680 Ma (Krogh et al., 1985). The granitic rocks (G) are locally slightly enriched in uranium, with airborne uranium anomalies of >2 ppm eU (equivalent uranium) occurring in several areas (Soonawala, 1979, Weber et al., 1982).

Supracrustal rocks - metabasalt (V), amphibolite(Af) and intermediate tuffaceous rocks (V) form isolated lenses between Bolton Lake (in NTS 53L) and Molson Lake, and at Little Playgreen Lake. They are interpreted as "roots" of a possibly older eroded greenstone belt, similar to supracrustal enclaves in plutonic rocks of the Winnipeg River Subprovince (Beakhouse, 1992). Through the central part of the Molson Lake domain, the supracrustal rocks typically comprise fine grained amphibolites that locally preserve remnant pillow

Monzodiorite (Zx) occurring along the eastern margin of 63I was dated at 2705 ± 6 Ma (Turek et al., 1985). This unit is interpreted as the deeper crustal level intrusive equivalent of shoshonitic volcanic rocks preserved in the Cross Lake and Oxford Lake areas. Gabbroic dykes (B), generally striking east-northeasterly, occur between Molson Lake and Joint

Lake. They are similar, in composition, igneous textures and structures, to dykes of the Molson swarm, but are weakly deformed and have been recrystallized under amphibolite facies conditions. They have been intruded by granitoid rocks of unit G and , therefore, are considered to be Late-Archean (2.7-2.6 Ma) in age. The Cross Lake greenstone belt is flanked by the Molson Lake domain to the south and a largely metaplutonic terrane of the Gods Lake domain to the northwest. The northern contact is a major northeasttrending fault system that records dextral strike slip and vertical motion indicative of relative uplift of the northwest side (Breedveld, 1988). The southern contact is a much broader zone of deformation in which a number of east-southeast-trending dextral fault zones imbricate supracrustal rocks of the Pipestone Lake and

records vertical motion indicative of south side (Molson Lake domain) up (Breedveld 1988). Metavolcanic rocks and subordinate metasedimentary rocks (PLV) of the Pipestone Lake Group are the oldest rocks recognized in the Cross Lake greenstone belt. They occur as homoclinal sequences up to 1400 m thick within fault-bounded blocks. The metavolcanic rocks comprise subaqueous flows, dominantly pillow basalts with subordinate massive flows that average 2 - 15 m, thick but ranging from 0.5 to 110 m in thickness. Chemically, the metavolcanic rocks are dominantly high-magnesium tholeite with subordinate komatiite (Corkery 1985). Basalts are typically aphyric, but plagioclase phyric flows occur in the upper part of the stratigraphic sequence. Thin sequences of laminated argillite and mafic greywacke and rare laminated

Gunpoint groups and, to a lesser extent, Molson Lake domain plutonic rocks. This dextral strike slip zone

chert-magnetite iron formation occur sporadically throughout the Pipestone Lake Group. Within the greenstone belt early intrusive rocks are either contemporaneous with, or postdate, the Pipestone Lake Group but clearly predate the Cross Lake Group. Units contemporaneous with the Pipestone Lake Group include: medium- to fine-grained gabbro dykes and sills; layered anorthositic gabbro (PLB) and anorthosite (PLA) (Pipestone Lake anorthosite complex); and a layered ultramafic sill (PLU). Quartz-feldspar porphyritic rhyodacite (GPR) intrudes the Pipestone Lake Group and is contemporaneous with the Gunpoint Group. Early tonalite to granodiorite bodies intrude the Pipestone Lake Group and contain xenoliths of Gunpoint Group sedimentary rocks. Clasts derived from the tonalite occur within Cross Lake Group conglomerates. Near the town of Cross Lake, conglomerates unconformably overlie the early tonalite, which has a U-Pb zircon age of 2712 ± 15 Ma (Ermanovics and Wanless, 1983).

The Gunpoint Group unconformably overlies layered gabbro and basalt of the Pipestone Lake Group and is unconformably overlain by sedimentary rocks of the Cross Lake Group. It comprises felsic volcaniclastic units (GPV), clast-supported conglomerate (GPC), sandstone (GPW), siltstone and mudstone (GPS) and subordinate ironstone that occurs within a structural block in the north-central Cross Lake area.

