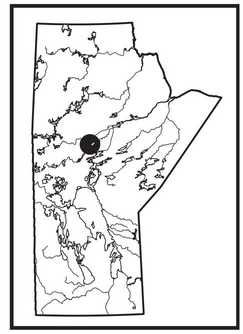
GS-6 The Grass River Project: geological mapping at Phillips Lake, and new geochronological results from Paint Lake and Manasan Falls, Thompson Nickel Belt, central Manitoba (parts of NTS 63O1, 8, 9, 63P5, 12)

by C.G. Couëslan



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Summary

Recent mapping in the Paint Lake, Phillips Lake and Manasan Falls areas has resulted in the recognition of at least one new metasedimentary succession in the Thompson Nickel Belt (TNB). Rocks of the Paint sequence consist largely of metawacke and metapsammite with subordinate meta–iron formation, metapelite and calcareous rocks. The Paint sequence occurs along the eastern boundary of the TNB with known exposures stretching from Phillips Lake in the south to north of Paint Lake. A possibly related supracrustal succession is present at Manasan Falls that includes a gradational sequence of mafic rocks and siliceous metasedimentary rocks. Neodymium-model ages for metawacke samples of the Paint sequence range from ca. 3.22 to 3.57 Ga, which is generally older than Ospwagan Group model ages of ca. 3.22–2.82 Ga; however, two samples of metawacke from Manasan Falls yielded Nd-model ages of ca. 3.08 and 3.12 Ga. Orthopyroxene-bearing leucosome in metawacke at Paint Lake has previously been interpreted to be the result of Archean metamorphism, but U-Pb ages of metamorphic monazite suggest that the leucosome formed after ca. 1806 Ma. Preliminary U-Pb ages from what are interpreted to be detrital zircons range from ca. 2018 to 2850 Ma suggesting that the Paint sequence was deposited in the Paleoproterozoic rather than the Neoarchean.

Sulphidic Ospwagan Group rocks hosting ultramafic intrusions are one of the major exploration targets for nickel in the TNB. Similarities between the Ospwagan Group and rocks of the Paint sequence include the presence of siliceous horizons and meta–iron formation, along with local horizons of metapelite and calcareous rocks. These similarities could allow for the misidentification of Paint sequence rocks for the more economically prospective Ospwagan Group rocks. Alternatively, the Paint sequence, if found to host mineralization, could represent a new exploration play for the TNB.

Introduction

Recent mapping at Paint Lake and Manasan Falls has revealed the presence of a supracrustal sequence not previously recognized in the TNB, referred to here as the Paint sequence (Couëslan, 2008, 2011). The Paint sequence consists of interbedded metapsammite and metawacke with subordinate meta–iron formation, metapelite, calcsilicate, calcareous metapsammite and rare horizons tentatively identified as metavolcaniclastic rock (Couëslan, 2008, 2009a). A second, possibly related supracrustal sequence was identified at Manasan Falls. The Manasan Falls sequence consists of metawacke and a heterogeneous, banded mafic rock interbedded with metawacke, semipelite, calcsilicate and rare marble horizons, and grades into a siliceous metasediment that, in turn, grades into metapelite (Couëslan, 2011). The age of the Paint sequence was tentatively interpreted as Neoarchean, based on a lack of correlation with known Paleoproterozoic supracrustal groups (e.g., Ospwagan Group, Grass River Group, Burntwood Group), and the presence of orthopyroxene-bearing leucosome previously attributed to Archean metamorphism (Russell, 1980; Couëslan, 2008, 2009a). However, Hudsonian metamorphism in the Paint Lake area is now recognized to have reached granulite-facies conditions (Couëslan and Pattison, in press), and the deposition of the Paint sequence is only constrained by Hudsonian penetrative deformation and high-grade metamorphism (ca. 1820–1780 Ma, Ansdell, 2005; Burnham et al., 2009). In addition, rocks of the Paint sequence are cut by metamorphosed mafic dikes with relict chilled margins. The mafic dikes have been interpreted as part of the Molson dike swarm (ca. 1880 Ma, Heaman et al., 2009; Couëslan and Pattison, in press), and the Paint sequence would therefore have been deposited prior to ca. 1880 Ma.

Geological mapping at Paint Lake indicated that Paint sequence rocks continue along strike, north-northeast, and south-southwest of the lake, along the Grass River (Couëslan, 2009a, 2010, Figure GS-6-1). The Grass River Project is intended to be a multiyear project investigating the extent and character of the Paint sequence supracrustal rocks along the Grass River system along the eastern side of the TNB. This report consists of two sections. The first section outlines the results from the first field season of the Grass River Project, consisting of a three-day geological mapping program of Phillips Lake during mid-June, 2012. The second section provides updates of isotopic and geochronological studies of rocks from Paint Lake and Manasan Falls.

Geological setting

The TNB is a roughly 200 by 35 km segment of the Superior Boundary Zone in Manitoba (Bleeker, 1990;

