Bedrock mapping in the Partridge Crop Lake area, eastern margin of the Thompson Nickel Belt

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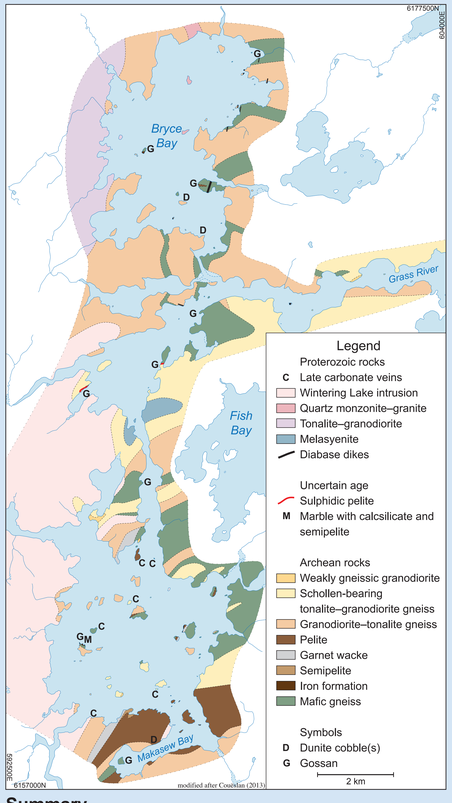
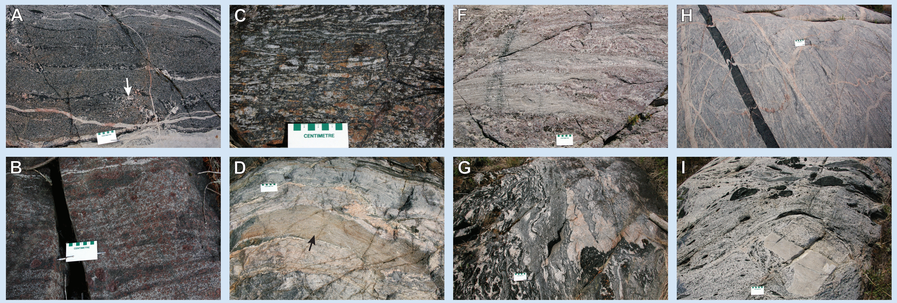


Summary

A project to re-map portions of the Archean Pikwitonei granulite domain in central Manitoba, with emphasis on interpretation of protoliths, was extended into the Partridge Crop Lake area in 2013. This area was subjected to relatively uniform, high-grade Neoarchean metamorphism and deformation, and was variably overprinted by high-grade Paleoproterozoic metamorphism and deformation. Exposures in the Partridge Crop Lake area are divided into three main age groups: Archean rocks, rocks of uncertain age, and Proterozoic rocks. Archean rocks include mafic gneiss, pelitic rocks, garnet wacke, iron formation granodiorite–tonalite gneiss, schollen-bearing tonalite–granodiorite gneiss, and weakly gneissic granodiorite. Rocks of uncertain age include sulphidic pelite, and semipelite associated with calcsilicate, impure marble, and ultramafic amphibolite. Proterozoic rocks consist of diabase dikes, melasyenite, several granitoid plutons, pegmatitic and aplitic granite dikes, and carbonate rocks of uncertain affinity. A roughly east-west-trending, subvertical Archean gneissosity is transected at a high angle over much of the area by a subvertical Paleoproterozoic foliation that is axial planar to minor folds. The Paleoproterozoic deformation becomes increasingly intense towards the west where the Archean gneissosity is transposed into the Paleoproterozoic foliation. Archean granulite-facies metamorphic assemblages are progressively overprinted by upper amphibolite-facies metamorphic assemblages from east to west across the map area.

Sedimentary sequences similar to the Ospwagan Group, exposures of sulphidic ultramafic amphibolite, and loose cobbles of serpentinized dunite suggest the area could be prospective for magmatic nickel deposits. Gossanous zones associated with iron formation and garnetite in mafic gneiss suggest potential for Archean gold and base metal (VMS) mineralization.