The Gunpoint Group forms a generally fining-upward sequence of subaerial-fluvial sedimentary rocks with interbedded felsic volcanic rocks. Thickly bedded, clast-supported conglomerates, interpreted as subaerial fan deposits, predominate in the lower part of the sequence. However, in several locations mafic mudstone and siltstone interbedded with oxide-facies iron formation form the base of the sequence. The conglomerates are overlain by trough-crossbedded lithic wackes, generally interbedded with matrix-supported conglomerate. Bedforms are indicative of a fluvial environment. The wackes are overlain by a 1 - 3 m thick feldspar porphyritic fragmental rhyodacite flow, which in turn is overlain by thickly bedded conglomeratic debris flows or sedimentary breccia up to 100 m thick. Conformably overlying the breccia and/or conglomerate is a 220 m thick sequence of wavy and flaser bedded (5 - 15 cm) lithic wacke. Throughout the Gunpoint Group, aphyric to quartz-feldsparphyric pyroclastic rocks of rhyodacite composition are interbedded with or form a detrital component in the sedimentary rocks.

A period of deformation affected the Gunpoint Group prior to the deposition of the Cross Lake Group. This is indicated by a series of northeast-trending folds that are truncated by the unconformity between the Gunpoint and Cross Lake groups.

The basal conglomerates (cLC) of the Cross Lake Group unconformably overlie massive and pillowed flows of the Pipestone Lake Group, thinly bedded siltstone of the Gunpoint Group and an early tonalite (TT -"Town Tonalite"), which intrudes the Pipestone Lake Group and contains xenoliths of the Gunpoint Group. The Cross Lake Group comprises alluvial-fluvial sedimentary rocks and subordinate felsic and mafic volcanic rocks, and is locally overlain by marine sedimentary rocks (cLW). The sequence generally fines upward. The lower part the sequence consists of thickly bedded unso by coarse clastic fluvial deposits that range up-section from thickly bedded, crossbedded clast-supported conglomerate through crossbedded matrix-supported conglomerate (cLC) to trough-crossbedded pebbly sandstone (cLS). The upper portion of the sequence consists of trough-and planar-crossbedded sandstone, thinly bedded crossbedded sandstone (cLW), siltstone and graded siltstone and argillite (cLP). Massive and pyroclastic shoshonitic basalt flows and reworked pyroclastic flows occur in the upper

part of the fluvial sequence. These flows also form a significant detrital component in the thinly bedded sedimentary rocks at the top of the exposed section of the Cross Lake Group. The eastern extension of the Cross Lake greenstone belt continues through Robinson and Logan lakes. A branch of the greenstone belt extends from Hairy Lake in a southwesterly direction. The supracrustal rocks in the Robinson-Logan lakes area include abundant mafic massive and pillowed flows, related gabbro

The most eastern bay of Walker Lake is underlain by the western termination of the Carrot River greenstone belt. It consists of metavolcanic (A) and metasedimentary rocks (W). Metavolcanics rocks are dominant and comprise pillowed and massive basaltic flows and hypabyssal sills. Isolated outcrops of serpentinized peridotite occur in close vicinity of the metavolcanic rocks. The metasedimentary sequence consists of fine- to very fine-grained rhythmically layered rocks interpreted as calcareous greywacke-subarkose and siltstone. Minor polymictic conglomerate and volcanogenic wacke are also part of the sequence.

