garnet ages indicate that part of the crust is ≥ 3.0 Ga (Mezger et al., 1989).

extensively intruded by tonalite.

The Sipiwesk Lake area (NTS 63P) is underlain by rocks of the Precambrian Shield. Rocks of the Archean Superior Province make up most of the map sheet, except the NW corner. This area is underlain by Archean and Paleoproterozoic rocks of the Superior Boundary Zone and Paleoproterozoic rocks of the adjacent

Churchill Province (Trans-Hudson Orogen). SUPERIOR PROVINCE

Superior Province rocks in the Sipiwesk Lake area are divided into the Gods Lake granite-greenstone domain, in the southeast corner, and the higher grade metamorphic equivalent rocks of the Pikwitonei granulite domain in the centre of the area. The contact between the two domains is the orthopyroxene-in Isograd of 2.7-2.65 Ga prograde metamorphism (Weber and Scoates, 1978). The contact between the Superior Province and the (Churchill-) Superior Boundary Zone is the less well defined eastern limit of the ca. 1.8 Ga Hudsonian tectonic overprint.

The Gods Lake domain comprises dominantly granitoid metaplutonic rocks and subordinate supracrustal rocks (greenstones). The granitoid rocks range in composition from tonalite to granite and in texture from massive rocks to gneiss. Small bodies of graphic leucogranite (GI), spatially associated with greenstones at Atik Lake, are probably S type granites. All granitoid rocks show intrusive relationships with the greenstones. Tonalitic gneiss (Tn) from Cauchon Lake yielded U-Pb zircon ages of 2695 ± 5 Ma and 2653 ± 16 Ma (Krogh et al., 1985), interpreted as two phases of Late Archean metamorphism and felsic melt formation. U-Pb

The supracrustal rocks form parts of three small greenstone belts, from south to north, the Bear Lake, Atik Lake and Bear Head greenstone belts. Westwards, the greenstone belts narrow and break up into discontinuous layers and lenses of amphibolite (A) representing "roots" of the greenstone belts that have been

The Bear Lake greenstone belt comprises felsic and mafic volcanic rocks, and tuffaceous metagreywacke. Granitoid rocks and greenstones are juxtaposed along a prominent northwest-trending fault with NE-side-up apparent vertical displacement.

The Atik Lake greenstone belt comprises mafic and very minor ultramafic metavolcanic rocks, oxide-, silicateand sulphide-facies banded iron formation and minor arenites (C). The Bear Lake greenstone belt is lithologically similar to the ca. 2.73 Ga volcanic arc type assemblage in the Rice Lake belt (cf. Turek and Weber, 1994), whereas the lithologies of the Atik Lake greenstone belt are comparable to the > 2.9 Ga platform assemblage. In both greenstone belts stratigraphic tops are to the south, suggesting that they comprise

At Atik Lake, discordant and concordant seafloor volcanogenic hydrothermal alteration below banded iron formation depleted Ca, Si, Mg and Na in metabasalt, which resulted in the formation of rocks rich in garnet-anthophyllite (± andalusite, cordierite) during subsequent regional metamorphism (Weber, 1974; Berer, 1989). The alteration triggered deposition of auriferous sulphide-bearing chert (see mineral occurrence No. 1) in association with banded iron formation (Bernier, 1989).

The Bear Head greenstone belt, the western extension of the High Hill greenstone belt in NTS 53M, is lithologically similar to the Atik Lake belt. The Bear Head belt comprises mainly amphibolites derived from mafic volcanic rocks. They are intruded by an anorthosite sill that is related to a similar intrusion at Cauchon

The Pikwitonei domain comprises granulite-facies metaplutonic and supracrustal rocks. Metaplutonic rocks are enderbite gneiss (En), locally garnet bearing (Eng), schollen enderbite (Es) and minor porphyritic opdalite (Op). They generally contain abundant mafic and ultramafic inclusions. Enderbite gneiss (En) is a granulite facies equivalent of tonalite gneiss (Tn) in the Gods Lake domain. Schollen enderbite and opdalite possibly intruded during granulite facies conditions (1100° C; Mezger et al., 1990) and are part of magmas that contributed heat towards high grade metamorphism. Amphibolite facies tonalite gneiss (Tn) occurs locally, e.g. south of Landing Lake, south of Arnot on the Nelson River and marginally to the anorthosite intrusion at Cauchon Lake. Generally these are zones of retrogression due to shearing.

