Geological Survey of Canada

CURRENT RESEARCH

2002-C25

Preliminary results from the Churchill River–Southern Indian Lake transect, Northern Manitoba Targeted Geoscience Initiative

David Corrigan, Ann Therriault, and Nicole M. Rayner

2002

Natural Resources Canada
Ressources naturelles Canada

Canada

A copy of this publication is also available for reference by depository
libraries across Canada through access to the Depository Services Program's
website at http://dsp-psd.pwgsc.gc.ca

A free digital download of this publication is available from the Geological Survey of
Canada Bookstore web site:

http://gsc.nrcan.gc.ca/bookstore/

Click on Free Download.

Authors' address

D. Corrigan *(dcorriga@nrcan.gc.ca)*
A. Therriault *(atherria@nrcan.gc.ca)*
N.M. Rayner *(nicole.rayner@nrcan.gc.ca)*
Continental Geoscience Division
601 Booth Street
Ottawa, Ontario K1A 0E8

Preliminary results from the Churchill River–Southern Indian Lake transect, Northern Manitoba Targeted Geoscience Initiative

David Corrigan, Ann Therriault, and Nicole M. Rayner
Continental Geoscience Division, Ottawa

Corrigan, D., Therriault, A., and Rayner, N.M., 2002: Preliminary results from the Churchill River–Southern Indian Lake transect, Northern Manitoba Targeted Geoscience Initiative; Geological Survey of Canada, Current Research 2002-C25, 11 p.

Abstract: This paper reports on the first field season of a new Targeted Geoscience Initiative designed to provide a regional tectonostratigraphic context for supracrustal and plutonic rocks that form the northern flank of the Trans-Hudson Orogen internides in Manitoba, as well as re-evaluating the mineral potential of the area. The project extends from the north flank of the Kisseynew Domain, through the Lynn Lake, Leaf Rapids, and Southern Indian domains, and into the south margin of the Chipewyan Batholith. It follows on from a similar transect recently completed in Saskatchewan, which provided new constraints on terrane composition and assembly, and tectonic environments of formation and/or deposition. That transect led to the discovery of new exploration targets and renewed economic interest in the region. Preliminary results show that most of the lithotectonic entities defined along the Churchill River–Southern Indian Lake transect can be traced westward to Saskatchewan, permitting regional correlations.

Résumé : Ce document fait état de la première campagne de travaux sur le terrain dans le cadre d'un nouveau projet de l'Initiative géoscientifique ciblée visant à déterminer le contexte tectonostratigraphique à l'échelle régionale des roches supracrustales et plutoniques du flanc nord des internides de l'orogène transhudsonien au Manitoba, ainsi qu'à effectuer une nouvelle évaluation du potentiel en ressources minérales de la région. Le projet couvre la région qui s'étend depuis le flanc nord du domaine de Kisseynew jusque dans la marge sud du batholite de Chipewyan en passant par les domaines de Lynn Lake, de Leaf Rapids et de Southern Indian. Il s'inscrit dans le prolongement d'un transect récemment complété en Saskatchewan, lequel a permis d'établir de nouvelles limites quant à la composition et à l'assemblage des terranes ainsi qu'aux cadres tectoniques de formation et de mise en place de la minéralisation. Ce dernier transect a mené à la découverte de nouvelles cibles d'exploration et a ravivé l'intérêt économique pour la région. Les résultats préliminaires indiquent que la plupart des entités lithotectoniques définies le long du transect fleuve Churchill–lac Southern Indian peuvent être suivies vers l'ouest jusqu'en Saskatchewan, permettant ainsi d'établir des corrélations à l'échelle régionale.

[1] Contribution to Northern Manitoba Targeted Geoscience Initiative

INTRODUCTION

In the summer 2000, a multidisciplinary geoscience project was initiated by the Manitoba Geological Survey in the Lynn Lake Belt area (Fig. 1) in order to provide an integrated and updated view of its geological and structural framework and economic potential. In the summer of 2001, the Geological Survey of Canada joined the Manitoba Geological Survey in a new federal government Targeted Geoscience Initiative, with the specific goal of providing a regional tectonostratigraphic context for volcanic, sedimentary, and plutonic assemblages that occur along the northern flank of the Trans-Hudson Orogen internides (Reindeer Zone) (Fig. 1). This transect incorporates the better known Rusty Lake Belt, which hosts the Ruttan Cu-Zn mine, as well as part of the Lynn Lake Belt, the lesser known Partridge Breast Belt and other minor supracrustal segments isolated by large intrusions (Fig. 2).

