Manitoba Far North Geomapping Initiative: Bedrock geology of the Seal River region

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Far North Geomapping Initiative — Manitoba

Sosnowski Lake camp (for sale)

Summary

Bedrock mapping in the Seal River region, supported by SHRIMP and ID-TIMS U-Pb geochronology, has fundamentally advanced our understanding of the complex nature, protracted evolution and diverse mineral potential of the southeast Hearne craton margin, one of the last remaining frontier areas in Manitoba. Of particular importance for regional tectonic correlations as well as mineral exploration is a new chronology of four sedimentary sequences, including U-Au-REE-mineralized conglomerate now recognized as a Neoarchean sedimentary sequence that unconformably overlies a Neoarchean greenstone belt with known Au occurrences. The revised stratigraphy and map provide a solid framework for mineral exploration and are key to resolving fundamental questions pertaining to the Precambrian geology and mineral potential of Manitoba's underexplored far northeast.

This report summarizes the results of fieldwork completed in 2010 during the second summer of bedrock mapping under the auspices of the Far North Geomapping Initiative – a three-year study of the Hearne craton margin in Manitoba being undertaken by the Manitoba Geological Survey (MGS) in conjunction with the Geological Survey of Canada (GSC) Geo-Mapping for Energy and Minerals (GEM) program.

The main objective of the Far North Geomapping Initiative is to further understanding of the nature, evolution and mineral potential of the Hearne craton margin, one of the principal geological building blocks of Manitoba's Precambrian shield. The 2010 map area extends south from near the Nunavut boundary to the North Knife River and west from the Hudson Bay coastline to the eastern boundary of Caribou Provincial Park, and thus represents a substantial addition to the map of the Great Island area released in 2009. By extending the new mapping significantly outward into the relatively underexplored and inadequately studied areas northeast and south of Great Island, we were able to gain a much improved understanding of the regional geological context of the principal map units and have acquired a substantial new geoscience dataset to inform land use planning decisions and guide mineral exploration. New bedrock mapping in far northeast Manitoba now covers an area of approximately 16,000 km².

Regional setting

The southeast margin of the Hearne craton comprises a heterogeneous basement of Archean orthogneiss, granitoid intrusions and rare supracrustal rocks overlain by scattered erosional remnants of latest Archean and Paleoproterozoic siliciclastic cover sequences, all of which have 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 proportions of cover and possible basement rocks and, to a lesser extent, by their structural trends and metamorphic grade (Schledewitz, 1986). As defined by Schledewitz (1986), the area investigated in 2010 includes the eastern portion of the Nejanilini Domain and parts of the Seal River and Great Island domains. The Nejanilini Domain is dominated by metaplutonic rocks, with minor enclaves of high-grade metasedimentary rocks, and is interpreted to include vestiges of the Archean basement of the Hearne craton. The Seal River and Great Island domains, which are herein collectively referred to as the Seal River Domain, are characterized by a dome-and-basin structural geometry, with the 'domes' defined by metaplutonic and metavolcanic rocks of known or inferred Archean age, and the 'basins' defined by synforms of latest Archean and Paleoproterozoic continental and marine siliciclastic rocks. To the south, the Seal River Domain is separated from accreted juvenile Paleoproterozoic terranes in the internides of the Trans-Hudson Orogen by the Wathaman–Chipewyan plutonic complex – a remnant of a vast continental magmatic arc that was emplaced between 1.87 and 1.85 Ga. In the southeast corner of the map area the Precambrian rocks are unconformably overlain by flat-lying Ordovician sandstone, limestone and dolomite at the west margin of the Hudson Bay basin.

Seal River Domain

The Seal River Domain defines the southeast margin of the Archean Hearne craton in Manitoba and comprises a geologically diverse and complex assembly of rocks that records nearly two billion years of early Earth history. The Seal River Domain contains the only known occurrences of volcanic rocks in Manitoba's far north and is characterized by the widespread preservation of siliciclastic cover sequences as relatively intact synforms that unconformably overlie older orthogneiss and volcanoplutonic terranes. Based on the results of the 2010 field program and ongoing U-Pb geochronology, the siliciclastic cover rocks, which were previously referred to as the 'Great Island Group' have been subdivided into four distinct sequences that provide a discontinuous record, spanning at least 700 million years, of intracratonic sedimentation and basin evolution at the south margin of the Hearne craton.