The supracrustal rocks in the Pikwitonei domain are lithologically similar to the greenstones in the Atik Lake and High Hill-Bear Head lakes greenstone belts. They include mafic (A, O) and ultramafic (pyroxenite) rocks (U) derived from volcanic flows and related intrusions, oxide and silicate facies banded iron formation, quartzite and calc-silicate rocks (Q). Garnet-sillimanite-cordierite-bearing rocks associated with iron formation are probably hydrothermally altered mafic metavolcanic rocks. Sapphirine-bearing granulites (Us) in the Sipiwesk Lake area formed as a result of interaction of spinel-bearing ultramafic granulites with siliceous melts (Macek, 1989). Layered anorthosite (I) that ranges in composition from anorthosite to pyroxenite occurs as a 40 km long stratiform intrusion at Cauchon Lake and as minor intrusions at Natawahunan Lake and elsewhere. The occurrence of anorthosite cobbles in a conglomerate at Cauchon Lake is evidence that post-volcanic supracrustal rocks equivalent to the Cross Lake Group are part of the granulite facies supracrustal rocks. This implies that these rocks were buried and metamorphosed to granulite facies within ca. 10 Ma (see below). Late-tectonic, ca. 2700 Ma granitoid rocks and pegmatites (G) (Mezger et al., 1990) at Cauchon Lake are the youngest Archean magmatic rocks.

North-northeast trending mafic to ultramafic Molson dykes are more abundant in the Pikwitonei domain than in the Gods Lake domain (cf. Macek and Scoates, 1979). A mafic Molson dyke at Cross Lake (NTS 63I) and a mafic-ultramafic Molson dyke at Cuthbert Lake have yielded the same U-Pb zircon age, 1884 ± 2 Ma and 1883 ± 2 Ma, respectively (Heaman et al., 1986). However, an east-trending mafic Molson dyke from Cauchon Lake is ca. 200 Ma older (Heaman, pers. comm., 1994). Paleomagnetic studies indicate that there may be three periods of Molson dyke intrusion between 2200 Ma and 1880 Ma (Zhai et al., 1994). The Molson dykes in the Pikwitonei and Gods Lake domains have primary mineralogy and unrecrystallized glassy chilled margins suggesting that at the time of their intrusion the present surface of both domains was at shallow crustal levels. Rift-type chemical affinity (Barager and Scoates, 1981), depleted mantle source signatures for comagmatic rocks (Halden, 1988), and an age of 1883 Ma, equal to arc magmatism in the Flin Flon belt, suggest that the 1883 Ma dykes were emplaced in a back arc spreading setting (Weber, 1990). The older dykes may be related to early-Hudsonian rifting at the Superior margin.

The contact between the Pikwitonei domain and the Gods Lake domain is the orthopyroxene-in isograd of prograde metamorphism. At Cauchon Lake two isograds have been established. The older one, dated at 2695 Ma, is shown as the domain boundary. The younger one, dated at ca. 2640 Ma, trends approximately 5 km south of the domain boundary. This younger M2 granulite metamorphism is characterized by hypersthenebearing partial melts that are preferentially localized along S2 axial planes (Hubregtse, 1981). At Sipiwesk Lake the orthopyroxene isograd is highly irregular, and amphibolite and granulite facies rocks appear mixed on a regional scale, probably because the contact surface between Pikwitonei granulites and Gods Lake domains dips flat to the west. Tonalite gneiss south of Landing Lake is retrogressed enderbite gneiss that probably formed along a large regional shear zone during Late-Archean uplift (Hubregtse, 1981). This shear zone extends from High Hill Lake in NTS 53M through the southern part of Cauchon Lake, towards Mustekapau Lake, southwest of Wintering Lake, where it is truncated by northeast-trending structures of the Thompson belt.

