Manitoba Energy and Mines
Geological Services
B.G.C.M. Series
Norway House, NTS 63H
1: 250 000

MARGINAL NOTES

The Norway House area (NTS 63H) in the Archean Superior Province encompasses parts of Sachigo subprovince to the north (Molson and Island Lake domains) and Berens River subprovince (Berens River domain) to the south (Card and Ciesielski, 1986). These domains are terranes that are distinguished by significantly different amounts of supracrustal relative to intrusive rock. Supracrustal rocks constitute 20% of the granite/greenstone Sachigo subprovince but only 4% of the plutonic Berens River subprovince (Ermanovics and Davison, 1976). Differences in the relative abundance of supracrustal vs. intrusive rocks have been attributed to vertical tectonic movements that resulted in juxtaposition of domains of different crustal level along major faults (Ayres, 1978). Molson and Berens River domains are relatively more deeply eroded and thus contain less supracrustal ('cover') rock compared to Island Lake domain (Ermanovics and Davison, 1976). The fact that rock types, structural patterns and geochronologic data in the various domains are comparable is consistent with their being part of a unified 'superterrane' in the northwest part of the Superior Province prior to the Mesoarchean (Uchi-Sachigo-Berens River superterrane; Thurston et al., 1991). However, recent studies show distinctive patterns in Nd-Sm isotopic systematics for several domains in the region (T. Skulski, pers. comm., 1999). These data are interpreted to indicate that each domain evolved along different paths in the Mesoarchean prior to amalgamation into a 'superterrane'. Thus the Nd-Sm isotopic variations may indicate that differences between the domains are not simply a reflection of different crustal level, but may be due to pre-'superterrane' variations in their lithologic components. Contacts between the domains are highly deformed; the Ponask Lake-Stevenson Lake supracrustal belt at the conjunction of the Molson Lake and Island Lake domains is moderately to intensely attenuated and faulted; the contact between the Island Lake and Berens River domains is marked by a mylonite zone (up to 2.4 km wide) that is coincident with a conspicuous aeromagnetic discontinuity (Ermanovics and Davison, 1976).

Sachigo subprovince spans approximately 1 billion years of earth history and contains the oldest Superior Province rocks (3.5 Ga Paleoarchean), and the products of two subsequent orogenies (3.0-2.9 Ga Wanipigowan and 2.8-2.7 Ga Laurentian; Ermanovics and Wanless, 1983). Supracrustal rocks in Sachigo subprovince represent oceanic arc/back-arc type volcanic sequences and related sedimentary rocks dated at 2.7-3.0 Ga (Corkery et al., 1992; Thurston et al., 1991). The oldest supracrustal rocks consist of 3.02 Ga tuff and 2.9-3.0 Ga quartz-rich platformal sediments and intercalated volcanic rocks that are basal members in many supracrustal sequences in Ontario (Corfu and Wood, 1986). Island Lake domain supracrustal rocks include 2895 ± 25 Ma volcanic-derived amphibolite at Stevenson Lake (**2**; Ermanovics and Wanless, 1983), which is the oldest dated rock in the Norway House area. 3547 ± 2 Ma detrital zircons in sandstone at Cross Lake (Corkery et al., 1992) attest to Paleoarchean magmatism that predated existing supracrustal belts.

The Ponask Lake-Stevenson Lake greenstone belt extends for approximately 65 km along the northwest margin of Island Lake domain, and extends a further 150 km to the east, through the Island Lake area (NTS 53E) into Ontario. The supracrustal rocks in the Stevenson Lake area are significantly more attenuated compared to those at Island Lake. However, lithologic units and the stratigraphic sequence are consistent with those established at Island Lake: a volcanosedimentary sequence (Hayes River Group) is unconformably overlain by fluvial/alluvial conglomerate and sandstone, and fine-grained marine turbidites (Island Lake Group; Weber, 1982; Neale, 1984; Gilbert, 1985). The basal Hayes River Group unit at Stevenson Lake (HV) consists of aphyric, pillowed to massive basalt and related gabbro up to 0.5 km wide; equivalent rocks at Island Lake have an estimated thickness of 0.8 to 1.2 km. Ultramafic lenses and small plugs occur sporadically within the volcanic rocks. Massive to fragmental felsic volcanic and related intrusive rocks (HV) up to 120 m thick, and a 180 m wide greywacke-siltstone unit (HW) apparently overlie the mafic volcanic section. The sedimentary rocks display normal size grading, and contain sporadic garnet and cordierite. Polymictic conglomerate of the Island Lake Group (IC) extends for at least 45 km through the centre of the Stevenson Lake supracrustal belt; the 300 m wide unit is interpreted to occupy the core of a major syncline (Gilbert, 1985). The conglomerate, which consists mainly of felsic plutonic fragments with subordinate volcanic, sedimentary and quartz clasts, is lithologically similar to the basal Island Lake Group conglomerate at Island Lake (Neale and Weber, 1981). The unit rests unconformably on post-Hayes River Group tonalite and quartz diorite (**D**) in the east part of Stevenson Lake and northwest part of Island Lake (NTS 53E).