(locally glomeroporphyritic), minor intermediate volcanic rocks, greywacke, conglomerate and magnetite iron

Late granitic intrusive rocks (Gn, Gp and Gr) occur within the Cross Lake greenstone belt and within the older gneissic terranes that flank the belt. Rare element-enriched and simple pegmatite dykes (X) are common throughout the central and western regions of the Cross Lake area. Anderson (1984) divided these pegmatites into four series based on chemical and textural variations. The mineralogically simple dykes appear to be products of migmatization in regions of highest metamorphic grade in the western part of the Cross Lake area. The other three series are interpreted as differentiates of separate unidentified granitic bodies. The rare element-enriched pegmatites () occur in belts parallel to major block boundaries. They postdate at least one major folding event but are themselves deformed and foliated. Many dykes show textures characteristic of crystallization in an active ductile shear environment. Pegmatites in the Cross Lake area are enriched in lithium, niobium, tantalum and may contain spodumene, tourmaline, pale green muscovite, beryl, apatite, traces of Nb Ta oxides, sicklerite and triplite (Lenton and Anderson, 1983).

Most of the N-E arm of Cross Lake is underlain by granodiorite gneiss (Gn). This unit forms medium grained, weakly to strongly foliated, schlieric to nebulitic to stromatic biotite ± hornblende gneiss. Tonalite gneiss (Tn) prevails in the area of the Wapaskathakow Narrows and east of it. Associated migmatites (agmatite, schollen, stromatic, folded and ophthalmic) are developed as zones of variable width in both types of

The Walker Lake - Fairy Lake area is dominated by two granite orthogneiss units (G): 1) medium grained, weakly to strongly foliated, biotite granite (Gn) (granodiorite); and 2) weakly foliated, porphyritic granite gneiss (Gp). Both units are generally homogeneous but contain sporadic mafic inclusions and schlieren. ntermediate gneiss (N) comprises migmatitic rocks and inclusion-rich zones. The inclusions are dominantly amphibolite, migmatitized amphibolite, migmatite and schlieric gneiss.

The Lawford Lake area is underlain by a heterogeneous gneiss-migmatite assemblage (T, G), which includes weakly to strongly foliated gneiss and stromatic, folded, agmatitic and nebulitic migmatite. Compositionally, the assemblage ranges from melanocratic hornblende tonalite to leucocratic biotite granodiorite-granite. Tonalitic rocks are more abundant than granodiorite and granite. Pegmatite, aplite and leucogranite mobilizates are ubiquitous. Rocks of the Pikwitonei domain in NTS 63I are similar to those in NTS 63P (Sipiwesk) and record

higher metamorphic grades (granulite facies) than the adjacent Archean domains. The principal rock type is enderbitic gneiss with mafic and ultramafic inclusions of various sizes. Mafic rocks are locally pillowed and contain orthopyroxene-bearing enderbitic mobilizate. This observation, coupled with the local development of fragmental intermediate metavolcanics, suggests that parts of the Pikwitonei domain represent upper crustal

Dykes of the Molson swarm (Scoates and Macek, 1978) occur throughout the map area. The type locality is the eastern part of Molson Lake, where three en echelon dyke complexes are well exposed on several islands and the north shore. Major Molson dykes also occur at Pipestone Lake and Cross Lake. A Cross Lake dyke was dated as 1884 ± 2 Ma (Heaman et al., 1986). The Molson dykes in NTS 63I are gabbroic to (subordinate) tonalitic in composition; ultramafic dykes have also been observed.

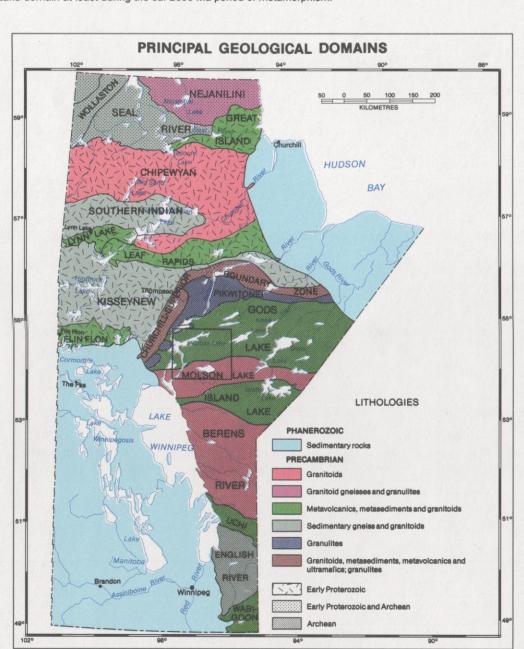
Tectonic synthesis

Recent studies of the Cross Lake greenstone belt and adjacent metaplutonic terranes indicate a complex history of cratonization that spans 110 million years from about 2750 Ma to 2640 Ma in the northwest Superior Province (Corkery et al., 1992). Some insight into the pre cratonization history of the area is provided by rocks from the sialic Molson Lake domain, the granite-greenstone Gods Lake and Island Lake domains, the Pikwitonei domain and the ocean-floor Pipestone Lake Group.