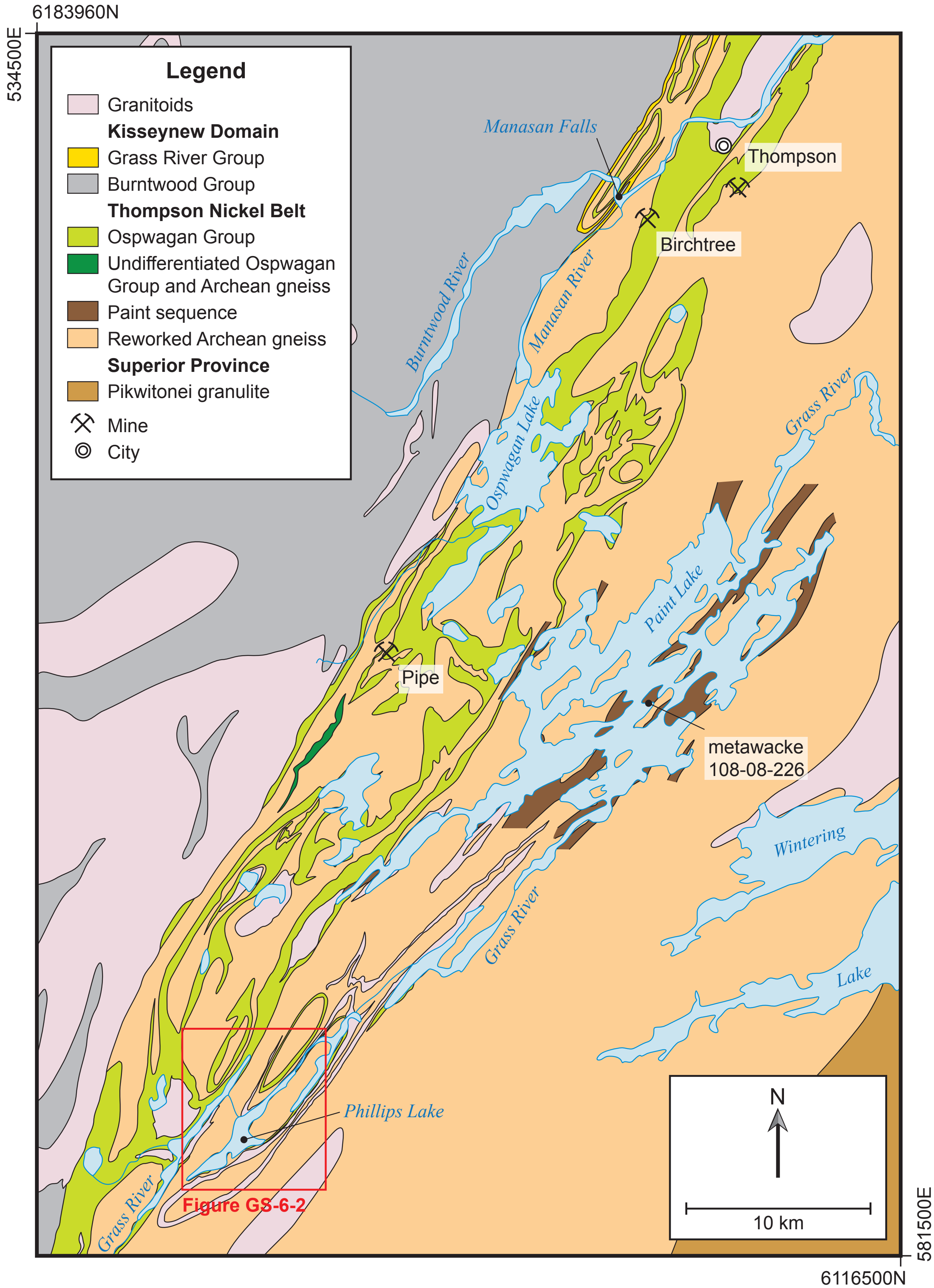

Figure GS-6-1: *Geology of the northern Thompson Nickel Belt and adjacent Kisseynew Domain, central Manitoba (modified from Macek et al., 2006; Couëslan 2009b, 2010). The locations of Manasan Falls and Figure GS-6-2, and the sampling locality of metawacke 108-08-226 used for U-Pb analyses are indicated.*