SUPERIOR BOUNDARY ZONE

The Superior boundary zone in NTS 63P comprises the southern end of the Orr Lake segment in the Spence Lake area (extreme north of map sheet) and the Thompson belt (or Thompson Nickel belt) extending from Moak Lake in a southwesterly direction. The Orr Lake segment comprises poorly exposed felsic migmatites (N). The Thompson belt is largely made up of felsic amphibolite facies gneisses and migmatites (N, NI). With some exceptions (see below) the Thompson belt gneisses and migmatites were derived from Pikwitonei-type 2.65-2.8 Ga granulites (Machado et al., 1990) through reworking; i.e., deformation and recrystallisation under greenschist to amphibolite facies conditions (from east to west), during collision of the Superior craton with the Reindeer zone (Bleeker, 1990; Weber, 1990) ca. 1880-1720 Ma (Machado, 1990, and in press). The metamorphic overprint hydrated the granulite facies assemblages, which broke down magnetite, orthopyroxene, calcic plagioclase and recrystallized greenschist assemblages along the eastern contact of the boundary zone. This difference in metamorphic mineralogy is responsible for the abrupt change from high to low aeromagnetic values along the eastern margin of the boundary zone (Geological Survey of Canada, 1965). The retrogressed gneisses were variably injected by several phases of felsic melts during and after the reworking that resulted in widespread migmatites.

Granulites (En) that have not been retrogressed are locally preserved in fault-bounded blocks, e.g. at Paint Lake (Russell, 1980). In places, such as the Wintering Lake area, gneisses and metaplutonic granitoid rocks reached amphibolite and not granulite facies. Gneisses at the western margin of the Thompson belt along the Manasan River appear to be part of an older (accreted?) terrain; they yielded ages ≥ 3.0 Ga and are possibly as old as 3.2-3.4 Ga (Machado et al., 1990).

Metasedimentary and metavolcanic rocks of the Ospwagan Group occur near the western margin of the Thompson belt. The metasedimentary rocks (oS) have been divided into the Manasan, Pipe, Thompson and Setting formations; the overlying metavolcanic rocks (oV) make up the Ospwagan Formation (Galley et al., 1990). The Manasan Formation stratigraphically overlies granulite-derived migmatite gneiss at Manasan quarries, in the Thompson open pit (Bleeker, 1989, 1991) and in the Pipe open pit, 35 km southwest of hompson (Bleeker and Macek, 1988a, b). The metasedimentary rocks were intruded by peridotite sills (U) that may have fed the Ospwagan Formation. Contamination of ultramafic magmas by crustal sulphur from sulphide facies iron formation during intrusion led to precipitation of nickel sulphides (Bleeker, 1991). These sulphides are presently not everywhere associated with ultramafic rocks, because subsequent folding and the formation of flat-lying nappe structures (F1-F2; Bleeker, ibid.) boudinaged the more competent ultramafic

The Ospwagan Group is intruded by mafic and ultramafic dykes of the Molson swarm that were folded and metamorphosed to amphibolites during F2 peak metamorphic conditions (Bleeker, 1991).

The entire Thompson belt was intruded by Proterozoic felsic melts that were emplaced as plutons (G), such as the 1822 ± 3 Ma Wintering Lake granodiorite or the 1836 ± 2 Ma Mystery Lake granodiorite (Machado et al., in press), and smaller sills, dykes and pegmatites. Pegmatites and pegmatitic granite (GI), dated at 1772 ±2 (Machado et al., in press), are related to Bleeker's F3 folding event. Potassic metasomatic fluids formed augen gneiss along the eastern Thompson belt margin at Apussigamasi Lake and elsewhere, e.g., in the overturned limb of the nappe structure at Thompson (Bleeker, 1991).