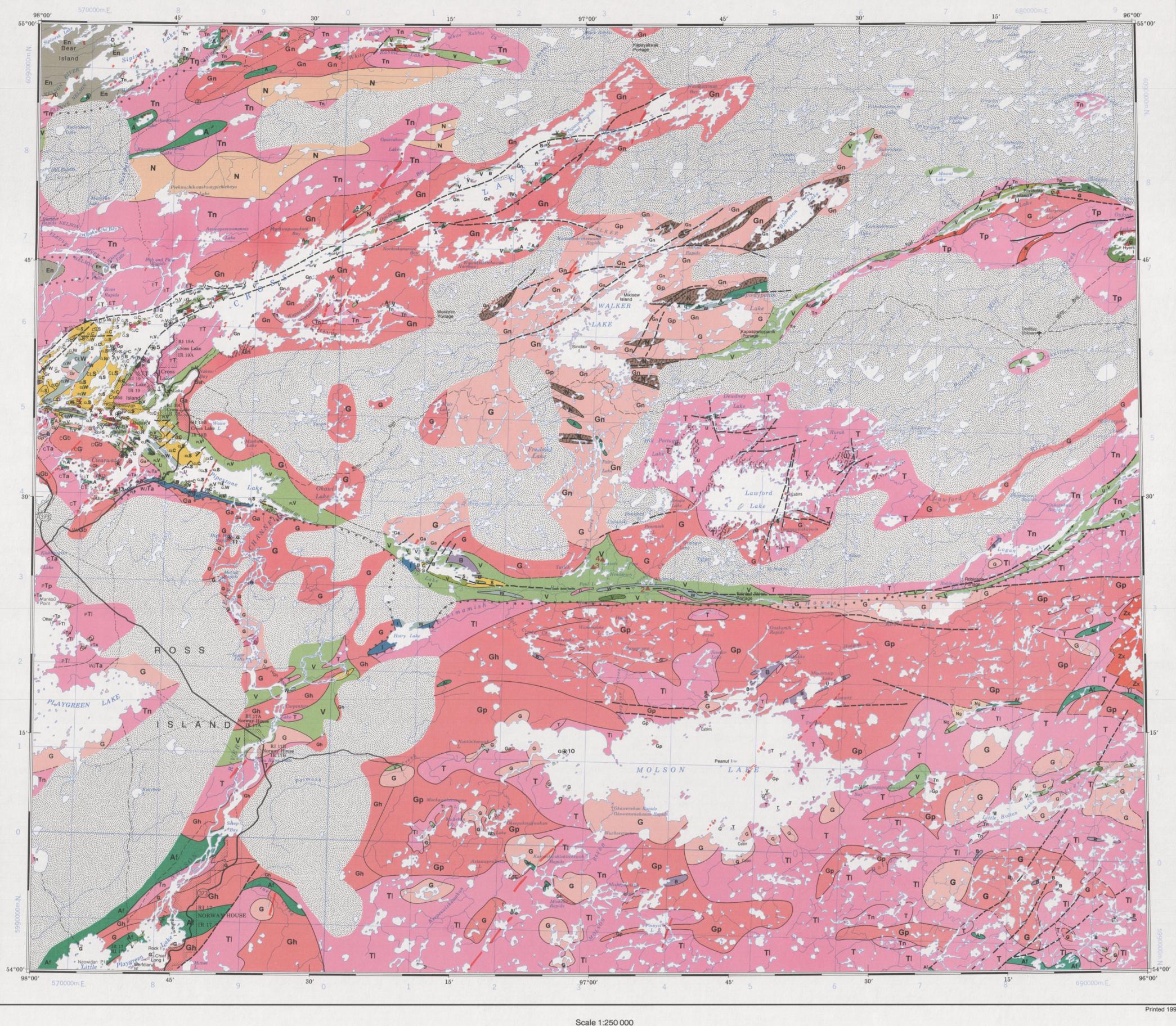
The Molson Lake domain exposes a deeper level of the Superior Province crust relative to the adjacent Gods Lake and Island Lake domains. The boundary between The Cross Lake-Red Sucker Lake greenstone belt and the Molson Lake domain (to the south) is similar to the major domain (or Subprovince) boundary between the Bird River greenstone belt and the Winnipeg River plutonic domain to the south. In both areas the domain boundary is characterized by supracrustal rocks juxtaposed against a large domain of higher metamorphic grade granitoid rocks that involve voluminous late tectonic granitoid melts. In Ontario, zones with rare earth element pegmatites have been interpreted as typifying major subprovince or terrane boundaries that acted as loci for the preferential transport of highly differentiated melts" (Williams et al., 1992, Geology of Ontario, p. 1290)."