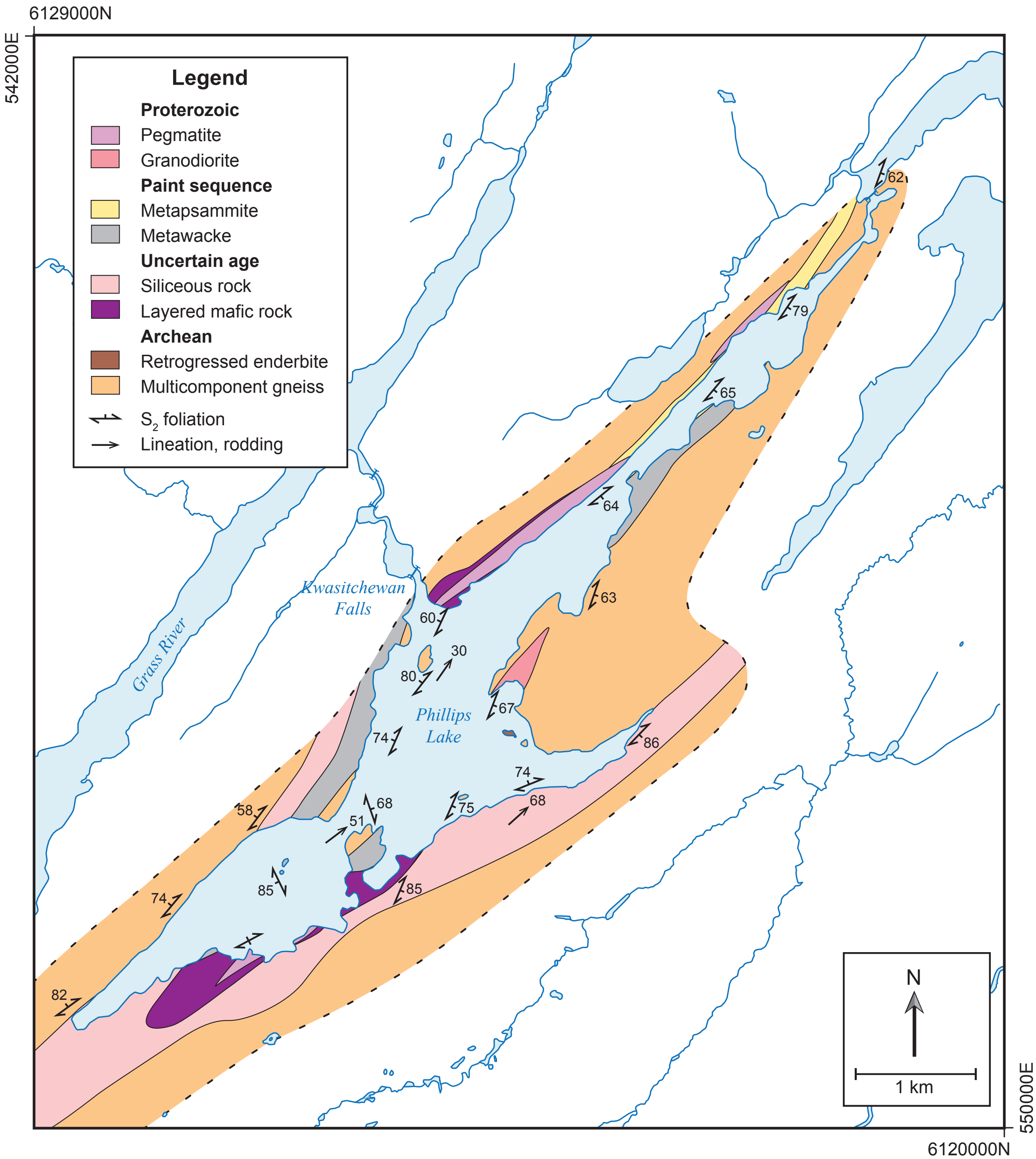

Figure GS-6-2: *Geology of the Phillips Lake area, central Manitoba.*

Burnham et al., 2009). This portion of the Archean Superior craton margin was tectonically reworked during the Trans-Hudson orogeny in response to convergence with the Paleoproterozoic arc-derived terranes of the Reindeer Zone (Bleeker, 1990; Ansdell, 2005). The TNB is largely underlain by reworked Archean gneiss interpreted to be derived from the adjacent Pikwitonei Granulite Domain, which was subjected to amphibolite- to granulite-facies metamorphic conditions from ca. 2720 to 2640 Ma (Hubregtse, 1977, 1978; Heaman et al., 2011). The Pikwitonei granulitic rocks were exhumed and unconformably overlain by the Paleoproterozoic Ospwagan Group (Bleeker, 1990). Rare Paleoproterozoic detrital zircons extracted from the Manasan and Setting formations of the Ospwagan Group have yielded maximum ages for deposition of ca. 2.24 and 1.97 Ga, respectively (Bleeker and Hamilton, 2001; Machado et al., 2011). The Ospwagan Group rocks were intruded by mafic dikes of the Molson swarm and Ni-deposit–hosting ultramafic bodies at ca. 1880 Ma (Heaman et al., 2009; Scoates et al., 2010).

The TNB was affected by three main generations of deformation during the Trans-Hudson orogeny (Bleeker, 1990; Burnham et al., 2009). Early deformation (D_1) predates the ca. 1880 Ma mafic magmatism and is largely obscured by later deformation (Bleeker, 1990; Burnham et al., 2009). The dominant phase of penetrative deformation is D_2, which resulted in the development of isoclinal to recumbent folds (F_2) (Bleeker, 1990; Burnham et al., 2009). Folding was accompanied by the regionally penetrative S_2 fabrics. Microstructural observations suggest that peak metamorphic conditions of middle amphibolite-facies to granulite-facies were attained during, and possibly outlasted, D_2 (Couëslan and Pattison, in press). The D_2 generation of deformation is estimated to have occurred in the interval 1840–1800 Ma (Burnham et al., 2009). The D_3 generation of deformation resulted in tight, vertical to steeply southeast-dipping isoclinal F_3 folds (Bleeker, 1990; Burnham et al., 2009). Infolded Archean gneiss and Ospwagan Group rocks typically form elongate chains of northeast-trending, doubly plunging F_3 synforms and antiforms (Bleeker, 1990; Burnham et al., 2009). Mylonite zones with subvertical stretching lineations parallel many of the regional F_3 folds. The D_3 generation of deformation was likely underway by ca. 1770 Ma (Bleeker, 1990; Burnham et al., 2009).

Geological mapping at Phillips Lake

Mapping in the Phillips Lake area was hampered by high water levels; however, mapped units appear to be equivalent to those observed on Paint Lake and consist of multicomponent gneiss, retrogressed enderbite, layered mafic rocks, metawacke, metapsammite, granodiorite, siliceous leucogneiss and granitic pegmatite (Figure GS-6-2). Only those units that may be related to the Paint sequence are discussed below. Descriptions of other units are in Couëslan (2008, 2009a).

The Phillips Lake area is underlain by a roughly isoclinal, upright F_3 fold structure that folds the regionally penetrative S_2 foliation. Outcrops are typically high strain. Amphibolite bands are commonly boudinaged, pegmatite dikes commonly display augen and locally flaser textures, and local outcrops take on the appearance of straight gneiss. The common occurrence of co-existing orthopyroxene and clinopyroxene in mafic rocks and orthopyroxene in the metawacke suggests the area was subjected to regional lower-granulite–facies metamorphic conditions, as reported by Couëslan and Pattison (in press). Retrograde amphibolite-facies mineral assemblages are also common.