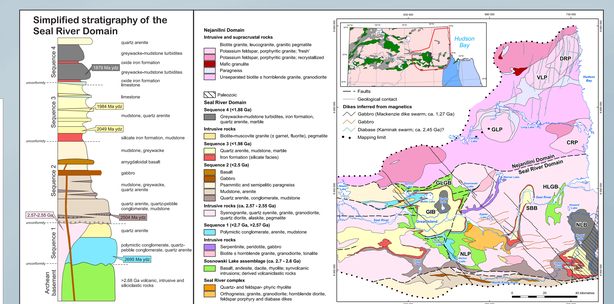
Nejanilini Domain

In the far northeast of Manitoba, the Nejanilini Domain consists mainly of unseparated granitoid orthogneiss (unit Na1) that contains enclaves of migmatized supracrustal rocks (units Na2 and Na3) and is intruded by strongly recrystallized (unit Na4) and comparatively fresh (unit Na5) porphyritic granite plutons, late granitoid sheets and dikes (unit Na6), and an interpreted swarm of discordant mafic dikes (Np1; see PMAP2010-1).

The south margin of the Nejanilini Domain is marked by a zone of greenschist-facies mylonite that ranges up to several kilometers wide and marks the northern limit of the relatively intact basins of supracrustal rocks that characterize the Seal River Domain.

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

Simplified stratigraphy of the Seal River Domain



Economic considerations

The diverse geology and nearly two billion years of early Earth history of the Seal River region have 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.

In the Seal River Domain, vestiges of Paleo- and Mesoarchean crust, Neoarchean (ca. 2.7–2.6 Ga) volcanic belts and fault-controlled fluvial-alluvial basins (<2.70 Ga) are intruded by voluminous Neoarchean (2.57–2.55 Ga) granitoid intrusions. Subaqueous volcanic rocks within this heterogeneous basement terrane exhibit good potential for several types of mineral deposits, including exhalative base-metal sulphides, shear-hosted (quartz-carbonate vein) Au and iron formation Au.

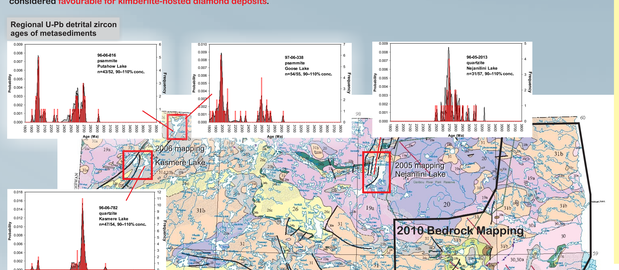
Quartz pebble conglomerate horizons in the fault-controlled fluvial-alluvial basins (Sequence 1) are being actively explored for paleoplacer Au-U deposits. Widespread erosional remnants of siliciclastic cover rocks in the Seal River Domain provide a discontinuous record of intracratonic sedimentation and basin evolution spanning at least 700 million years and show evidence of additional mineral potential. For example, horizons of supermature quartz pebble conglomerate near the base of Sequence 2 are considered to have good potential to host paleoplacer Au-U deposits, whereas coeval basalt flows higher up in the sequence indicate the possibility of high heat flows during sedimentation and thus potential for sedimentary exhalative sulphide (SEDEX) deposits.

Furthermore, the protracted depositional history recorded by these rocks requires the presence of long-term stable (i.e., thick) crust of the type considered favourable for kimberlite-hosted diamond deposits.

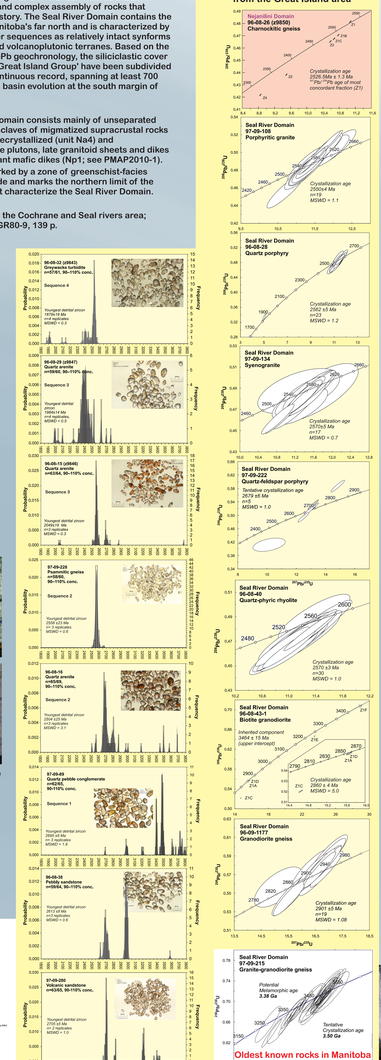


Outcrop photographs of alteration and mineralization in supracrustal rocks in the Great Island area: u.l.) intense calcsilicate alteration of pillowed andesite flow; u.r.) closed-framework breccia composed of fragments of vein quartz and silicified wallrock in matrix of quartz, sericite and fuchsite; l.l.) sulphidic quartz-pebble conglomerate; l.r.) patchy quartz-magnetite alteration (arrow) in crossbedded quartz arenite.