Evidence from the Cross Lake area indicates that the northwest portion of the Superior Province has remained a stable craton since 2640 Ma, and largely escaped the effects of the collision between the Superior Province and the Trans Hudson Orogen at approximately 1.8 Ga (Machado et al. 1990). The only manifestations of this event in the Cross Lake area are: (1) intrusion of Molson dykes; (2) minor brittle deformation along restricted northeast-trending zones; and (3) isotopic rejuvenation of K/Ar and Rb/Sr in biotite and hornblende related to tectonic activity (Ermanovics and Wanless 1983).

Detrital zircons in the Cross Lake Group record ages of 3547 Ma to 2709 Ma and indicate derivation from a continental land mass with a long and complex history (Corkery et al., 1992). Several other studies (e.g. Mezger, 1989; Machado et al., 1990; Turek et al., 1986; Corfu and Wood, 1986; Corfu and Ayres, 1984) provide evidence for pre-2800 Ma sialic crust in the northwest Superior Province. The location and extent of this older crust and its relationship to the Cross Lake greenstone belt is unclear. The 2839 Ma inherited grain in the Clearwater Bay batholith (Corkery et al., 1992) shows that pre greenstone crust was present in the Molson Lake domain at least during the ca. 2690 Ma period of metamorphism.



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



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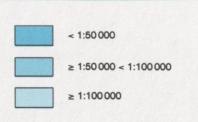
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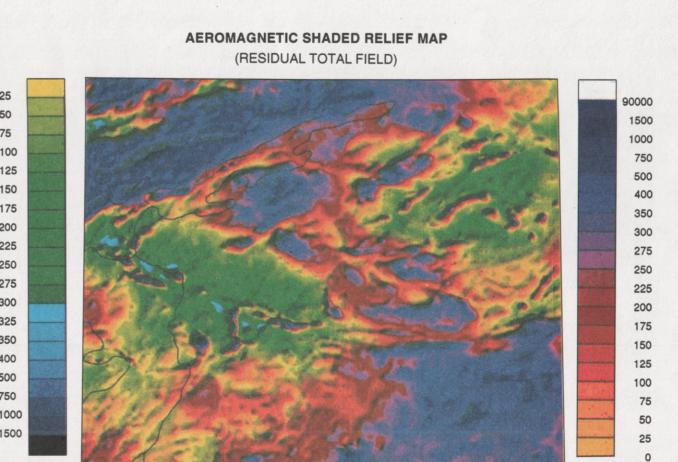
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In addition, recent unpublished data have been incorporated.