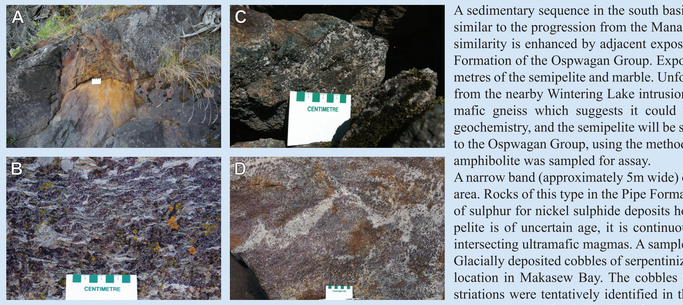
Archean rocks



A) Amphibolitized mafic gneiss with texturally preserved Archean leucosome (arrow). B) Garnet-rich mafic gneiss. The largely preserved Archean mineral assemblage consists mostly of garnet, orthopyroxene, and plagioclase. The mafic gneiss is locally interbanded or spatially associated with garnetite, (C) iron formation, (D) chert, and (E) Al-rich rocks, and rarely garnet-bearing marble. C) Iron formation typically forms centimeter-scale bands in mafic gneiss, but can also form horizons up to several meters thick. D) Chert horizons are relatively rare and contain bands of lean iron formation (arrow). E) Aluminous bands (arrow) in the mafic gneiss are garnet- and biotite-rich and appear pelitic; however they are K-feldspar-free and commonly contain amphibole and cordierite.

F) Pelitic granulite with abundant garnet, orthopyroxene, cordierite, sillimanite, and K-feldspar. G) Retrogressed pelite and semipelite, cordierite, orthopyroxene, and garnet have been replaced or partially replaced by biotite ± chlorite. H) Granodiorite gneiss with cross-cutting amphibolitized diabase dike. I) Schollen-bearing tonalite gneiss with abundant schollen (xenoliths) of amphibolite and locally anorthosite (right of scale card). J) Weakly gneissic granodiorite. The gneissosity is defined by the attenuation of Archean leucosome and schlieric material.

Economic Considerations



A) Local gossanous bands within the mafic gneiss are typically sub-concordant to the gneissosity. B) Aluminous bands within or closely associated with the mafic gneiss are typically enriched in Mg and Fe and may represent zones of hydrothermal alteration. C) Rare bands of garnet-bearing marble are also present in the mafic gneiss and may represent zones of carbonate alteration. Local bands of D) garnetite and E) iron formation, and rare bands of chert are associated with the mafic gneiss. This suggest that some or all of the mafic gneiss could represent mafic metavolcanic rocks and that volcanism was accompanied by syn-volcanic hydrothermal systems and exhalative sediment deposition.

A sedimentary sequence in the south basin consisting of semipelite grading into calcsilicate and impure marble, is similar to the progression from the Manasan Formation to the Thompson Formation of the Ospwagan Group. This similarity is enhanced by adjacent exposures of iron formation, which could potentially be correlated to the Pipe Formation of the Ospwagan Group. Exposures of sulphidic, ultramafic amphibolite are also present within several metres of the semipelite and marble. Unfortunately this sequence has been partially disrupted by granitic stockwork from the nearby Wintering Lake intrusion. The sedimentary sequence is also closely associated with exposures of mafic gneiss which suggests it could be Archean. The semipelite and marble were sampled for bulk-rock geochemistry, and the semipelite will be submitted for Sm-Nd isotopic analysis to ascertain its possible relationship to the Ospwagan Group, using the methodology set out by Böhm et al. (2007). A sample of the sulphidic ultramafic amphibolite was sampled for assay.

A narrow band (approximately 5m wide) of sulphidic and graphitic pelite is present in the central portion of the map area. Rocks of this type in the Pipe Formation of the Ospwagan Group are considered to have been the main source of sulphur for nickel sulphide deposits hosted by ultramafic intrusions of the Thompson nickel belt. Although the pelite is of uncertain age, it is continuous over a couple of kilometres and could have supplied sulphur to any intersecting ultramafic magmas. A sample of sulphidic and graphitic pelite was selected for bulk-rock geochemistry.