Regional U-Pb detrital zircon ages of metasediments



New U-Pb geochronology results from the Great Island area

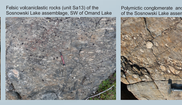




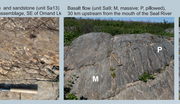
3.5 Ga granitic gneiss (unit Sa1) of the Seal River complex, north of Seal River (sample 97-09-215)



Multicomponent orthogneiss (unit Sa1) and metasedimentary enclave (unit Sa2) cut by biotite granodiorite dike (unit Sa3) Seal River complex



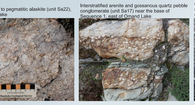
Felsic volcaniclastic rocks (unit Sa13) of the Sosnowski Lake assemblage, SW of Omand Lake



Polymictic conglomerate and sandstone (unit Se13) of the Sosnowski Lake assemblage, SE of Omand Lake



Basalt flow (unit Se9; M, massive; P, pillowed), 30 km upstream from the mouth of the Seal River



Granitoid orthogneiss (unit Se15), Northeast of Eyzler Lake



Coarse-grained to pegmatitic alaskite (unit Sa22), NW of Nowell Lake



Interstratified arenite and gossanous quartz pebble conglomerate (unit Sa17) near the base of Sequence 3 east of Omand Lake



Quartz, feldspar and lithic pebbles in a thin conglomeratic layer in quartz arenite (unit Sa21) near the base of Sequence 2, North Knife River

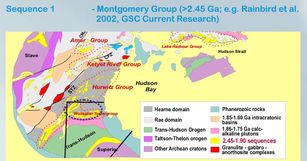


Massive basalt flows in Sequence 2 (unit Se5?) defined by variations in quartz amygdule content, approximately 20 km upstream from Teepee Falls

Andalusite porphyroblastic psammitic arenite of Sequence 2 (unit Sa2), SW of Lovat Lake

Muscovite-biotite-garnet-fluorite granite (unit Sp4) that intrudes Sequence 2, south of Great Island on the North Knife River

Tough crossbedded quartz arenite (unit Sp13) at the top of Sequence 4 in the central portion of the Nowell Lake basin, northeast of Nowell Lake



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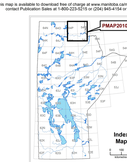
Laser-ablation multi-collector ICP-MS detrital zircon age data, University of Alberta
Radiogenic Isotope Facility

Precambrian geology of the Seal River region, Manitoba (parts of NTS 54L, M, 64I, P)

Geology by: S.D. Anderson, C.O. Böhm and E.C. Syme

This map is a provisional summary of work carried out during the summer field season and is produced directly from the geologist's manuscript. It is not to be regarded as a final interpretation of the geology of the area.

This map is available to download free of charge at www.manitoba.ca/minerals; to purchase a copy contact Publication Sales at 1-855-GEO-5378 or (204) 945-4154 or minerals@gov.mb.ca.



Cartography by S.K.Y. Lee

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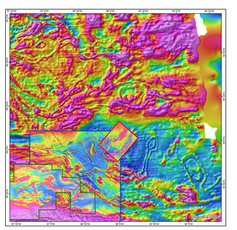
Anderson, S.D., Böhm, C.O. and Syme, E.C. 2010: Precambrian geology of the Seal River region, Manitoba (parts of NTS 54L, M, 64I, P); Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, Preliminary Map PMAP2010-1, scale 1:175 000.



