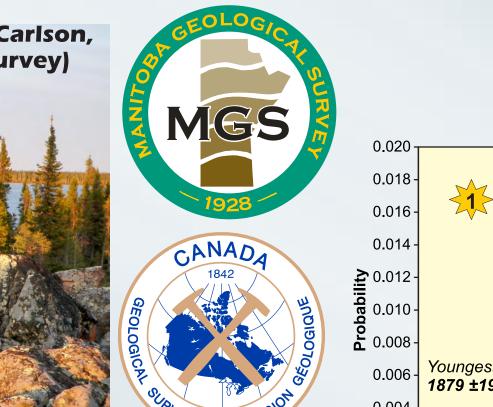


Far North Geomapping Initiative: Bedrock geology of the Great Island area

Linda Murphy, Sharon Lee (Manitoba Geological Survey) Nicole Rayner (Geological Survey of Canada)



Conglomerate (AP1)
S. of Seal River

arc and back-arc volcanic rocks.

belt in Manitoba's far north.

breccia in buff marble (unit P4b).

New U-Pb geochronology results

from the Great Island area

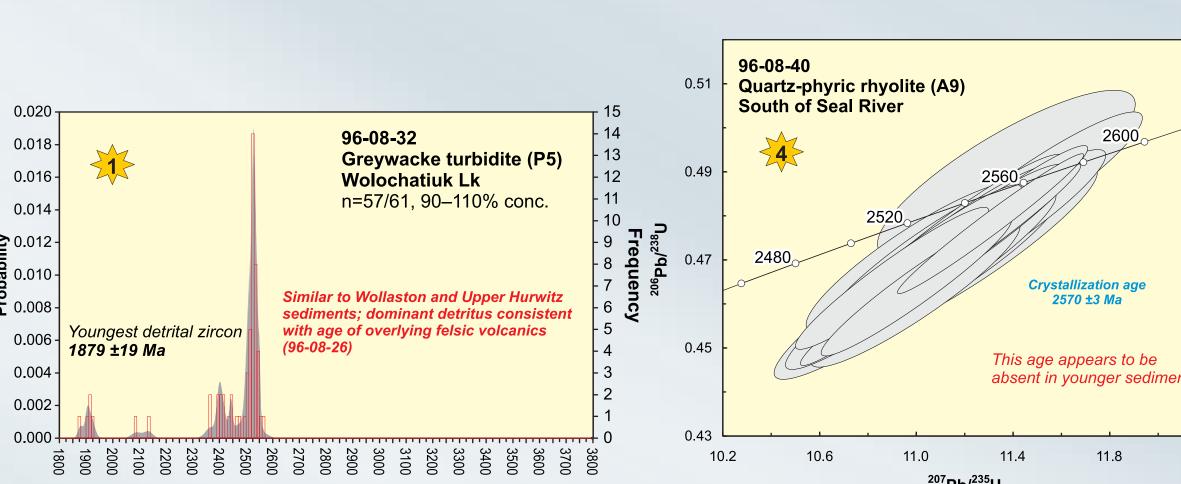
Quartz arenite (P2)

Similar to Wollaston and

Hurwitz quartzites

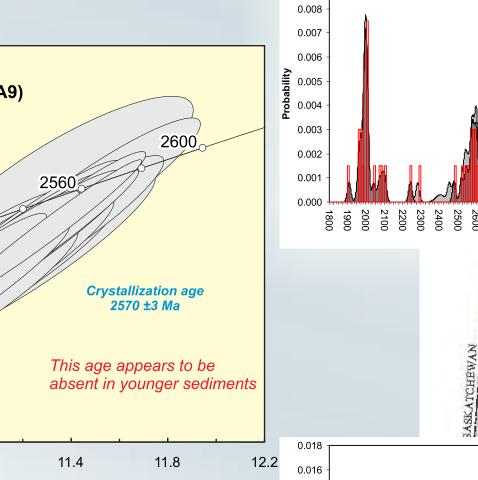
Great Island, N. Seal Rive

n=59/60, 90–110% conc.