Layered mafic rocks

The layered mafic rocks occur in two locations on Phillips Lake, directly east of Kwasitchewan Falls and along the southeastern shore of the lake (Figure GS-6-2). Layering is parallel to the regional foliation (S_2), typically at a 1–50 cm scale, and consists of varying proportions of quartz, clinopyroxene, orthopyroxene, hornblende and plagioclase, with accessory garnet, biotite, pyrrhotite and apatite. Plagioclase and quartz typically make up less than 50% and 15% of a given layer, respectively (Figure GS-6-3a). Orthopyroxene-bearing leucosome is common.

Metawacke

Outcrops of metawacke are most common south of Kwasitchewan Falls, but also occur along the eastern shore of the northern arm of the lake (Figure GS-6-2).

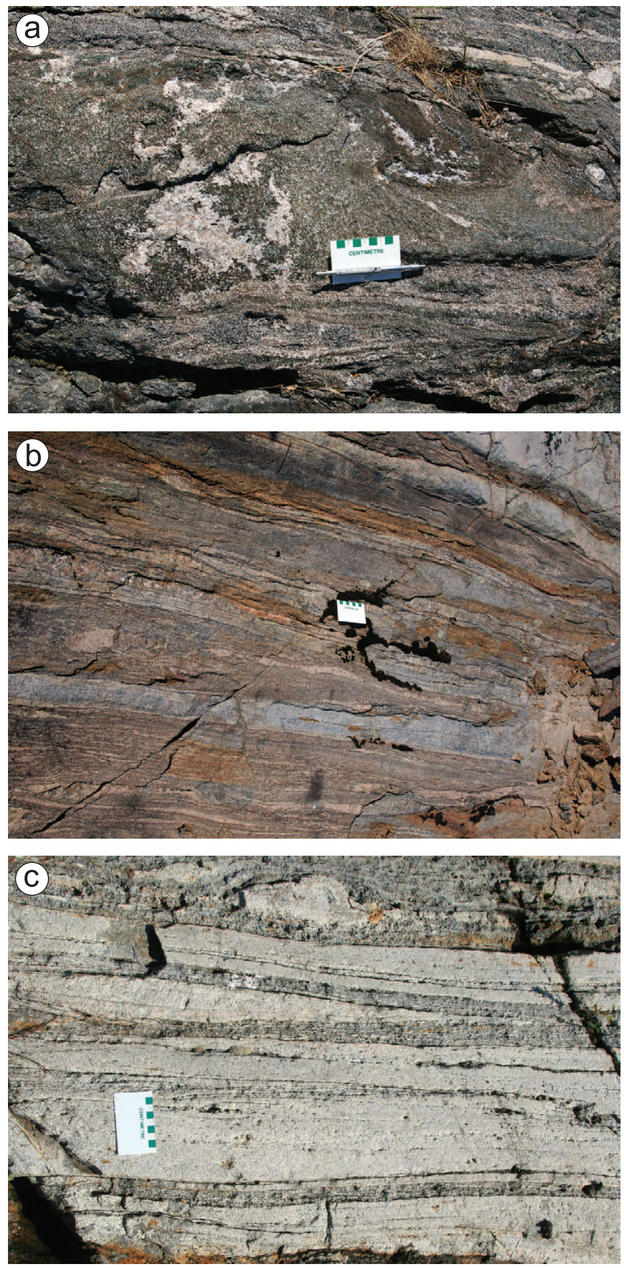

Figure GS-6-3: *Outcrop photographs from Phillips Lake, central Manitoba:* ***a)*** *layered mafic rock, layering is subparallel to the pen;* ***b)*** *metawacke with typical light gossan stain and leucosome subparallel to compositional layering;* ***c)*** *metapsammite with interbeds of metawacke.*

Exposures are characterized by rusty weathering and compositional layering on a scale of 1–15 cm, parallel to the regional foliation (S_2, Figure GS-6-3b). The metawacke is quartz- and plagioclase-rich and typically contains 10–20% biotite and 3–10% garnet and/or orthopyroxene. The proportion of garnet to orthopyroxene appears to be, at least in part, compositionally controlled and varies from layer to layer. The rock is migmatitic, and leucosome is locally orthopyroxene bearing. Local interbeds of metapsammite are up to 10 cm thick.

Metapsammite

Outcrops of metapsammite were only recognized along the western shore of the northern arm of the lake (Figure GS-6-2). Compositional layering parallels the regional foliation (S_2) and occurs on a scale of 1–20 cm. The metapsammite is quartz- and plagioclase-rich, and typically contains <10% combined biotite and garnet, with trace amounts of magnetite. Local interbeds of metawacke can be up to 20 cm thick (Figure GS-6-3c). Garnet-bearing and quartz-rich bands (up to 60% quartz) in the multicomponent gneiss, especially along the southwestern shore of the lake, may indicate the presence of modified metapsammite or metawacke.

Isotope geochemistry

Sm-Nd isotope geochemistry

Böhm et al. (2007) demonstrated that Sm-Nd isotope geochemistry can be a useful tool in distinguishing metamorphosed Ospwagan Group rocks from other, texturally and compositionally similar, Paleoproterozoic metasedimentary rocks and Archean gneiss in the TNB. Although some overlap exists between calculated Nd-model ages for Archean gneiss and Ospwagan Group rocks, the Ospwagan Group rocks typically yield younger model ages ranging from 2.82 to 3.22 Ga, while model ages of the Archean gneiss are typically older, ranging from 3.14 to 3.70 Ga (Figure GS-6-4). The Nd-model ages calculated for Burntwood Group and Grass River Group rocks of the Kisseynew Domain are distinctly younger, ranging from 2.14 to 2.62 Ga and 2.02 to 2.41 Ga, respectively.