Layered gneisses (**N**) are interspersed with plutonic rocks throughout the Molson and Island Lake domains, and are a subordinate component of the mainly granitoid Berens River domain. The migmatitic gneisses are characterized by alternating leucocratic and amphibolitic layers and minor pelite, and are interpreted as derived from (a) supracrustal rocks that were intruded by pervasive granitoid phases, and (b) tonalite that was intruded by diabase and gabbro; precursors probably include rocks of both Mesoarchean and Neoarchean ages. Synkinematic granitization and late K-metasomatism associated with granodiorite/granite intrusions are characteristic of the gneisses. The layered gneisses are classified as leucocratic (**N**f); intermediate (**N**); mesocratic to melanocratic (**N**m); and mafic migmatite, derived in part from diorite and gabbro (**N**). Contacts between layered gneiss and greenstone belts are typically tectonic, whereas contacts with felsic plutonic rocks are gradational (Thurston et al., 1991).

The four main granitoid rock suites in the Norway House area, possibly correlative with suites 1 to 4 in the Sachigo and Berens River subprovinces in Ontario (Thurston et al., 1991), are (in order of decreasing age):

1. quartz dioritic to granodioritic felsic augen gneiss (**Ga**), interpreted as coeval with tonalitic phases in layered gneiss (**N**);
2. foliated quartz diorite and tonalite (**D**), diorite (**D**h);
3. massive to foliated granodiorite (**G**, **G**h, **G**k, **Gx**);
4. massive granite (**G**).

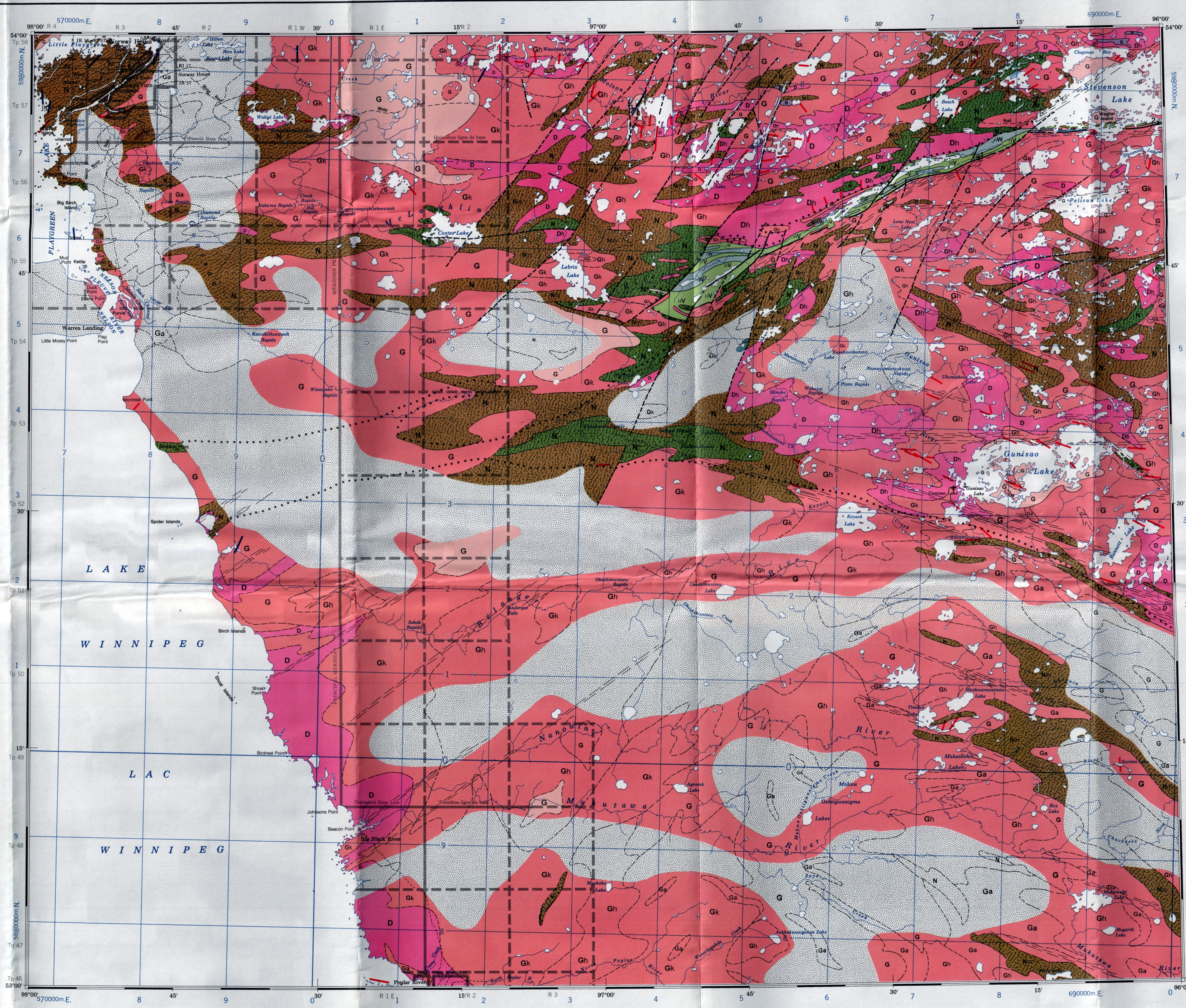
In Ontario, suite 1 includes 2.95 Ga orthogneiss (Corfu and Ayres, 1984) that is approximately coeval with the oldest supracrustal rocks in the Sachigo and Berens River subprovinces; suite 2 (2.87-2.71 Ga) and suite 3 (ca. 2.70 Ga; Thurston et al., 1991) postdate volcanic rocks in the Ponask-Stevenson Lake belt; whereas suite 4 (ca. 2.65 Ga; Mezger et al., 1990) postdates both the volcanic rocks and overlying Island Lake Group fluvial sedimentary rocks.