Sosnowski Lake assemblage: remnants of an Archean greenstone belt

felsic volcanic rocks, derived volcaniclastic and epiclastic rocks, and iron formations



Interpreted crystallization age
Mean 207Pb/206Pb age of fraction Z1A, Z1D, Z1C

The Sosnowski Lake assemblage (SLA) consists predominantly of subaqueous, mafic to intermediate, lava flows and related intrusions, with rare

continuous sections in the former location range up to 300 m in thickness. These rocks are characterized by patchy epidotization and silicification.

pillow-fragment breccia are more abundant than massive flows. Andesite flows commonly display patchy to pervasive epidotization, silicification

or carbonatization. The mafic volcanic and associated intrusive rocks of the SLA have major- and trace element characteristics similar to modern

Dacite and rhyolite of possible effusive origin (subunit A9a) are a minor component of the SLA (Garlinski and Thibeault lakes, northwestern end of

represent flow-banding. A sample of this outcrop yielded a U-Pb zircon age of 2570 Ma, which makes the SLA the only known Archean greenstone

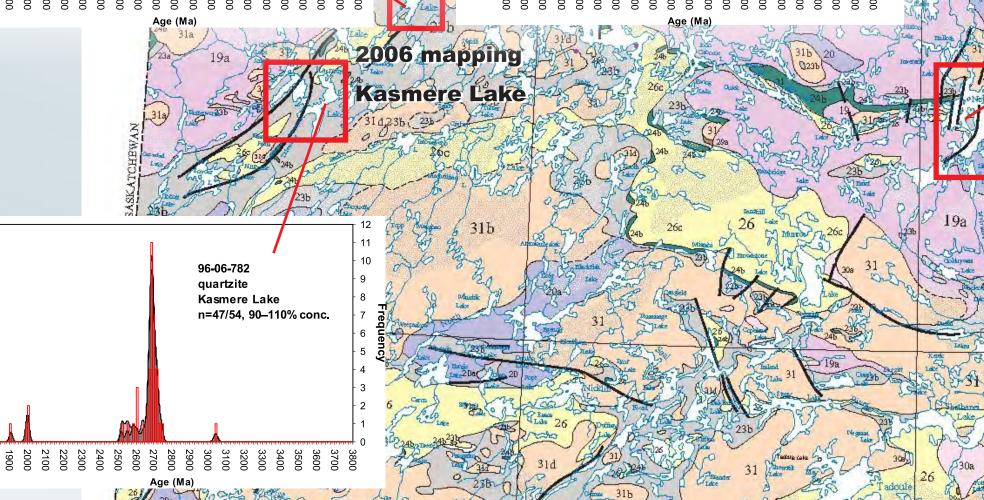
Andesite flows (unit A8) are extensive northeast of Garlinski Lake and south of Hebner and Sosnowski lakes. Pillowed flows and intercalated

Great Island). A distinctive rhyolite at Thibeault Lake contains blue-quartz phenocrysts and very fine-scale compositional layers, interpreted to

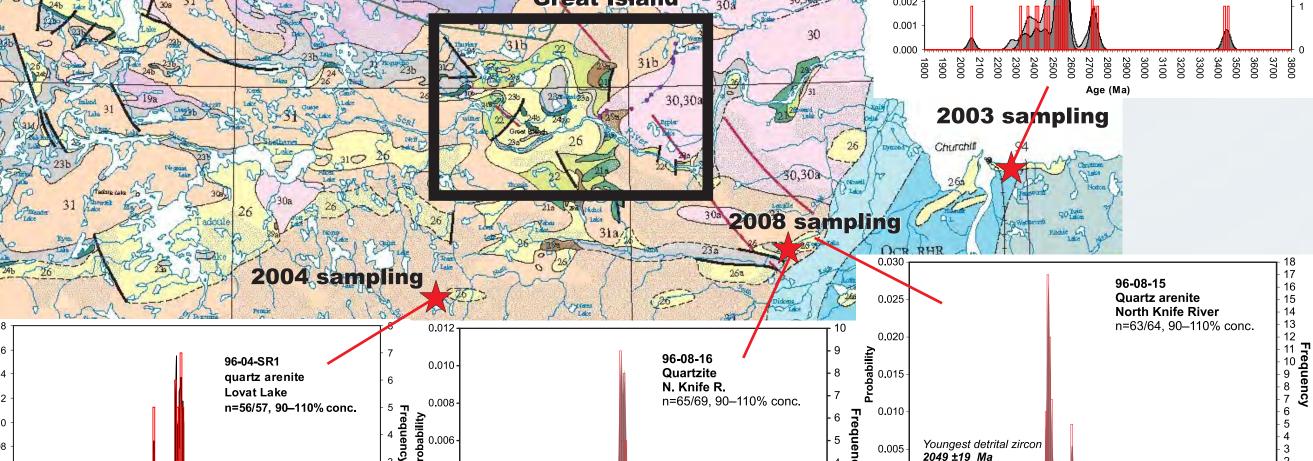
Basalt and basaltic andesite (unit A7) flows are most extensive southwest of Sosnowski Lake and at the northwestern end of Great Island;