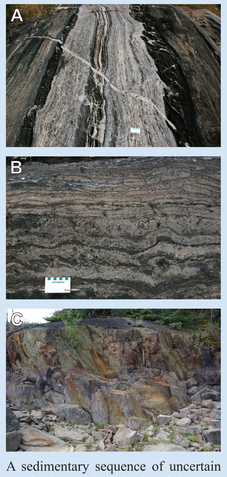
Glacially deposited cobbles of serpentinized dunite were observed at two locations in southeast Bryce Bay, and one location in Makasew Bay. The cobbles are subangular suggesting limited transport. Two generations of glacial striations were tentatively identified in the Partridge Crop area: an older set trending approximately 200°, and a younger set trending 260°. Therefore, an ultramafic body similar to those that generated the nickel deposits of the Thompson nickel belt may lie to the east and north of Bryce Bay.

Gossanous zones up to one metre thick are locally present within the mafic gneiss. These zones are typically subconcordant to the gneissosity and spatially associated with bands of silicate- and oxide-facies iron formation, and garnetite. The presence of exhalative sedimentary rocks suggests that these sections of mafic gneiss likely represent mafic volcanic rocks, and the gossanous zones in association with exhalative sedimentary rocks suggest a potential for both gold and base metal (VMS) mineralization. Samples of sulphide-bearing iron formation and mafic gneiss were collected for assay.

Samples of the carbonatite-like bands from outside the map area, and the carbonate veins from the south basin of the map area were collected for geochemical and petrographic analyses. Carbonatites are important sources for a variety of rare metals (REE, Y, Nb) and if the carbonate rocks from the Partridge Crop area are found to be of carbonatitic affinity then additional mapping towards the south and west is warranted.

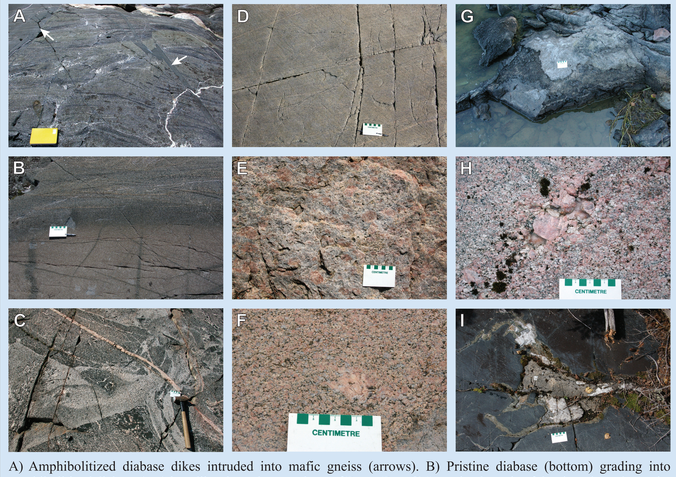
Although some anorthositic rocks are known from eastern Partridge Crop Lake (Weber and Malyon, 1978), the presence of anorthosite fragments within the schollen-bearing tonalite–granodiorite gneiss could indicate that it is more widespread than previously recognized, which may in turn indicate potential for anorthosite-hosted Ti-Fe-V-P deposits.

Rocks of uncertain age



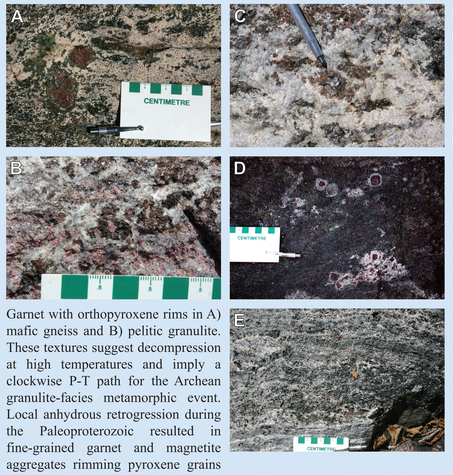
A sedimentary sequence of uncertain age in the southern basin of the map area consists of (A) semipelite grading into (B) calcsilicate and marble. Adjacent exposures consist of iron formation. C) A 5 m wide band of graphitic and sulphidic pelite occurs in the central portion of the map area, and is continuous over ~2 km.