Unpublished Sm-Nd isotope data for three samples of Paint sequence metawacke collected at Paint Lake yielded Nd-model ages ranging from 3.23 to 3.57 Ga (samples 108-08-226A, 108-09-422 and 108-09-453). These results are similar to those of two previously published samples of Paint sequence metawacke at 3.22 and 3.49 Ga (Böhm et al., 2007). Consequently, the range of Nd-model ages calculated for the Paint sequence appears to be comparable to model ages calculated for the Archean gneiss of the TNB rather than the Ospwagan Group. An unpublished Nd-model age of 3.12 Ga was calculated for a metawacke sample from Manasan Falls (108-11-007F), which is similar to a previously published age of 3.08 Ga for a paragneiss collected just below the falls at the mouth of the Manasan River (Böhm et al., 2007). These ages are more typical of model ages calculated for known Ospwagan Group rocks (Figure GS-6-4).

In-situ U-Pb isotopic analyses

A sample of metawacke from Paint Lake (108-08-226) was selected for in-situ U-Pb isotope analysis by laser ablation–multicollector–inductively coupled plasma–mass spectrometry (LA-MC-ICP-MS). The data presented here are a subset of a much larger collection of data and should be considered preliminary; however, they do provide some insight into the possible age of the Paint sequence.

U-Pb dating of monazite

The metawacke at Paint Lake commonly contains orthopyroxene-bearing leucosome. Such leucosome was previously attributed to Neoarchean metamorphism (Hubregtse, 1977, 1978; Macek and Russell, 1978; Russell, 1980), which would suggest an Archean age for the metawacke (Couëslan, 2008). This interpretation has now been brought into question. Recent work by Couëslan and Pattison (in press), challenges the previous interpretations by suggesting that the Paint Lake area was subjected to granulite-facies metamorphic conditions during the Trans-Hudson orogeny, and therefore, the orthopyroxene-bearing leucosome could be Paleoproterozoic rather than Archean.

Samples of metawacke were collected from a single outcrop in 2010 and contain what is interpreted as in-situ,

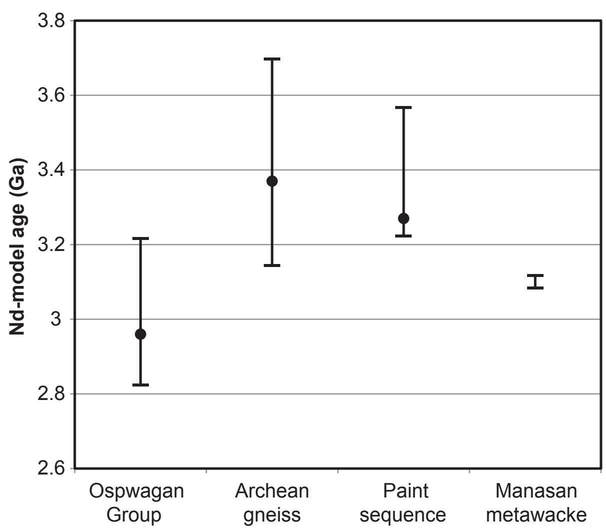

***Figure GS-6-4**: Range of Nd-model ages obtained from Ospwagan Group rocks (n=28), Archean gneiss (n=18), Paint sequence metawacke (n=5) and Manasan Falls metawacke (n=2), central Manitoba. Dots indicate the median age from each group, data are from this report and Böhm et al. (2007).*

orthopyroxene-bearing leucosome (108-08-226A–G, Figure GS-6-5a). Study of thin sections revealed the presence of large monazite grains (up to 1.7 mm) within the matrix of the metawacke and leucosome. Sample 108-08-226A contains two monazite grains in the matrix of the metawacke (monazite 1 and 2) and one monazite grain in the leucosome (monazite 3). These monazite grains are relatively homogeneous with little zoning observed in backscattered electron images. Monazite grain 1, within the matrix of the metawacke, is oriented parallel to, and enclosed by, S_2 biotite (Figure GS-6-5b). Monazite grain 2, also in the matrix, is equant and enclosed by S_2 biotite. Monazite grain 3, in the leucosome, is partially enclosed by a subidioblastic orthopyroxene porphyroblast, and is characterized by embayments along the grain margin that is in contact with the leucosome matrix (Figure GS-6-5c).

Nineteen spot analyses on the three monazite grains from sample 108-08-226A yielded $^{207}Pb/^{206}Pb$ ages ranging from ca. 1794 to 1827 Ma. The combined U-Pb data from the three monazite grains plot near concordia and define a single, nearly concordant mean age of 1802.4 ±6.5 Ma. An improved mean deviation can be obtained by fitting an anchored regression line through the data, which yields an upper intercept of 1805.5 +5.1/–5.0 Ma (Figure GS-6-5d), interpreted as the best age estimate for monazite growth in the metawacke sample. In addition to a period of monazite growth at ca. 1805 Ma, the U-Pb analyses of monazite grains from samples 108-08-226B–G, collected at the same metawacke outcrop, also suggest periods of monazite growth at ca. 1820 and 1755 Ma, but further work is required to reach a comprehensive interpretation of the entire dataset.