GODS LAKE DOMAIN MOLSON LAKE DOMAIN

MAJOR PRECAMBRIAN DOMAINS



SYMBOLS Geological boundary (approximate, interpreted) Area of little or no outcrop 1 ★ Sample locality for U-Pb age determination Rare-element-enriched pegmatite Area of extreme deformation and recrystallization MINERAL OCCURRENCES 1 A Pipestone Lake Jobin-Bevans, et al., 1995 M.I. 63I/7¹; Tanton, 1937 3 🔺 O'Day...... ..6030315/630250...... AuM.I. 63I/6, 7 AU1; Tanton, 1937M.I. 63I/7 CU1; Bell, 1962 5 🛕 Oxo......M.I. 63I/16 ZN1; Barry, 1960

PROPERTY STATUS

▲....important mineral occurrence

Mineral Inventory card, Manitoba Energy and Mines

LEGEND

PRECAMBRIAN

SUPERIOR PROVINCE

Pegmatitic granite and pegmatite

Ga - augen granite

augen granodiorite

2712 ± 5 Ma; 5: 2719 ± 1 Ma

Granite, porphyritic granite, leucogranite; Gn

granite to granodiorite gneiss; locally inclusion bearing; Gp - porphyritic granite-granodiorite; 2:

2718 ± 1 Ma; Gr - seriate leucogranite; 3: 2653 ± 3 Ma;

Granodiorite, gneissic granodiorite ± hornblende,

locally porphyritic; G (patterned) - migmatite; Gn -

Tonalite-granodiorite ± hornblende; T (patterned) -

migmatite; Tn - gneissic tonalite ± hornblende; Tp -

granodiorite (Clearwater Bay complex); ET

tonalite-granodiorite-granite (Eves Rapids

complex); TT - leucotonalite ("Town Tonalite"); 4:

Granitized gneisses, mainly derived from Tn and

Multicomponent migmatite: granite and granite

gneiss with inclusions of amphibolites and locally,

Calcareous greywacke interlayered with subarkose

Quartz feldspar porphyry, feldspar porphyry

vroxenite, gabbro and sediments

Sandstone and pebbly sandstone

Chloritoid schist, carbonate bearing

Amphibolite; Ag - garnet-bearing amphibolite

Felsic volcanic and related sedimentary rocks

Metabasalt, shoshonitic; massive and fragmental

Sandstone ± muscovite, arkosic sandstone, quartz-

Polymictic conglomerate; clast supported and matrix supported; 6: 2709 ± 3 Ma; 2713 ± 3 Ma; 2937;

Psammitic greywacke interlayered with sandstone,

interlayered with siltstone, minor calcarenite

Metamorphosed shale and silty shale

siltstone and minor calcarenite

Intrusive felsite porphyry

th arkosic sandstone and pebbly sandstone

Polymictic conglomerate

and siltstone

Cross Lake Group

Lithic sandstone

orphyritic tonalite; TI - leucotonalite; cT - tonalite-

gneissic granodiorite, locally migmatitic; Gn

(patterned) - migmatitic granodiorite gneiss; Ga -

Mafic dykes (Molson swarm); 1: 1884 ± 2 Ma

GODS LAKE DOMAIN

Gunpoint Group

feldspathic siltstone and GPV

Mafic-lithic sandstone, sandstone interbedded with

Polymictic conglomerate, mafic-lithic clasts

Intrusive felsite porphyry; 7: 2732 ± 4 Ma; 8: 2729 ± 3

Greywacke, muscovite bearing ± sillimanite

Fragmental felsite and derived sediments

Mafic metavolcanic rocks; 9: 2758 ± 3 Ma

Pipestone Lake Group

Layered amphibolite

Mafic dykes and sills

Pipestone Lake Complex

Anorthosite, anorthositic gabbro

Gabbro, diorite; dykes and sills

Anorthosite, anorthositic gabbro

sedimentary rocks

U Ultramafic rocks (Open symbol - drill intersection)

Felsic volcanic, subvolcanic and related

Intermediate tuffaceous rocks (± garnet, cordierite)

Volcanogenic sedimentary rocks with minor calc-

Proterozoic

Archean

PIKWITONEI DOMAIN

Enderbitic gneiss, minor opdalite gneiss

Tonalite gneiss, minor granodiorite gneiss

Granitized gneisses, mainly derived from Tn and

Pyroxene-plagioclase ± hornblende ± garnet ±

quartz gneiss

References for U-Pb ages:

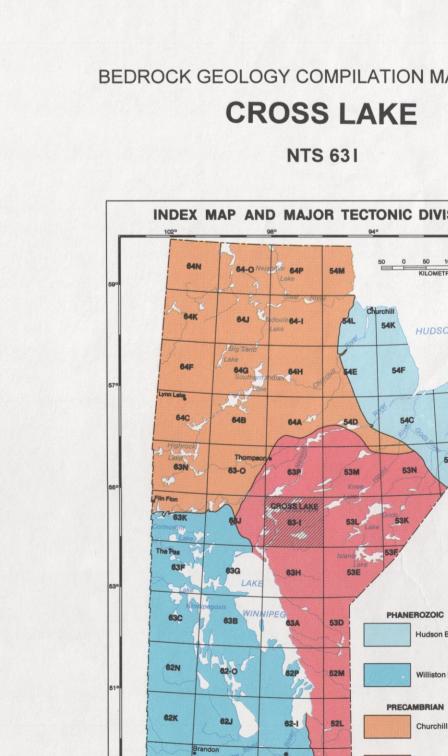
1 Heaman et al., 1986

2, 11 ® Davis, D., 1989

4 Ermanovics et al., 1983

10 ® Krogh et al., 1985

3, 5, 6, 7, 8, 9, 12,13 ® Corkery et al., 1992



..... M.I. 63I/16 CU1:

COMMODITIES

Ag.....Silver

Au.....Gold

Cu.....Copper

Pb....Lead

Zn.....Zinc

TiTitanium

V.....Vanadium

Haskins and Stephenson, 1974

BEDROCK GEOLOGY COMPILATION MAP SERIES

Published 1996

Suggested reference to this publication: Manitoba Energy and Mines, 1996;

Bedrock Geology Compilation Map Series, Cross Lake, NTS 63 I; 1: 250 000.

Synoptic geology by M.T. Corkery, W. Weber and J.J. Macek

Compilation by D. Lindal and W. Weber

Cartography by T. Franceschet

Approximate mean declination (1996)

for centre of map

Decreasing 6.6' annually

MOLSON LAKE DOMAIN

Granite, locally porphyritic; intrusion breccia:

granite with inclusions of mainly gabbro and minor

quartzite composition; 10: 2680 +3/-2 Ma; Ga - augen

granite; Gp - peristerite granite; JGr - seriate to

Granodiorite-tonalite, locally megacrystic; 11: 2748

granodiorite: Gh - porphyritic granodiorite and

tonalitic gneiss with mafic inclusions and granite

sills and dykes; cG - granodiorite (Clearwater Bay

Complex); 12: 2689 ± 2 Ma; cGb - biotite granodiorite

to tonalite (Clearwater Bay Complex): JGb - biotite

granodiorite to granite (Jenpeg Complex); wJGb

Hornblende (± biotite) tonalite to granodiorite

locally porphyritic; TI - leucotonalite; Tn - tonalite,

tonalitic gneiss, minor amphibolite; JT - tonalite to

granodiorite, megacrystic (Jenpeg Complex); cTa -

augen biotite tonalite; PTp - Porphyritic biotite

tonalite (Playgreen Complex); PTa - hornblende or

Leucocratic biotite tonalite to granodiorite

(Playgreen Complex); wJTa - augen tonalite

Metabasalt, massive or pillowed; locally biotite-

interlayered with diopside-plagioclase layers

Amphibolite to gabbro, plagioclase porphyritic

Intermediate tuffaceous rocks

hornblende schist; amphibolite, sporadically

biotite augen tonalite (Playgreen Complex); PTI

(Whiskey Jack Complex); 13: 2749 ± 3 Ma

Garnetiferous quartzofeldspathic gneiss

Polymictic conglomerate

biotite granodiorite (Whiskey Jack Complex)

Quartz diorite with diorite inclusions

± 1 Ma; Ga - augen granodiorite; Gp - megacrystic

pegmatitic red granite (Jenpeg Complex);

Pyroxene-bearing monzodiorite