Proterozoic rocks

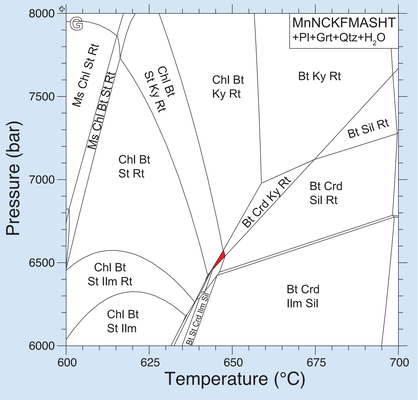


A) Amphibolitized diabase dikes intruded into mafic gneiss (arrows). B) Pristine diabase (bottom) grading into amphibolitized diabase (top) in a dike along the east shore of Bryce Bay. C) Intrusion breccia of dominantly melasyenite intruded by at least three generations of syenite and leucosyenite dikes. D) Tonalite–granodiorite froms an intrusion along the west shore of Bryce Bay. E) Quartz monzonite–granite occurs along the central islands and north shore of Bryce Bay. It appears to be part of a large intrusion that continues to Apussigamasi Lake. F) The Wintering Lake intrusion underlies much of the western edge of the map area and is largely granitic. G) Carbonate bands of uncertain affinity near the Hudson Bay Railway bridge over the Grass River. H) Carbonate metasomatism in a nearby exposure of the Wintering Lake intrusion. I) A late carbonate vein of uncertain affinity hosted in amphibolitized diabase. Late carbonate veins are present at several locations in the southern basin of the map area.

Metamorphic Geology



Garnet with orthopyroxene rims in A) mafic gneiss and B) pelitic granulite. These textures suggest decompression at high temperatures and imply a clockwise P-T path for the Archean granulite-facies metamorphic event. Local anhydrous retrogression during the Paleoproterozoic resulted in fine-grained garnet and magnetite aggregates rimming pyroxene grains in the mafic gneiss and C) pelitic granulite. Metamorphism during the Paleoproterozoic more commonly resulted in the hydrous retrogression of the Archean granulite-facies assemblages. D) Pyroxenes within the mafic gneiss were replaced by amphibole, and garnet is partially or completely replaced by fine-grained aggregates of plagioclase. E) Orthopyroxene, cordierite, garnet, and K-feldspar are partially or completely replaced by biotite ±chlorite in hydrously retrogressed pelite.



F) Kyanite-bearing aluminous rock from Bryce Bay is interpreted to be a product of hydrothermal alteration. Although the protolith may be Archean, the mineral assemblage of Pl-Grt-St-Crd-Ky-Bt-Rt-Qtz is interpreted to reflect Hudsonian metamorphic conditions. G) Equilibrium-assemblage diagram for the kyanite-bearing sample, the red field indicates the observed mineral assemblage and suggests metamorphic conditions of approximately 650 °C and 6500 bars. The equilibrium-assemblage diagram was calculated with the Theriak/Domino software package of de Capitani and Petrakakis (2010), using the updated 2003 ds5.5 thermodynamic dataset of Holland and Powell (1998) and the activity models outlined in Tinkham and Ghent (2005), Pattison and Tinkham (2009), and Couëslan et al. (2011). Abbreviations: Bt, biotite; Chl, chlorite; Crd, cordierite; Grt, garnet; Ilm, ilmenite; Ky, kyanite; Ms, muscovite; Pl, plagioclase; Qtz, quartz; Rt, rutile; Sil, sillimanite; St, staurolite.

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