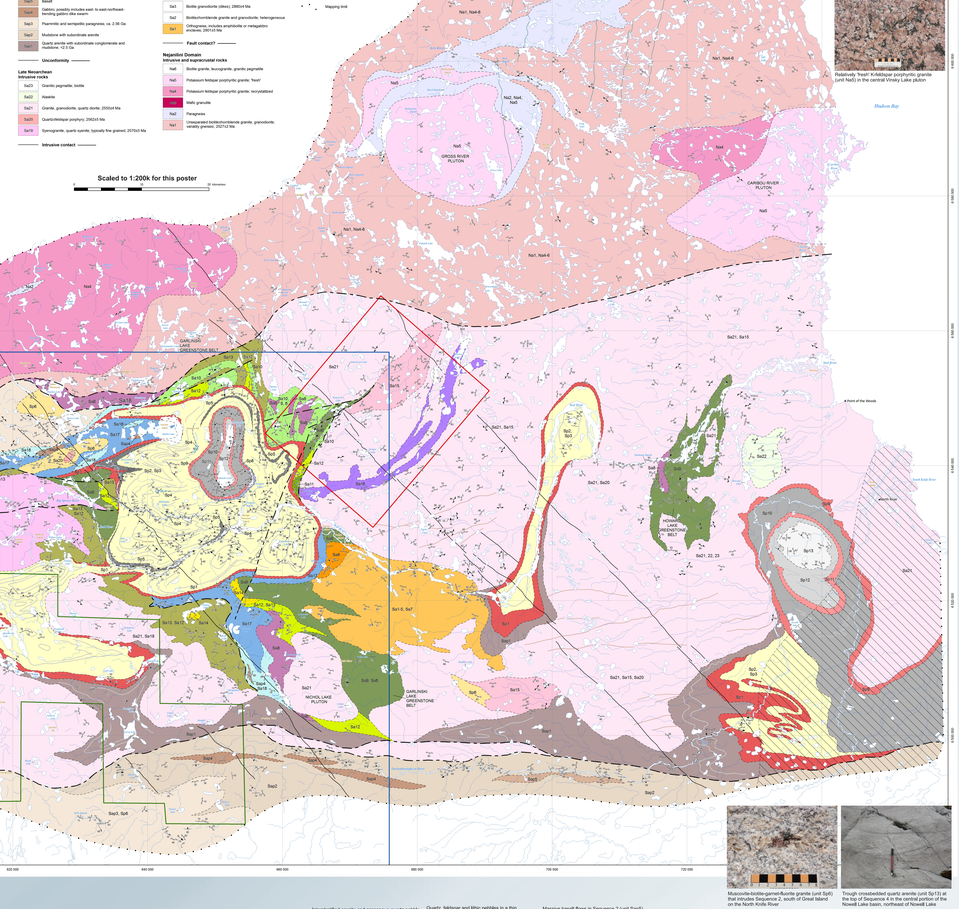
Scaled to 1:200k for this poster

SOURCES OF AEROMAGNETIC DATA
Assessment File 74007, Manitoba Innovation, Energy and Mines, Winnipeg. Airborne magnetic and MEGATEM Survey, Seal River and Kaweskot blocks, Churchill, Manitoba. BHP Billiton World Exploration Inc.

Assessment File 94132, Manitoba Innovation, Energy and Mines, Winnipeg. High resolution aeromagnetic survey (HRAM) logistical report for Western Wemyt Resources Ltd, Eppler Lake Project, Churchill area, Manitoba, NTS 54L/13 (west), 64I/16, & 64P/1.

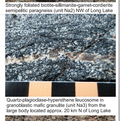
Fiorin, R., Coyle, M., Carson, J.M. and Kiss, F. 2009: Airborne geophysical survey of the Great Island and Seal River areas, Manitoba (parts of NTS 54L/13, 54M/4, 64I/16, 64P/1, 64P/2, 64P/7, 64P/8, 64P/9, 64P/10, 64P/15, 64P/16, 64P/17, 64P/18, 64P/23 and part of 64L/12, 64I/07, 64I/08, 64I/09 and part of 64L/05; parts of Mb, MAP, 54L and 64M), Manitoba Geological Survey, Open File OF2009-1, 1:50 000 scale maps and 1:100 000 scale maps, Manitoba Geological Survey, Open File OF2009-1-2, 1:DVD-ROM (120 colour maps), scale 1:50 000.

Vilpen, D., Charbonneau, L., Lenton, P. and Broome, H.J., 1999: Geology, magnetic & gravity maps of Manitoba: A Digital Perspective; Geological Survey of Canada, Open File D3680; Manitoba Energy and Mines, Geological Services, Open File Report OF99-10, 1:1 CD-ROM.





Strongly foliated biotite-sillimanite-garnet-orthoclase semipelitic paragneiss (unit Na2) NW of Long Lake



Quartz-plagioclase-hypersthene ± muscovite ± orthoclase porphyritic granite (unit Na5) from the large body located approx. 20 km N of Long Lake



Strongly recrystallized K-feldspar porphyritic granite (unit Na6) from the Dickins River pluton

Relatively 'fresh' K-feldspar porphyritic granite (unit Na5) in the central Vinsky Lake pluton