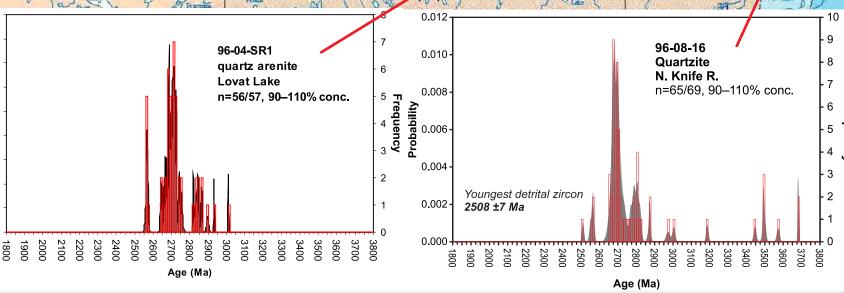
Massive flows transition upward into abundant amoeboid pillow breccia and are locally capped by discontinuous iron formation

corresponds with lower intercept of 2843 ±16 Ma



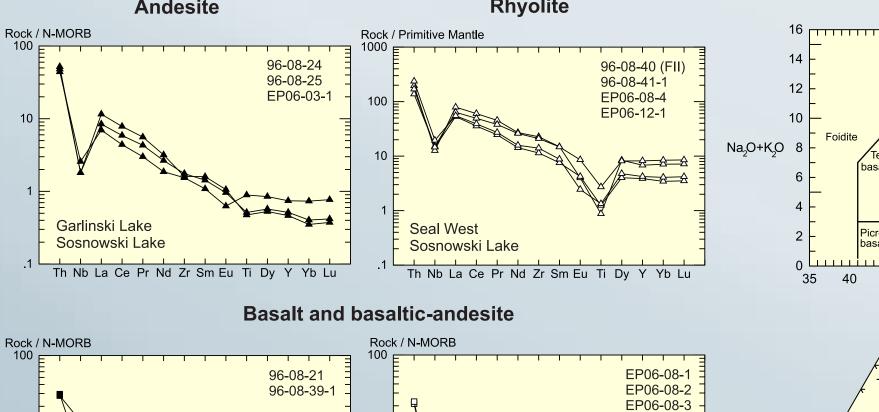
n=43/52, 90–110% conc.