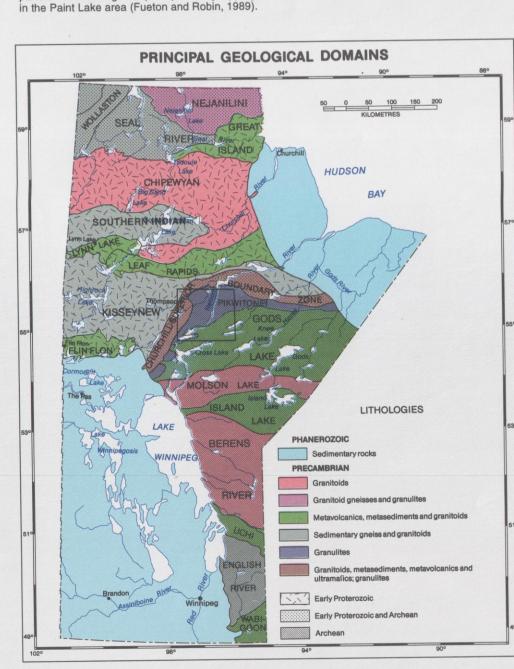
TRANS-HUDSON OROGEN

Rocks of the Kisseynew domain make up the Trans-Hudson Orogen (formerly Churchill Province). They consist of aluminous cordierite-garnet-bearing metagreywacke of the Burntwood Metamorphic Suite and letasandstones of the Missi Metamorphic Suite. The contact between the Superior Boundary Zone and the Trans-Hudson Orogen is not exposed. Since this contact generally coincides with a linear topographic depression it probably is a fault. Recent LITHOPROBE seismic surveys indicate that it is a late to post-collisional, transpressional, subvertical strike-slip fault (White and Lucas, 1994).

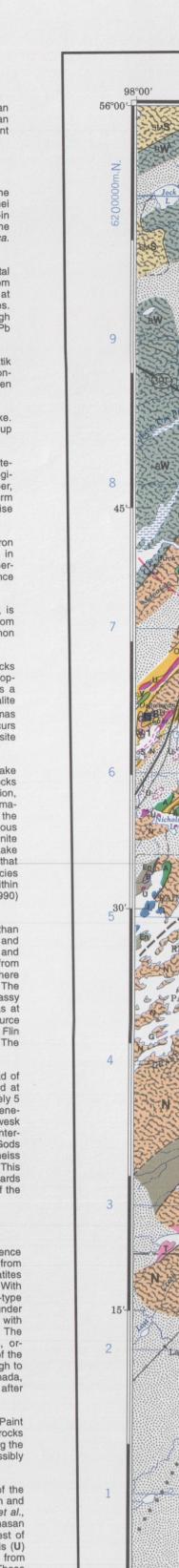
In NTS 63P an oblique cross section of ca. 20 km middle (Gods Lake domain) to lower (Pikwitonei domain) Archean crust of the Superior Province is exposed. U-Pb garnet and zircon ages indicate that rocks ≥ 3.0 Ga have undergone at least four periods of metamorphism in the lower crust, at 2744-2738 Ma, 2700-2687 Ma, 2660-2637 Ma and 2629-2591 Ma (Mezger et al., 1990). These metamorphic events have been correlated with distinct depositional/intrusive events in the upper crust, in the Cross Lake and Oxford Lake greenstone belts (Weber and Mezger, 1990). Petrologic data suggest peak metamorphic conditions during the ca. 2640 Ma regional metamorphism, from southeast to northwest: 575° C/3kb at Atik Lake, 750° C/7kb at Cauchon Lake, 830° C/7.5-8kb at Natawahunan Lake and 9kb close to the Thompson belt. P-T-t paths derived from this data suggest that the main source of heat during metamorphism was the intrusion (and underplating?) of

Retrogressed granulites form the stratigraphic basement to Ospwagan Group rocks implying that the granulites were at surface prior to the deposition of the Ospwagan Group. Tectonic thinning in a continental margin setting, i.e., early Hudsonian rifting, is the most likely cause for exposing an oblique crustal cross section along the northwest margin of the Superior Province.