Quartz dioritic to granodioritic felsic augen gneiss (**Ga,** suite 1) is characterized by mafic micaceous segregations, quartz aggregates and stringers, and mafic xenoliths and schlieren assumed to be derived from supracrustal rocks (Ermanovics, 1973). Quartz diorite and tonalite (**D**, suite 2), which also contain supracrustal enclaves and related schlieren, are moderately to strongly foliated, and mylonitic toward contacts with greenstone belts; the granitoid rocks contain abundant epidote in the area east of Lake Winnipeg. Mafic intrusions of suite 2 (foliated diorite, **D**h) are abundant in the Island Lake domain and contiguous parts of Molson Lake domain; the mafic intrusive rocks are assumed coeval with quartz diorite (**D**). Predominantly massive granodiorite of suite 3 underlies over 65% of the Norway House area (NTS 63H); subdivisions of this suite are based on mafic mineral type (biotite, **G**; hornblende, **G**h) and texture (with microcline megacrysts, **G**k; pegmatitic **Gx**). The granodioritic rocks are relatively free of alteration, in contrast to more recrystallized quartz diorite/tonalite (**D**). Massive, coarse-grained to pegmatitic granite dykes and small plutons (**G**, suite 4) occur within and at the margins of older granitoid terranes. This suite includes muscovite granite, leucogranite and 2-mica granite; in Ontario, related pegmatite dykes, emplaced in major shear zones, are commonly fractionated and contain rare metal minerals (Thurston et al., 1991). The late (suite 4) granites have been interpreted as anatectic products of metasedimentary origin, and are commonly located at major shear zones and/or domain boundaries (Thurston et al., 1991; Breaks and Osmani, 1989).

Three mafic intrusive suites postdate Hayes River Group supracrustal rocks. Sporadic mafic dykes and small plugs (gabbro (**B**), altered to amphibolite) are largely confined to the granodiorite terrane (**G**) of Molson Lake domain, and are interpreted as pre-Island Lake Group. Massive to foliated diabase dykes, which occur mostly in Sachigo River subprovince, postdate all granitoid rocks except late granite (suite 4), and are equated with post-Island Lake Group metadiabase in the Island Lake area (Weber et al., 1982). These dykes, which are also altered to amphibolite, are generally conformable with host rock foliation trends. North to north-northeast trending, massive gabbro and diabase Molson dykes are common in the marginal, northwest part of Superior Province (Scoates and Macek, 1978); within the Norway House map sheet, all but one of these dykes occur in Sachigo subprovince. The Proterozoic Molson dykes (1884 ± 2 Ma; Heaman et al., 1986) display fresh igneous textures, and locally contain olivine, pyroxene and/or plagioclase phenocrysts.