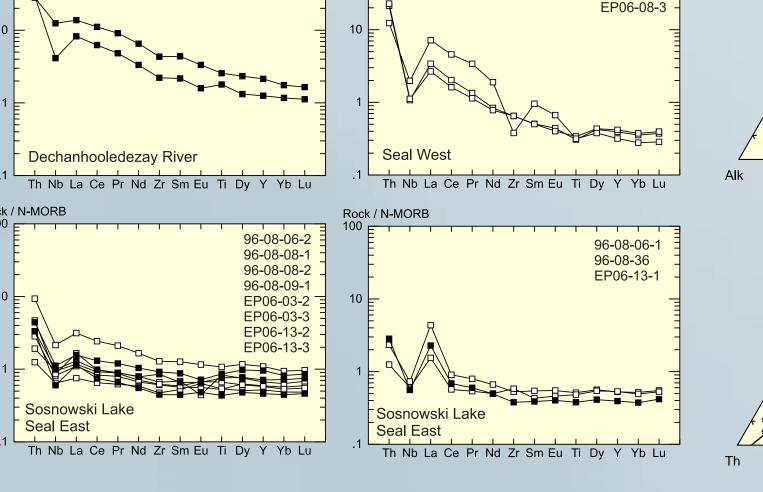


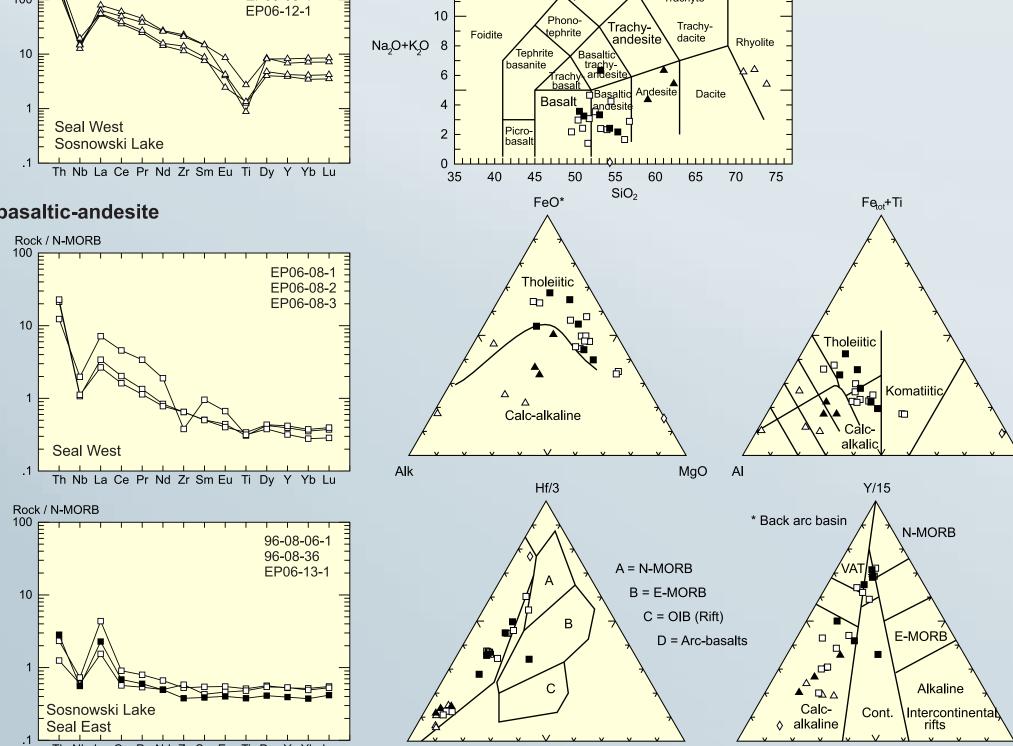
96-05-2013 quartzite Nejanilini Lake

Peaty tundra east of Meades Lake











Bugs are taking over Manitoba's far nort

96-08-15 Quartz arenite North Knife River

Outcrop photographs of alteration and mineralization in supracrustal rocks in flow; n) closed-framework breccia composed of fragments of vein quartz and silicified wallrock in matrix of quartz, sericite and fuchsite; o) sulphidic quartz-pebble conglomerate; p) patchy quartz-magnetite alteration (arrow) in

The diverse geology in the Great Island area has the potential to host a variety of mineral deposits. Much of the area was burned in 1998 and outcrops are cleaner than when last mapped in the 1970s; as a result, a number of new localities with mineralization or alteration were documented. Crossbedded quartz arenite and quartz-pebble conglomerate in the Omand Lake assemblage southeast of Great Island display intense pervasive fuchsite alteration, as well as fracture-controlled to patchy to semiconformable gossan (locally confined to conglomeratic beds) due to the presence of finely-disseminated sulphide minerals. Boulders of quartz-pebble conglomerate observed northeast of Omand Lake are