U-Pb dating of zircon

In addition to monazite, metamorphic and detrital zircon from metawacke samples 108-08-226A–G were analyzed by LA-MC-ICP-MS. Analyses of the metamorphic rims indicate periods of zircon growth at ca. 1800

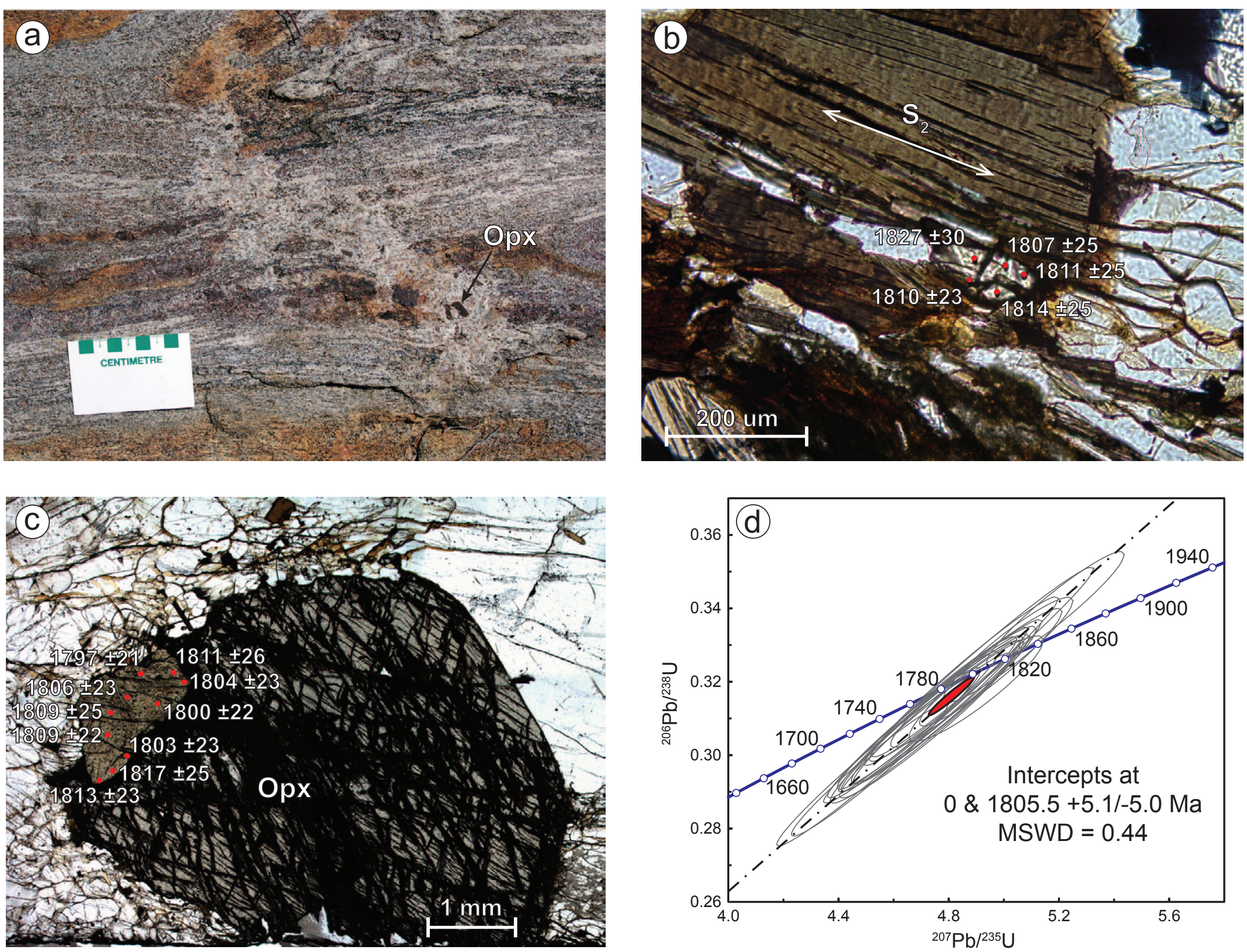

Figure GS-6-5: a) *A photograph of typical leucosome from the outcrop where samples 108-08-226A–G were obtained at Paint Lake, central Manitoba; diffuse contacts between the orthopyroxene-bearing leucosome and metawacke suggest the leucosome is in-situ. Photomicrographs of monazite grains from sample 108-08-226A:* ***b)*** *monazite 1 in the matrix of the metawacke and subparallel to enclosing grains of S_2 biotite;* ***c)*** *monazite 3 in the leucosome and partially overgrown by an idioblastic orthopyroxene.* ***d)*** *Concordia diagram of LA-MC-ICP-MS analyses of monazite in thin section of sample 108-08-226A. Abbreviation: OPX, orthopyroxene.*

and 1750 Ma during the Trans-Hudson orogeny and require further study. Based on backscattered electron images, 11 of the analyzed spots appear to fall onto relict, detrital zircon (Figure GS-6-6a, b). The metawacke zircon $^{207}Pb/^{206}Pb$ age results are plotted in Figure GS-6-6c, alongside typical detrital zircon spectra for Ospwagan Group rocks plotted in Figure GS-6-6d–f. For the Paint sequence metawacke sample, all data are <10% discordant, with five analyses <5% discordant including the oldest and youngest results at ca. 2850 and 2018 Ma, respectively. The relatively small dataset limits the statistical significance of the results; however, it is worth noting a ca. 2650 Ma age mode similar to the dominant detrital age of the Manasan Formation, and an early Paleoproterozoic age mode at ca. 2440 Ma.

Discussion

The interbedded relationship between the metawacke and the metapsammite at Phillips Lake is similar to the sequence mapped along strike at Paint Lake. This combined with similar mineral assemblages, and likely similar bulk compositions, suggests the metasedimentary rocks at Phillips Lake and Paint Lake could be part of the same sequence, termed here as the Paint sequence. The layered mafic rocks at Phillips Lake are texturally similar to those observed on Paint Lake; however, garnet appears to be less abundant in the exposures visited on Phillips Lake.

Metawacke at Manasan Falls, although orthopyroxene-free due to the lower metamorphic grade (Couëslan, 2011; Couëslan and Pattison, in press), is texturally and petrographically similar to metawacke at Paint and Phillips lakes. Parallels can be drawn between the transition from layered metagabbro to leucocratic metagabbro at Paint Lake and the gradational transition from layered mafic rock to siliceous metasediment at Manasan Falls; however, no direct correlation can be made between the layered mafic rocks at Manasan Falls and those observed on Paint and Phillips lakes. At this time, no interbeds of metasedimentary rocks have been recognized in the layered mafic rocks in the Paint and Phillips lakes areas.