Multiple metamorphic events have affected supracrustal and early plutonic rocks in the Norway House area. U/Pb geochronology studies of metamorphic garnets have documented three Neoarchean high grade metamorphic events in the western Sachigo subprovince between 2.74 and 2.64 Ga (Mezger, 1989). Subsequent regional greenschist facies retrogression is locally intensified in shear zones, and in attenuated supracrustal rocks in the Ponask Lake-Stevenson Lake belt. The influence of the Hudsonian orogeny at the margin of the northwest Superior Province is documented by K/Ar and Rb/Sr age determinations that record the resetting of Archean rock formational ages in a zone that extends for up to 350 km southeast of the Churchill/Superior Province boundary (Ermanovics and Wanless, 1983). The effects of this ca. 1.80-1.70 Ga Paleoproterozoic metamorphism were probably very similar to, and indistinguishable from, the preceding Neoarchean retrogressive metamorphism.

Major, belt-parallel folds in the Ponask Lake-Stevenson Lake belt are accompanied by a regional foliation, which was in turn deformed in a later fold event (Gilbert, 1985). Warping of major fold axial planes may have been due to the emplacement of granitoid plutons, which were associated in Ontario with localized hornfelsing of regionally foliated rocks (Thurston et al., 1991). Northeast and west-northwest trending shear zones that transect the map area are interpreted as coeval with vertical displacement at domain-bounding faults, which is assumed to postdate the folding.



Printed 1999

Scale 1:250 000

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

LEGEND

MOLSON LAKE DOMAIN

Proterozoic

- Gabbro and diabase dykes, massive (Molson swarm)

Archean

- **G** — Granite, leucocratic, biotite-bearing, massive to porphyritic
- Diabase dykes, massive to foliated
- **B** — Gabbro, minor related granitoid rocks
- **G** — Biotite granodiorite, tonalite; leucocratic, massive to foliated (2181 ± 99 Ma[1]); **G**h - hornblende granodiorite, tonalite; **G**k - megacrystic granodiorite
- **D** — Quartz diorite, tonalite; leucocratic, strongly foliated; **D**h - diorite, quartz diorite; biotite + hornblende-bearing ± volcanic and/or sedimentary inclusions
- **Ga** — Felsic augen gneiss
- **N** — Intermediate layered gneiss with granitoid phases, derived in part from quartzofeldspathic sediment; **N**f - leucocratic layered gneiss; **N**m - mesocratic to melanocratic layered gneiss with granitoid phases, derived in part from mafic volcanic rocks (2665 ± 63 Ma[2]; 2061 ± 48 Ma[3])
- **N** — Mafic migmatitic gneiss with granitoid phases, in part derived from diorite and gabbro

ISLAND LAKE DOMAIN

- **G** — Granite, leucocratic, biotite-bearing, massive to porphyritic
- Diabase dykes, massive to foliated

Island Lake Group

- **IC** — Polymictic conglomerate, minor sandstone
- **B** — Gabbro, massive
- ⊛ **G** — Biotite granodiorite, tonalite; leucocratic, massive to foliated (**1**: 2703 Ma - minimum age); **G**h - hornblende granodiorite, tonalite; **G**k - megacrystic granodiorite; **Gx** - pegmatite
- **D** — Quartz diorite, tonalite; leucocratic, strongly foliated (2668 ± 64 Ma[4]; 2153 ± 48 Ma[5]); **D**h - diorite, quartz diorite; biotite + hornblende-bearing ± volcanic and/or sedimentary inclusions

Hayes River Group

- **HW** — Greywacke, siltstone, intermediate to felsic, biotite-bearing; minor chert
- **HV** — Felsic volcanic rocks, massive and fragmental, aphyric to porphyritic, and related intusive rocks
- ⊛ **HV** — Intermediate to mafic flows and related amphibolite, aphyric to porphyritic, minor related gabbro; massive to foliated, locally gneissic or mylonitic (**2**: 2895 ± 25 Ma; 3170 ± 68 Ma[6])
- **Ga** — Felsic augen gneiss
- **N** — Intermediate layered gneiss with granitoid phases, derived in part from quartzofeldspathic sediment; **N**m - mesocratic to melanocratic layered gneiss with granitoid phases, derived in part from mafic volcanic rocks
- **N** — Mafic migmatitic gneiss with granitoid phases, in part derived from diorite and gabbro