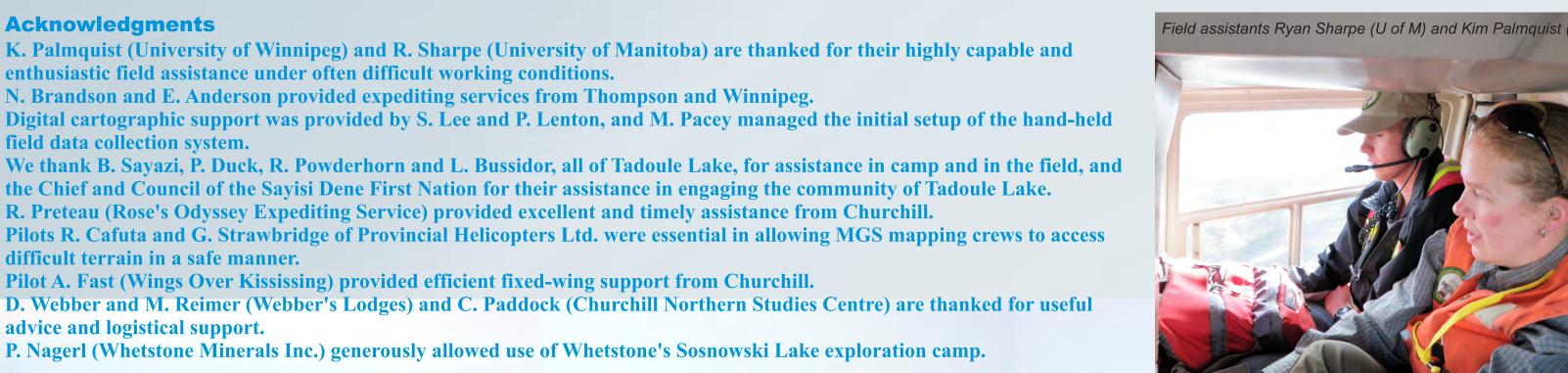
rock (unit A10c); g) stratified polymictic conglomerate (unit AP1a; well-rounded quartzite clasts indicated by arrows) and planar-bedded quartz arenite; h) trough-crossbedded quartz arenite showing quartz-pebble

The Sosnowski Lake assemblage is dominated by mafic to intermediate volcanic rocks that vary considerably in composition and include rocks of both tholeitic and calcalkalic affinity. Volcaniclastic sequences are prominent, which suggests that accumulation occurred in intravolcanic basins or synvolcanic structures. A thin horizon of silicate iron formation, chert and graphitic mudstone at the top of a felsic epiclastic unit south of Hebner Lake indicates a depositional hiatus, and perhaps coeval exhalative activity, within the volcanic succession. Widespread semiconformable alteration (silica, epidote or calcillicate) is locally sufficiently intense to obscure or obliterate primary volcanic and volcaniclastic textures, and is similar to high-temperature alteration associated with volcanogenic massive sulphide deposits. In three locations along the east margin of the belt, intermediate volcanic rocks of the Sosnowski Lake assemblage host unusual zones of intense quartz veining and alteration. These zones trend northeast to east-southeast and range from 30 to 150 m thick over exposed strike lengths of more than 100 m. Closed-framework breccia in the central portions of these zones consists of angular fragments and slabs of vein quartz and intensely silicified wallrock in a matrix of fine-grained quartz, sericite, fuchsite and minor pyrite. Minor through-going quartz veins in the breccia locally appear to 'bleed out' into the surrounding rock. One zone is sharply bound by a brittle fault, whereas another shows a more gradational transition over 23 m from breccia, through a marginal zone of stockwork quartz veins and intensely altered wallrock, to weakly-veined and altered intermediate volcanic rocks. Both matrix and fragments in the breccia are moderately to strongly foliated, which indicates that multiphase quartz veining, alteration and brecciation preceded the latest increments of ductile deformation. Falconbridge Limited reported values up to 520 ppb Au from grab samples of this breccia (Assessment File 92910), which have never been followed up in detail.



stratabound silica-magnetite alteration.