Along the Superior boundary zone, the Superior Province collided with Paleoproterozoic rocks of the Reindeer zone during the Hudsonian orogeny. Geological evidence (Weber, 1990; Bleeker, 1990) suggests that the Superior craton was underplating the Reindeer zone during early stages of the orogeny. During this early crustal thickening, southeast verging nappes (F1; Bleeker, 1991) were emplaced in the Thompson belt. Subsequently, 1883 Ma Molson dykes intruded, most likely during back arc spreading. The Hudsonian metamorphic overprint peaked during Bleeker's F2 event (ca. 1880-1835 Ma). During thermal relaxation, 1840 and 1820 Ma felsic magmas were intruded. East-dipping seismic reflectors underneath the Thompson belt, and extending underneath the Pikwitonei in NTS 63J, indicate reversed tectonic stacking during the final phase of the collision. This has been related (Bleeker, 1990; Lewry et al., 1994) to transpression and crustal shortening at a high angle to the Thompson belt, producing Bleeker's steep F3 fold structures, and 1790-1770 Ma pegmatites and granitoid rocks in the migmatites (Machado et al., 1990). These reflectors are also parallel with Hubregtse's (1981) easterly dipping S₃ transposed planar structures and east-side-up late faults



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.



Cross Fortage,

Proterozoic and Archean References for U-Pb ages: 1, 2, 3, 5
Machado et al., in press 4 🛞 Machado et al., 1990 6 Machado et al., 1987 7 R Heaman, pers. comm., 1994 8 🕏 Heaman et al., 1986b 9, 11 * Mezger et al., 1989 10 🖈 Heaman et al., 1986a; Krogh et al., 1986 12 🖈 Krogh et al., 1986 13 🕏 Krogh et al., 1985

TRANS-HUDSON OROGEN

KISSEYNEW DOMAIN

Sickle Metamorphic Suite

from sandstone; magnetiferous

Burntwood River Metamorphic Suite

Migmatite with <75% mobilizate (metatexite) derived

Greywacke derived pelitic gneiss; BW - (patterned)

greywacke derived graphitic garnet-biotite gneiss

Paleoproterozoic

96°00′

Approximate mean declination (1995) for centre of map Decreasing 8.9' annually Synoptic geology by W. Weber and J.J. Macek

LEGEND

PRECAMBRIAN

Late Proterozoic

SUPERIOR BOUNDARY ZONE

protolith unknown)

Thompson Belt

Ospwagan Group

Felsic mylonite (Assean Lake mylonite zone,

Granitoid rocks ± hornblende ± garnet ± magnetite;

GI - leucogranitoid rocks, aplite, pegmatite; 1:

Granodiorite to granite, massive to weakly foliated,

in part porphyritic; 2: monazite, 1836 ± 2 Ma (Mystery

Lake granodiorite); 3: zircon, 1822 ± 3 Ma (Wintering

Metabasalt, in part komatiitic, pillowed and massive

Metasedimentary rocks: quartzite, chert, aluminous and ferruginous graphitic schist ± sillimanite, garnet;

silicate, carbonate and sulphide facies banded iron

Ultramafic rocks, largely serpentinized peridotite (In

Na - augen gneiss, associated with white pegmatite

and granodiorite; N - (patterned) layered felsic

migmatite with mafic (to ultramafic) inclusions,

generally intruded by granite and pegmatite

Ma; 6: zircon, 1786 ± 3 Ma; NI - well layered migmatite

Tonalite, tonalite gneiss (retrogressed enderbite and

enderbite gneiss) with mafic to ultramafic inclusions;

Enderbite gneiss, minor opdalite gneiss and 11 🏵

enderbite; Eng - enderbite gneiss, garnet bearing

Amphibolite ± garnet, medium- to coarse-grained,

Garnet–pyroxene–plagioclase \pm hornblende gneiss

ocally associated with hornblendite; Ag

amphibolite, garnet-bearing; layered

Layered metagabbro ± garnet ± pyroxen

onalite, tonalite gneiss

dykes/sills; 4: zircon, 2772 ± 7 Ma; 5: zircon, 1771 ± 2

the Thompson belt, additional ultramafic rocks have 9 🕏 G

formation; calc-silicate rocks, conglomerate

been reported in drill hole data.)