BERENS RIVER DOMAIN

- Gabbro and diabase dykes, massive (Molson swarm)
- **G** — Granite, leucocratic, biotite-bearing, massive to porphyritic
- Diabase dykes, massive to foliated
- **G** — Biotite granodiorite, tonalite; leucocratic, massive to foliated; **G**h - hornblende granodiorite, tonalite; **G**k - megacrystic granodiorite
- **D** — Quartz diorite, tonalite; leucocratic, strongly foliated; **D**h - diorite, quartz diorite; biotite + hornblende-bearing ± volcanic and/or sedimentary inclusions
- **Ga** — Felsic augen gneiss
- **N** — Intermediate layered gneiss with granitoid phases, derived in part from quartzofeldspathic sediment; **N**m - mesocratic to melanocratic layered gneiss with granitoid phases, derived in part from mafic volcanic rocks

Reference for U-Pb zircon age:
1 ⊛ Ermanovics and Wanless, 1983
Reference for Pb-Pb zircon age:
2 ⊛ Ermanovics and Wanless, 1983
References for K/Ar mineral ages:
1 Lowdon, 1961 (hornblende)
2, 3 Wanless et al., 1978 (hornblende, biotite)
4, 5 Moore et al., 1960 (hornblende, biotite)
6 Wanless et al., 1979 (hornblende)

SYMBOLS

- Geological boundary (approximate, interpreted)
- Fault (defined, assumed)
- Domain boundary
- Area of little or no outcrop
- ⊛ Sample locality for U-Pb or Pb-Pb zircon age determination
- Shear zone

Synoptic geology by H. P. Gilbert

Compilation by D. Lindal

Cartography by T. Franceschet

Suggested reference:
Manitoba Energy and Mines
1999: Norway House; Manitoba Energy and Mines, Geological Services, Bedrock Geology Compilation Map Series, NTS 63H, scale 1: 250 000.