uartz arenite and associated mudstones in the Great Island Group locally contain fracture-controlled, disconformable to semi-conformable hematite or silica alteration. The hematite-altered rocks are characterized by brick-red weathered surfaces and locally well-developed Liesegang banding, which indicates repeated fluid infiltration. Zones of intense and pervasive semi-conformable silica alteration locally range up to at least 150 m thick. The silicification obscures primary features in quartz-arenite beds and is associated with stockwork and/or sheeted quartz veins. Other outcrops of quartz arenite show patchy to K. Palmquist (University of Winnipeg) and R. Sharpe (University of Manitoba) are thanked for their highly capable and



Pilot A. Fast (Wings Over Kississing) provided efficient fixed-wing support from Churchill. D. Webber and M. Reimer (Webber's Lodges) and C. Paddock (Churchill Northern Studies Centre) are thanked for useful P. Nagerl (Whetstone Minerals Inc.) generously allowed use of Whetstone's Sosnowski Lake exploration camp.



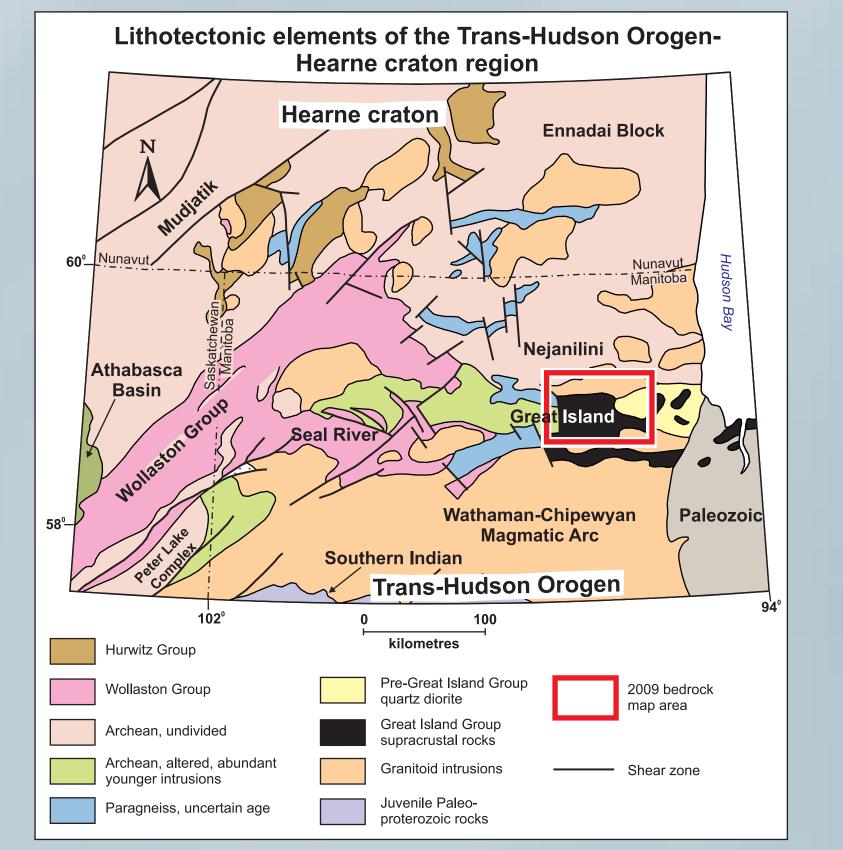
A major new phase in the remapping of selected portions of Manitoba's fa north was initiated in 2008 with a scoping study and continued with a focuse effort in 2009. The Great Island area, 120 km west of Churchill, was chosen because of its importance to the resolution of several fundamental question pertaining to the Precambrian geology and mineral potential of northern includes the only known exposures of metavolcanic rocks in Manitoba's far north and contains several important mineral occurrences.