The Nd-model ages for Paint sequence rocks range from ca. 3.22 to 3.57 Ga and are typically older than those of known Ospwagan Group rocks (ca. 2.82–3.22 Ga), suggesting an older average provenance for the Paint sequence; however, a minor overlap between the model ages is present (Figure GS-6-4). Although the layered mafic rocks at Manasan Falls cannot be directly correlated to the layered mafic rocks on Paint and Phillips lakes, the metawacke from Manasan Falls is similar in character to the Paint sequence. If the metawacke from Manasan Falls is correlative to the metawacke from the Paint sequence, this would extend its range of Nd-model ages to as young as ca. 3.08 Ga, and imply significantly more overlap between the Nd-model ages of the Ospwagan Group and the Paint sequence.

Ages calculated from metamorphic monazite have traditionally been interpreted as dating the peak of metamorphism (Rayner et al., 2006b; Schneider et al., 2007; Machado et al., 2011; Craven et al., 2011); however, a growing body of evidence suggests that this is not likely the case. Under subsolidus conditions, monazite is most commonly the product of prograde metamorphic reactions involving the breakdown of allanite (Wing et al., 2003; Tomkins and Pattison, 2007; Janots et al., 2008; Spear, 2010; Gasser et al., 2012). Uranium-lead ages of such monazites would therefore date the timing of allanite breakdown/monazite growth along the prograde segment of a metamorphic pressure-temperature (P-T) path rather than the timing of peak metamorphism. Monazite is soluble in peraluminous melts (Rapp and Watson, 1986; Rapp et al., 1987; Montel, 1993; Wolf and London, 1995), and under suprasolidus conditions, commonly attained at upper-amphibolite– to lower-granulite–facies conditions, monazite is predicted to dissolve into anatectic melts (Pyle and Spear, 2003; Kelsey et al., 2008; Spear and Pyle, 2010). Whether a given monazite grain is likely to dissolve completely into the melt is controlled by the local concentration of rare earth elements in the melt, temperature and grain size of the monazite (Rapp and Watson, 1986; Montel, 1993; Wolf and London, 1995). Work by Rapp and Watson (1986) suggested that monazite grains of >50 mm are likely to survive a partial melting event. The crystallization of partial melt in a migmatitic rock should therefore result in the growth of monazite along the retrograde segment of a metamorphic P-T path (Pyle and Spear, 2003; Kelsey et al., 2008; Spear and Pyle, 2010; Gasser et al., 2012). The significance of the age results from monazite grains from metawacke sample 108-08-226A need to be assessed with these considerations in mind.

The alignment of monazite parallel to S_2 biotite in the matrix of sample 108-08-226A suggests that this monazite grew during the D_2 generation of deformation (Figure GS-6-5b). Monazite 3 occurs in the leucosome, partially enclosed by an orthopyroxene porphyroblast (Figure GS-6-5c). The idioblastic nature of the orthopyroxene suggests it likely grew while the enclosing leucosome was still liquid (Sawyer, 1999). Because monazite is likely to be soluble in an anatectic melt, it is assumed that monazite 3 likely grew prior to partial melting and was then entrained by the melt. Embayments along the leucosome-monazite margin suggest partial dissolution of the monazite into the melt, but complete dissolution was likely prevented by the large size of the monazite grain (~1.7 mm). This implies that melt generation and orthopyroxene growth both postdate ca. 1806 Ma, and that some, or all, of the orthopyroxene-bearing leucosome on Paint Lake formed during a Paleoproterozoic rather than Archean metamorphic event. The recognition that the leucosome is Paleoproterozoic also invalidates the necessity that the Paint sequence is Archean, based on the