BEDROCK GEOLOGY COMPILATION MAP SERIES

NORWAY HOUSE

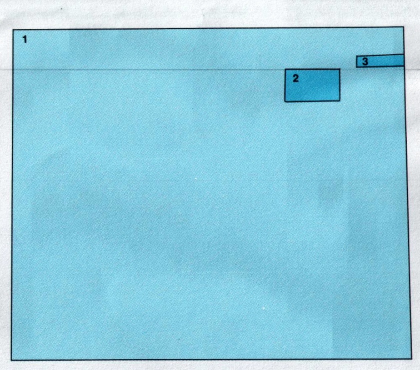
NTS 63H

Published 1999

SELECTED BIBLIOGRAPHY

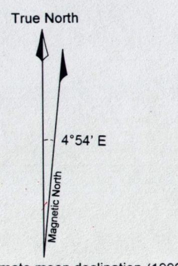
1. Ayres, L.D.
1978: Metamorphism in the Superior Province of northwestern Ontario and its relationship to crustal development; **in** Metamorphism in the Canadian Shield; Geological Survey of Canada, Paper 78-10, p. 25-36.
2. Ayres, L.D. and Cerny, P.
1982: Metallogeny of granitoid rocks in the Canadian Shield; Canadian Mineralogist, v. 20, p. 439-536.
3. Bell, C.K.
1971: Boundary geology, upper Nelson River area, Manitoba and northwestern Ontario; **in** Geoscience studies in Manitoba, (ed.) A.C. Turnock; Geological Association of Canada, Special Paper no. 9, p. 11-39.
4. Breaks, F.W. and Osmani, I.A.
1989: The peraluminous granite-rare element pegmatite association in the northwestern Superior Province; Ontario Mines and Minerals Symposium Abstracts, p. 9.
5. Card, K.D. and Ciesielski, A.
1986: DNAG #1. Subdivisions of the Superior Province of the Canadian Shield; Geoscience Canada, v. 13, p. 5-13.
6. Corfu, F. and Ayres, L.D.
1984: U-Pb age and genetic significance of heterogeneous zircon populations in rocks from the Favourable Lake area, northwestern Ontario; Contributions to Mineralogy and Petrology, v. 88, p. 86-101.
7. Corfu, F. and Wood, J.
1986: U-Pb zircon ages in supracrustal and plutonic rocks, North Spirit Lake area, northwestern Ontario; Canadian Journal of Earth Sciences, v. 23, p. 967-977.
8. Corkery, M.T., Davis, W.D., and Lenton, P.G.
1992: Geochronological constraints on the development of the Cross Lake greenstone belt, northwest Superior Province, Manitoba; Canadian Journal of Earth Sciences, v. 29, p. 2171-2185.
9. Elbers, F.J.
1972: Beaver Hill Lake-Goose Lake area; **in** Summary of Geological Field Work,1972, Manitoba Department of Mines, Resources and Environmental Management, Mines Branch, Geological Paper 3/72, p. 43-44.
10. Ermanovics, I.F.
1973: Precambrian geology of the Norway House and Grand Rapids map area; Geological Survey of Canada, Paper 72-29, 27 p.
11. Ermanovics, I.F. and Davison, W.L.
1976: The Pikwitonei granulites in relation to the northwestern Superior Province of the Canadian Shield; **in** The Early History of the Earth, (ed.) B. F. Windley; John Wiley & Sons, London, p. 341-347.
12. Ermanovics, I.F. and Wanless, R.K.
1983: Isotopic age studies and tectonic interpretation of Superior Province in Manitoba; Geological Survey of Canada, Paper 82-12, 22 p.
13. Gilbert, H.P.
1985: Geology of the Knee Lake-Gods Lake area; Manitoba Energy and Mines, Geological Services, Geological Report 83-1B, 76 p.
14. Heaman, L.M., Machado, N., Krogh, T.E., and Weber, W.
1986: Precise U-Pb zircon ages for the Molson dyke swarm and the Fox River sill: constraints for Early Proterozoic crustal evolution in northeastern Manitoba, Canada; Contributions to Mineralogy and Petrology, v. 94, p. 82-89.
15. Hubregtse, J.J.M.W.
1980: The Archean Pikwitonei granulite domain and its position at the margin of the northwestern Superior Province (central Manitoba); Manitoba Energy and Mines, Mineral Resources Division, Geological Paper GP80-3, 16 p.
16. Lowdon, J.A.
1961: Age determinations by the Geological Survey of Canada, Report 2 – Isotopic ages; Geological Survey of Canada, Paper 61-17, 127 p.
17. Mezger, K.
1989: Dating the PT evolution of granulites; Ph.D. thesis, State University of New York at Stony Brook, Stony Brook, New York, 172 p.
18. Mezger, K., Bohlen, S.R., and Hanson, G.N.
1990: Metamorphic history of the Archean Pikwitonei granulite domain and the Cross Lake Sub-province, Superior Province, Manitoba; Canadian Journal of Petrology, v. 31, p. 483-517.
19. Moore, J.M., Jr., Hart, S.R., Barnett, C.C., and Hurley, P.M.
1960: Potassium-argon ages in northern Manitoba; Geological Society of America Bulletin, v. 71, p. 225-230.
20. Neale, K.L. and Weber, W.
1981: Island Lake (parts of NTS 53E/15 and 53E/16); **in** Report of Field Activities, 1981, Manitoba Energy and Mines, Mineral Resources Division, p. 38-42.
21. Neale, K.L.
1984: Stratigraphy and basin evolution of the upper Hayes River and Cochrane Bay groups, Island Lake greenstone belt, northeastern Manitoba; M.Sc. thesis, Carleton University, Ottawa, Ontario, 177 p.
22. Rousell, D.H.
1965: Geology of the Cross Lake area; Manitoba Department of Mines and Natural Resources, Mines Branch, Publication 62-4, 69 p.
23. Scoates, R.F.J. and Macek, J.J.
1978: Molson dyke swarm; Manitoba Department of Mines, Resources and Environmental Management, Mineral Resources Division, Geological Paper 78-1, 53 p.
24. Thurston, P.C., Osmani, I.A., and Stone, D.
1991: Northwest Superior Province: review and terrane analysis; **in** Geology of Ontario, (ed.) P.C. Thurston, H.R. Williams, R.H. Sutcliffe, and G.M. Stott; Ontario Geological Survey, Special Volume 4, Part 1, p. 81-142.
25. Wanless, R.K., Stevens, R.D., Lachance, G.R., and Delabio, R.N.
1978: Age determinations and geological studies: K-Ar isotopic ages, Report 13; Geological Survey of Canada, Paper 77-2, 60 p.
1979: Age determinations and geological studies: K-Ar isotopic ages, Report 14; Geological Survey of Canada, Paper 79-2, 67 p.
26. Weber, W. and Scoates, R.F.J.
1978: Archean and Proterozoic metamorphism in the northwestern Superior Province and along the Churchill-Superior boundary, Manitoba; **in** Metamorphism in the Canadian Shield, (ed.) J. A. Fraser and W. W. Heywood; Geological Survey of Canada, Paper 78-10, p. 5-16.
27. Weber, W., Gilbert, H.P., Neale, K.L., and McGregor, C.R.
1982: Island Lake (NTS 53E/15); **in** Report of Field Activities, 1982, Manitoba Energy and Mines, Mineral Resources Division, p. 34-43.