Neoarchean and possible Mesoarchean 'basement' rocks at the Hearne craton in shoreline outcrops on the Seal River, 30 km downstream from the east end heterogeneous biotite (±hornblende) granite and discordant dikes of biotite granodiorite, hornblende porphyry (diorite), feldspar porphyry (rhyolite) and

assemblage) that are in turn unconformably overlain by the Paleoprotein Great Island Group, exposed in a structurally complex, north-trending

The Great Island Group is divided into lower and upper subgroups, which are provisionally interpreted to represent marine-deltaic and basinal-marine depositional settings, respectively. Sandstone beds in the former are mostly composed of relatively mature quartz arenite, whereas those in the latter consist of relatively immature feldspathic greywacke. Oxide-silicate facies iron formation forms the base of each of the subgroups, which in addition feature distinct units of dolomitic marble and mudstone.

Intrusive rocks ranging in composition from granite to peridotite are a significant component of both the Seal River intrusive complex and the Garlinski Lake greenstone belt, but are nowhere observed in the overlying Great Island Group. Emplacement is thus constrained to the late Neoarchean to earliest Paleoproterozoic. On the basis of composition and texture, these rocks are divided into seven map units, the relative and absolute ages of which are unknown.



Regional setting

The Archean continental crust of the southeast Hearne craton is overlain by Paleoproterozoic cover rocks and, together with the cover rocks, has been variably overprinted by tectonothermal and magmatic activity associated with the Paleoproterozoic Trans-Hudson orogeny. In Manitoba, the southeast margin of the Hearne craton is divided into the Mudjatik, Wollaston, Seal River, Great Island and Nejanilini domains, which are distinguished by their respective proportions of cover and possible basement rocks and, to a lesser extent, by their structural trends and metamorphic grade. The area investigated in 2009 lies wholly within the Great Island Domain, which is bounded to the north by the Nejanilini Domain and to the south by the WathamanChipewyan plutonic

The Nejanilini Domain is dominated by granulite-grade metaplutonic rocks, with minor enclaves of metasedimentary rocks, and is interpreted vestiges of the Meso- to Neoarchean basement of the Hearne craton. The Great Island Domain, in contrast, is characterized by the presence of widespread metasedimentary rocks of generally lower-metamorphic grade and inferred Paleoproterozoic age that were assigned to the Great Island Group by Schledewitz (1986). These rocks unconformably overlie metaplutonic rocks of probable Archean age and are inferred to be broadly correlative with similar, comparatively well-dated rocks of the ca. 2.1-1.9 Ga Wollaston Supergroup in Saskatchewan and the partially timeequivalent ca. 2.5-1.9 Ga Hurwitz Group in Nunavut. In the study area, the Great Island Group defines a largely intact, though structurally complex, synclinorium (the 'Great Island basin' of Schledewitz, 1986), which is everywhere underlain by metavolcanic rocks of presumed Archean or Early Paleoproterozoic age. To the west, the Great Island Domain transitions into partially equivalent, though generally higher-grade, rocks of the Seal River Domain.

The Wathaman-Chipewyan plutonic complex separates the Great Island Domain from accreted juvenile Paleoproterozoic terranes farther south in the Reindeer Zone of the Trans-Hudson Orogen, and is interpreted to represent a remnant of a vast, ca. 1.86 Ga continental magmatic arc. Widespread syn- to late-tectonic granodiorite, quartz monzonite and granite plutons in the Great Island Domain are superficially similar to plutons in the Wollaston Domain in Saskatchewan that have yielded ages ranging from 1.84 to 1.80 Ga, which corresponds to the main period of Hudsonian granite emplacement throughout the western Churchill

Peak-metamorphism in the greenschist to lower-amphibolite facies characterizes the mineral assemblages in supracrustal rocks in the eastern Great Island Domain, including the Great Island Group. Upper-amphibolite facies assemblages (biotitesillimanite±cordierite±garnet) are observed in paragneiss northwest of Great Island and appear to require the presence of a local metamorphic discontinuity with the overlying Great Island Group.

Reference: Schledewitz, D.C.P. 1986: Geology of the Cochrane and Seal rivers area; Manitoba Energy and Mines, Geological Report GR80-9, 139 p.