Pelitic metasedimentary rocks, well bedded

Metadiabase, metagabbro dyke (Molson swarm) 7,8 €

monazite, 1772 ± 2 Ma (Ospwagan Lake pegmatitic

Diabase dyke (Mackenzie swarm)

PIKWITONEI DOMAIN

Diabase, gabbro dyke (Molson swarm); 7: zircon,

2089 Ma; **U** - ultramafic to gabbroic dyke; **8**: zircon, 1883 ± 2 Ma

Granite to monzonite; 9: zircon, 2598 ± 1 Ma

Porphyritic opdalite

Tonalite; Tn - tonalite gneiss

Ma; zircon, 2654 ± 2 Ma

Metaconglomerate

zircon, 2681 ± 2 Ma

Tonalite, tonalite gneiss (retrogressed enderbite and

Enderbite, in part gneissic; minor opdalite; En

enderbite gneiss with mafic/ultramafic inclusions;

enderbite with mafic inclusions; 10: zircon, 2695 ± 2

Felsic garnet ± biotite ± sillimanite gneiss, commonly

Intermediate garnet-bearing gneiss ± cordierite ±

Ultramafic rocks, pyroxenite; Us - ultramafic to mafic

Amphibolite; Ag - amphibolite, garnet bearing;

Mafic granulite, norite, minor ultramafic granulite; Og

- gabbroic to leucogabbroic rocks, commonly garnet

Quartzite, generally associated with garnet-bearing

felsic gneiss, mafic and calc-silicate rocks

earing; layered; Os - mafic granulite, sapphirine

rocks, sapphirine bearing; 12: zircon, 2719 ± 5

associated with mafic rocks and quartzite

sillimanite; 11: gamet, 2687 ± 1 Ma

Eng - enderbite gneiss, garnet bearing; Es - schollen

enderbite gneiss) with mafic/ultramafic inclusions

SUPERIOR PROVINCE

Archean

Mylonitic granitoid gneiss, augen gneiss

GODS LAKE DOMAIN

G Granite; GI - leucogranite; Gp - porphyritic granite

porphyritic granodiorite

Quartz diorite to monzogabbro

Anorthosite

Metagabbro

Polymictic conglomerate

Feldspar ± quartz porphyry

True North

Compilation by W. Weber and D. Lindal

Suggested reference to this publication:

Map Series, Sipiwesk, NTS 63P, 1: 250 000.

Manitoba Energy and Mines, 1995; Bedrock Geology Compilation

BEDROCK GEOLOGY COMPILATION MAP SERIES

SIPIWESK

NTS 63P

INDEX MAP AND MAJOR TECTONIC DIVISIONS

Cartography by T. Franceschet

intercalated metagreywacke/argillite

Granodiorite, tonalite; Gn - granodiorite to granite,

generally gneissic, with mafic inclusions; Gp -

Tonalite; TI - leucotonalite; Tn - tonalite gneiss, minor

granodiorite gneiss; 13: zircon, 2695 ± 5 Ma; zircon,

Pyroxene-plagioclase ± hornblende gneiss

Metagreywacke/argillite, minor intercalated crystal

Amphibolite ± garnet, pyroxene, metabasalt

Intermediate to felsic agglomerate, crystal tuff, minor

Metabasalt, commonly pillowed, minor massive

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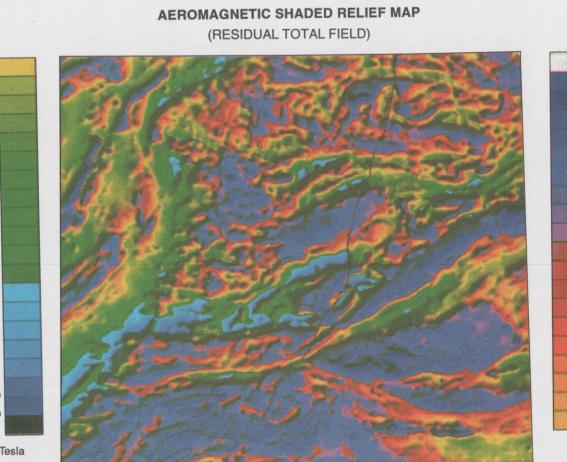
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PIKWITONEI DOMAIN GODS LAKE DOMAIN