SOURCES OF INFORMATION



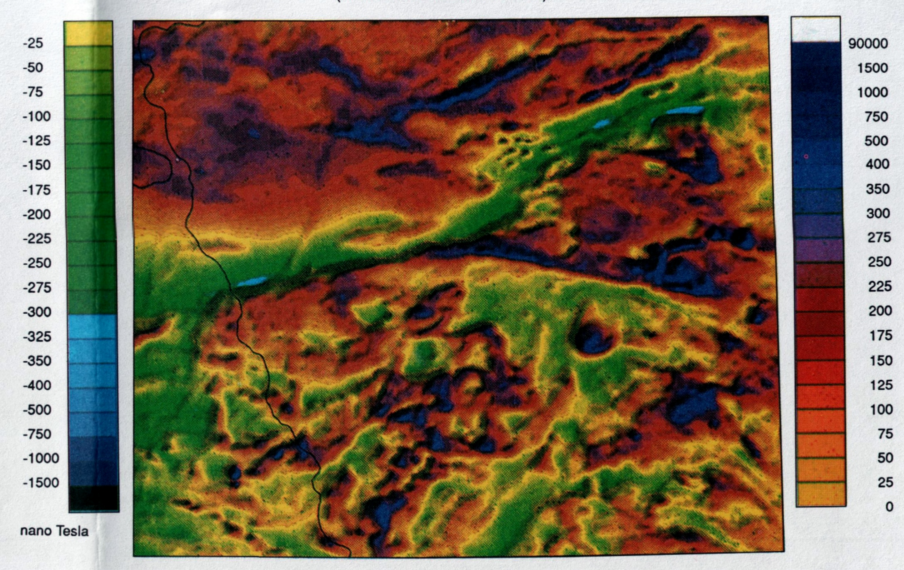
- < 1:50 000
- ≥ 1:100 000

1. Ermanovics, I.F., 1971: Norway House and Grand Rapids; Geological Survey of Canada, Map 5-1972 (accompanies Paper 72-29); scale 1: 250 000.
2. Weber, W., 1986: Ponask Lake; Manitoba Energy and Mines, Preliminary Map 1986 I-1; scale 1: 20 000.
3. Gilbert, H.P., 1985: Wagner Island; Manitoba Energy and Mines, Preliminary Map 1985 I-5; scale 1: 20 000.