/ / Bedding: tops unknown, known, overturned Pillows: tops unknown, known, overturned

Mackenzie dike

Dike inferred from magnetics, age unknown

Extent of GSC magnetic data (Fortin et al., 2009)

Fold axis: symmetry unknown, S, Z

Geological contacts (in part inferred from geophysical data)

Mesoarchean to Neoarchean Seal River intrusive complex Late Neoarchean or Paleoproterozoic (? AP7
Serpentinite, peridotite, gabbro
a) Peridotite: serpentinized
b) Leuco- to mesogabbro Granitic pegmatite

— Intrusive contact —

Greywacke-mudstone turbidites; thin, feldspathic greywacke

Greywacke-mudstone¹ turbidites; thick, quartzose greywacke beds

Actinolite ± diopside calcsilicate

Black-grey, graphitic and sulphidi

Green with pink garnetiferous beds

Quartz arenite with subordinate mudstone²

b) Grey-brown, micaceous
 c) Reddish brown, hematitic
 d) Light grey-green, sericitic

Dolomitic marble and calcsilicate rocks

Mudstone with subordinate arenite

a. 1.27 Ga Mackenzie dike swarm

Feldspar (± hornblende, quartz) porphyry (dikes) Quartz ± feldspar porphyry AP4

Granite, granodiorite

a) Equigranular

b) Porphyritic

c) Augen granite AP3 Gabbro; derived amphibolite AP2 Two-mica granite

Hornblende diorite (dikes) Biotite granodiorite (dikes)5 Biotite ± hornblende granite; heterogeneous Orthogneiss

a) Includes amphibolite or metagabbro enclaves ungest detrital zircon 1980 Ma; latest Paleoproterozoic detritus dominates ungest detrital zircon 1880 Ma; Mesoarchean detritus dominates

Late Neoarchean or Paleoproterozoic Sarlinski Lake greenstone belt

Conglomerate and quartz arenite³

Gabbro; may include ultramafic phases

c) Heterolithologicd) Felsic volcanic sandstone, bedded

a) Massive to brecciated (probable flows)

b) Dacite dikes: porphyritic, locally amygdaloidal

b) Pillowed flows, flow breccia: plagioclase phyric

Pillowed to massive flows, flow breccia: aphyric Pillowed to massive flows, flow breccia: plagioclase phyric

Andesite

a) Pillowed flows, flow breccia: aphyric; includes rare massive

Basalt and basaltic andesite; related gabbro

Dacite and rhyolite⁴

Diabase (dikes)

a) Polymictic pebble and cobble conglomerate

Omand Lake assemblage

Sosnowski Lake assemblage

(A4 - A6) Biotite granodiorite (A3; ca. 2860 Ma) Archean basement (A1 - A2; >2860 Ma)

Schematic

stratigraphi

Post-tectonic dikes

(1269 Ma)

Upper subgroup

Basinal marine

Marine-deltaic

angular unconformity

Intrusive rocks

Hypabyssal dike swarms

Arc and back-arc (A7 - A13; ca. 2570 Ma)

(AP2 - Ap7) Omand Lake assemblage Fluvial-alluvial basin (AP1; <2613 Ma)

characterized by intense sericite-hematite alteration of the matrix material, resulting in a distinctive brick-red appearance. The metallogenic significance of these alterations, if any, remains unclear, but similar rocks further to the southeast are reported to contain anomalous concentrations of Au (up to 430 ppb; Assessment File 92910) and show evidence of significant potential for paleoplacer Au deposits. Outcrop photographs of characteristic rock types in the Sosnowski Lake and Omand Lake assemblages of the Garlinski Lake greenstone belt: e) pillowed

iron formation (unit P1a) near the base of the Great Island Group; j)

interlayered quartz arenite and mudstone showing beds of massive and

crossbedded quartz arenite and well-developed load structures (arrows; unit

P2b); k) thin-bedded and laminated mudstone (unit P3); l) possible karstic

conglomerate bottomsets (unit AP1a).



type locality on the Seal River, east of Great Island: a) multicomponent orthogneiss (unit A1); b) orthogneiss and biotite granite (units A1 and A2) crosscut by a granodiorite dike (unit A3); c) intrusion breccia composed of angular granitoid xenoliths in a matrix of hornblende porphyry (diorite; unit A4); d) thick chilled margin (indicated by arrow) on feldspar-porphyry dike