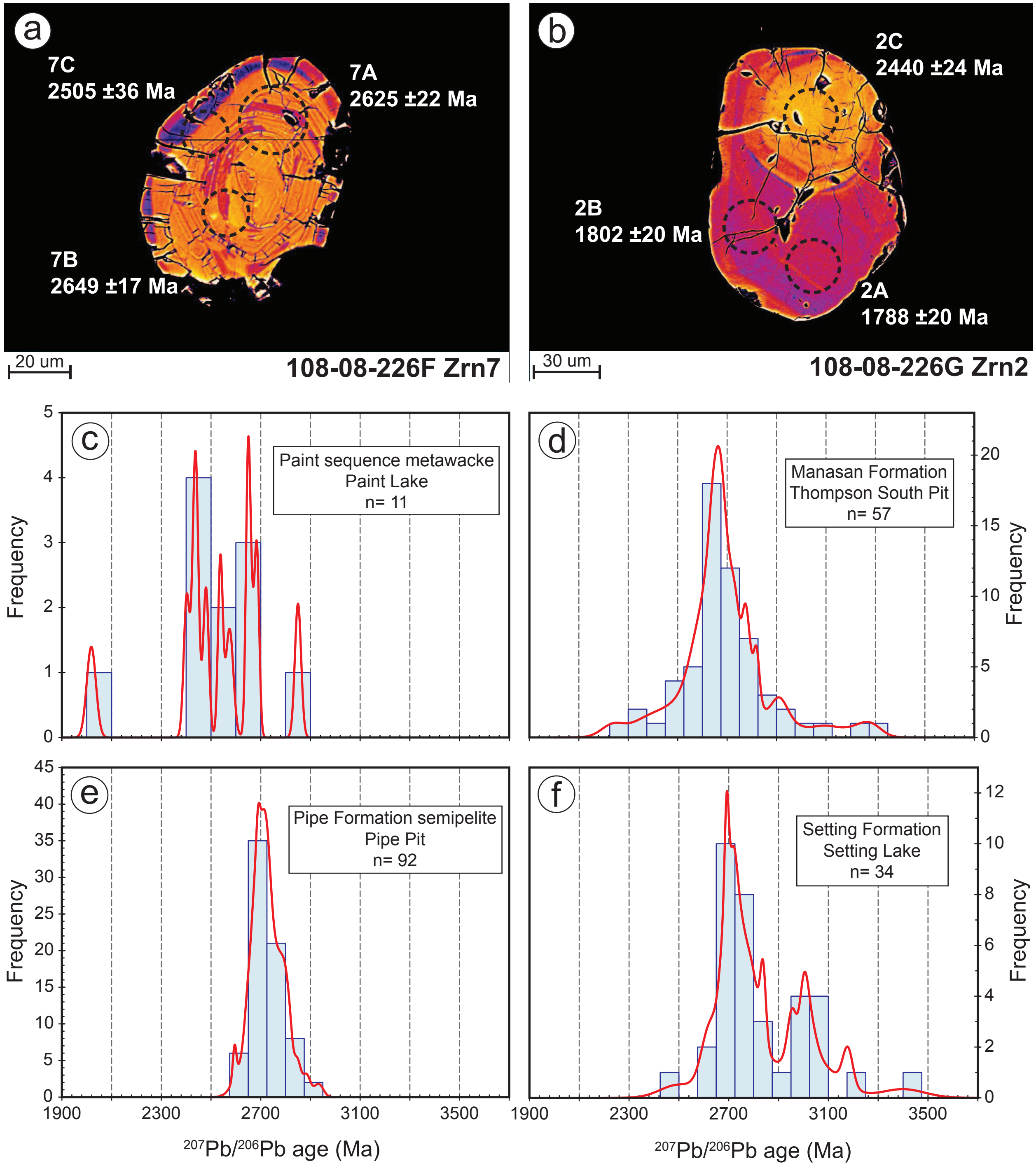

***Figure GS-6-6**: Backscattered electron images of zircon in metawacke from Paint Lake, central Manitoba: **a)** zircon 7, sample 108-08-226F, analyses 7A and B are of detrital zircon, analyses 7C likely represents a mixed age and includes both detrital zircon and minor metamorphic overgrowth (dark rim); **b)** zircon 2, sample 108-08-226G, analysis 2C is of a detrital core, while analyses 2A and B are of a metamorphic overgrowth; **c)** age histogram for detrital zircons from Paint sequence metawacke; **d)** age histogram for detrital zircons from Manasan Formation, M1 member (data from Machado et al., 2011); **e)** age histogram for detrital zircons from Pipe Formation, P2 member, metapelite (data from Rayner et al., 2006a); **f)** age histogram for detrital zircons from Setting Formation, S2 member (data from Machado et al., 2011).*

presence of orthopyroxene-bearing leucosome (Couëslan, 2008).

Two main $^{207}Pb/^{206}Pb$ age modes are present in the preliminary results of detrital zircons from metawacke at Paint Lake (Figure GS-6-6c). An age mode at ca. 2650 Ma is similar to metamorphic ages for the Pikwitonei Granulite Domain (Heaman et al., 2011), whereas a ca. 2440 Ma age mode is enigmatic, with closest known sources of that age from the Sask craton (Rayner et al., 2005). Perhaps just as important as determining the zircon provenance is their actual age. Circa 2440 Ma and even younger zircon ages (ca. 2400 and 2018 Ma) provide a Paleoproterozoic maximum age of deposition for the metawacke. However, this interpretation warrants caution. Even minor (<5%) discordancy in the younger zircon analyses theoretically allows these analyses to fall within error on a discordia array between Neoarchean ages typical for the Pikwitonei Granulite Domain and the approximate timing of metamorphism in the TNB (ca. 1800–1770 Ma, Bleeker and Hamilton, 2001; Rayner et al., 2006b; Burnham et al., 2009; Machado et al., 2011). Alternatively the younger zircon ages could be mixed, for example, caused as the laser ablated through an Archean core, and into a Paleoproterozoic metamorphic growth zone. Nevertheless, the new Nd isotopic and U-Pb age results for metawacke samples from Paint Lake are most consistent with a Paleoproterozoic age of deposition and high-grade metamorphism of the Paint sequence rocks.

Economic considerations

The full economic implications of the Paint sequence are still unclear. Sulphidic Ospwagan Group rocks hosting ultramafic intrusions are one of the major exploration targets for nickel in the TNB. These metasedimentary rocks act as a source of sulphur for the intruding ultramafic body, and may also have acted as preferential horizons for the development of sills. Similarities between the Ospwagan Group and rocks of the Paint sequence include the presence of siliceous horizons and meta–iron formation, along with local horizons of metapelite and calcareous rocks. These similarities allow for easy misidentification of Paint sequence rocks for the more economically prospective Ospwagan Group rocks.

Alternatively, the Paint sequence could represent a new exploration play in the TNB. Outcrops of metawacke from the Paint sequence are characterized by variable but ubiquitous gossan staining, suggesting the common presence of sedimentary sulphide. Pyrrhotite-bearing iron formation horizons, although discontinuous, are common. Metasedimentary rocks from the Paint sequence could therefore, similar to Ospwagan Group rocks, have acted as a source of sulphur for intruded ultramafic bodies such as those found at Phillips Lake (Macek et al., 2006). If the Paint sequence represents a Paleoproterozoic succession, as supported by the current data, compositional and competency contrasts between sedimentary layers may have facilitated the emplacement of ultramafic sills.

Acknowledgments

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