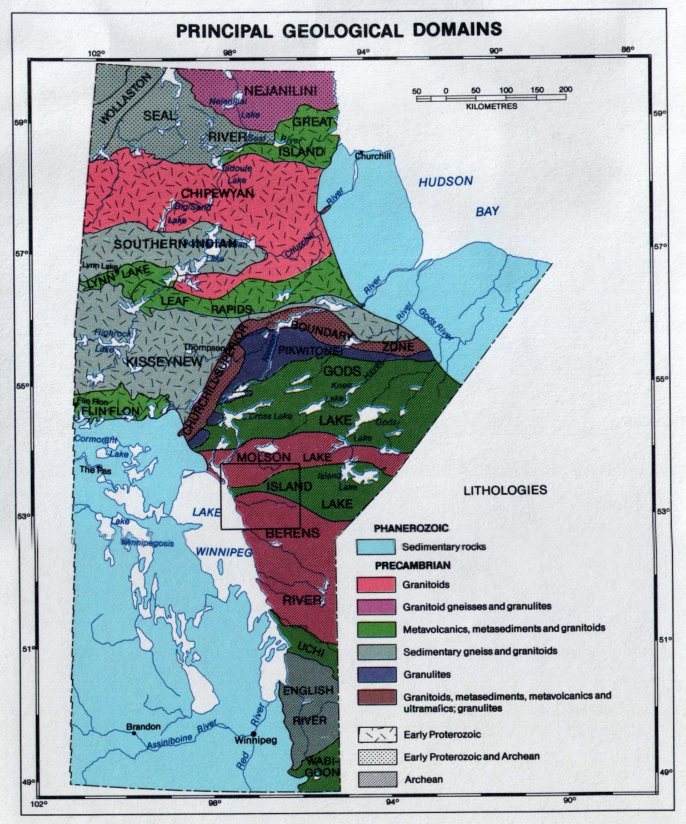


Approximate mean declination (1999) for centre of map
Decreasing 6.3' annually

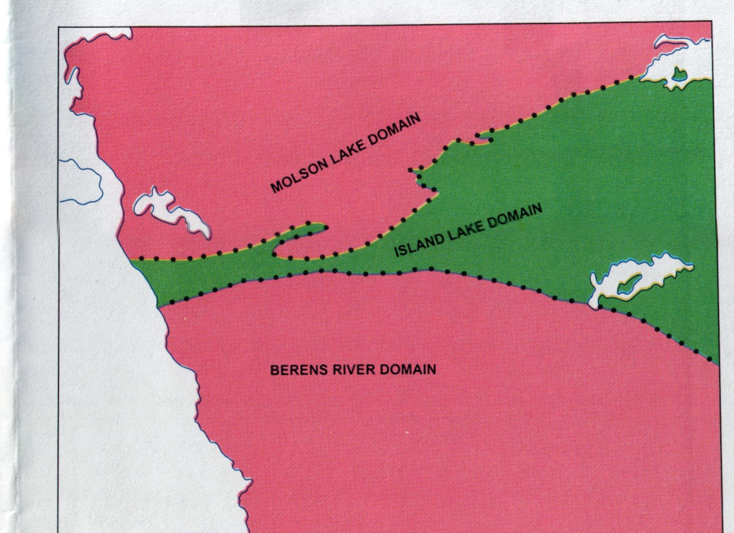
AEROMAGNETIC SHADED RELIEF MAP
(RESIDUAL TOTAL FIELD)



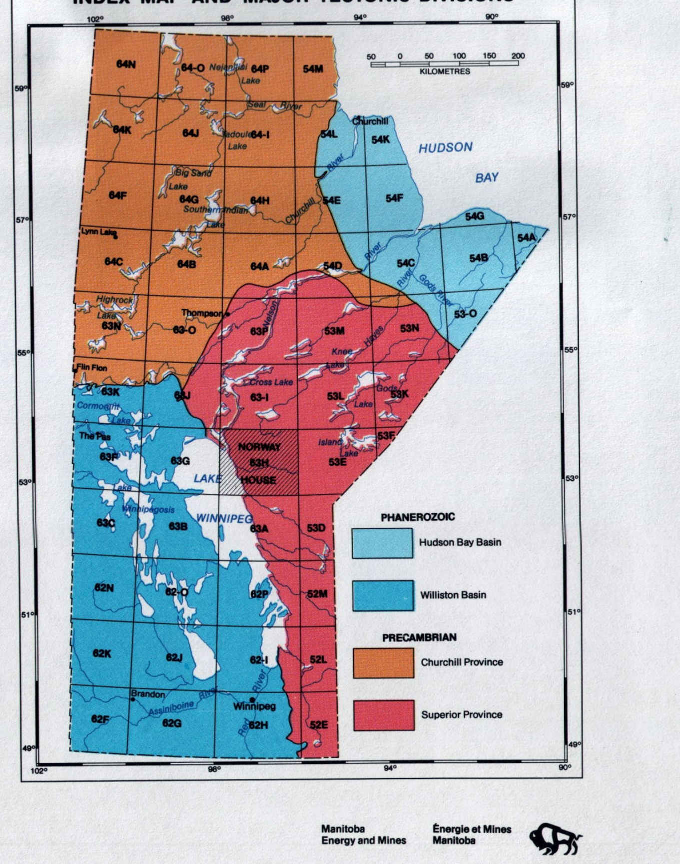
PRINCIPAL GEOLOGICAL DOMAINS



MAJOR PRECAMBRIAN DOMAINS



INDEX MAP AND MAJOR TECTONIC DIVISIONS



Manitoba Energy and Mines