MAJOR PRECAMBRIAN DOMAINS





Sample locality for U-Pb age determination

SYMBOLS

Geological boundary (approximate, interpreted)

Stratigraphic top (upright, overturned)

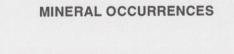
Domain boundary

¹ Mineral Inventory card, Manitoba Energy and Mines

Area of little or no outcrop

silicate facies iron formation)

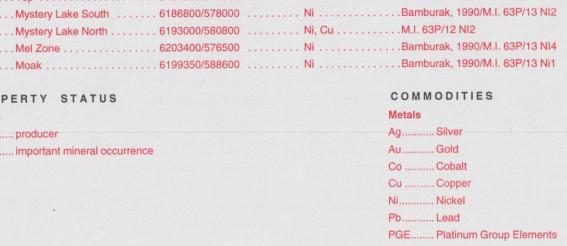
Fault (defined, interpreted, assumed)

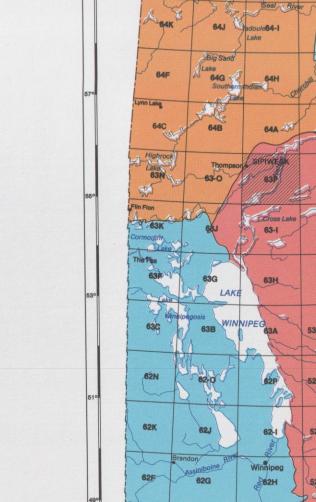


Iron formation (IF - banded iron formation; IFo - oxide facies iron formation; IFs -

Name	UTM Northing/Easting	Commodity	References
1 .▲ Atik Lake	6124900/689350	. Au	Northern Miner, April 27, 1987
2 Wintering Lake Island	6141300/584700	. Cu	M.I. 63P/5 CU3 ¹
3 Wintering Lake North	6149150/589600	Cu, Ag	M.I. 63P/5 CU1
4▲ Cop	6137100/616150	. Ni, Cu	M.I. 63P/6 NI2
5 Utik	6127650/690550	. Cu	M.I. 63P/8 CU1
6▲ Cuthbert Lake	6155400/599900	. Ni, Cu	M.I. 63P/11 NI1
7 🛦 Alb	6151700/573200	. Cu, Ni	M.I. 63P/12 CU1
8 MANASAN QUARRY	6163650/563500	. Si	M.I. 63P/12 SIA1
9 BIRCHTREE	6173200/567400	. Ni, Cu	Bamburak, 1990/M.I. 63P/12 NI1
10. ■ THOMPSON	6174400/572100	Ni, Cu, PGE, Co	Bamburak, 1990/M.I. 63P/12 NI2
11. ▲ Top	6181550/570500	. Ni	M.I. 63P/13 NI5
12. ▲ Mystery Lake South	6186800/578000	. Ni	Bamburak, 1990/M.I. 63P/13 NI2
13. ▲ Mystery Lake North	6193000/580800	. Ni, Cu	M.I. 63P/12 NI2
14. ▲ Mel Zone			
15 ▲ Moak	6199350/588600	. Ni	Bamburak, 1990/M.I. 63P/13 Ni1
PROPERTY STATUS			COMMODITIES
Metals			Metals
producer			AgSilver
important mineral occurren	ice		Au Gold

Co Cobalt Cu Copper





Hudson Bay Basin

Manitoba Énergie et Mines Energy and Mines Manitoba