This new Targeted Geoscience Initiative project covers parts of four 1:250 000 scale maps (NTS areas 64 A, 64 B, 64 G, 64 H) and is modelled after a similar, multidisciplinary bedrock mapping project recently completed along Reindeer Lake in Saskatchewan (Maxeiner 1997, 1998; Corrigan et al., 1998, 1999, 2000; Corrigan, 2000a, b, 2001; Maxeiner and Demmans, 2000). The Reindeer Lake project resulted in an improved and updated tectonostratigraphy and a better understanding of the internal framework and mutual relationships between the Kisseynew, La Ronge, Rottenstone, and Peter Lake domains (Fig. 1). One of the primary aims of the Manitoba Geological Survey project and specifically of this Targeted Geoscience Initiative is to complete a similar transect from the northern flank of the Kisseynew Domain, across the Lynn Lake–Leaf Rapids and Southern Indian domains and into the southern margin of the Chipewyan Batholith (Fig. 2). The new data will lead to a better understanding of the lithological framework and tectonic assembly of the orogen internides in Manitoba. The ultimate integration of the results with those from the Reindeer Lake transect will further our understanding of the Trans-Hudson Orogen, provide a tectonic context for ore formation and mineralization, and enhance the ability to compare and contrast features with other known metallotects such an the Flin Flon and Snow Lake belts. The principal findings are summarized below.

REGIONAL GEOLOGY

Supracrustal and associated plutonic rocks in the northern flank of the Trans-Hudson Orogen in Manitoba (Fig. 1) have been previously assigned to three main lithological packages identified as the Kisseynew, Lynn Lake–Leaf Rapids, and Southern Indian domains (Hoffman, 1988). The Kisseynew Domain comprises mainly upper amphibolite- to granulite-facies metaturbidite of the Burntwood Group, which is unconformably overlain to the north by molassic sediments of the Sickle Group (Table 1). Geochronological data obtained mainly in the south and western margins of the Kisseynew Domain constrain respective ages of deposition during the interval 1855–1840 Ma for the Burntwood Group and 1840–1835 Ma for the Sickle Group (Ansdell and Yang, 1995). The boundary between the Burntwood and Sickle groups (Granville Lake structural zone; Zwanzig (2000)) consists of a narrow, but laterally continuous belt (over 400 km in strike length) comprising folded and boudined mafic flows and sills of MORB geochemical signature, interlayered with calcareous psammite, metapelite, and minor quartzite of uncertain affinity. A similar package, named the 'Levesque Bay assemblage' in Saskatchewan (Corrigan et al., 1998) is intruded by 1896 +18/-16 Ma leucogranite dykes (D. Corrigan, unpub. preliminary data, 2000), suggesting that it may be either contemporaneous with, or older than, the La Ronge and Lynn Lake arcs (Table 1).

The Kisseynew Domain is flanked to the north by the Lynn Lake–Leaf Rapids Domain (Fig. 1), which comprises ca. 1.90–1.88 Ga (Baldwin et al., 1987) volcanic rocks of diverse tectonic setting, including arc tholeiite, calc-alkaline arc, MORB-like, and ocean-island basalt (OIB)-like rocks (Syme, 1985; Ames and Taylor, 1996; Zwanzig et al., 1999), as well as associated epiclastic and sedimentary rocks. Two major volcanic belts have been identified; the Lynn Lake and Rusty Lake belts (Fig. 2), and each has been further

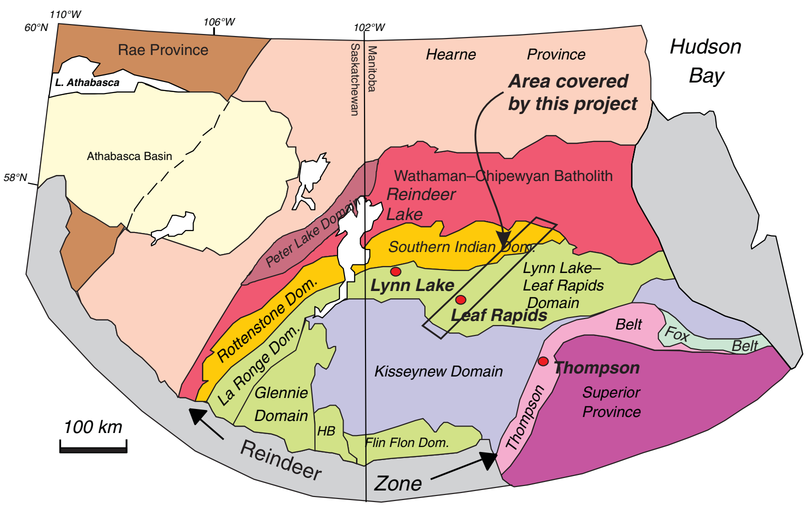

Figure 1.

Main geological divisions of the Trans-Hudson Orogen in Manitoba and Saskatchewan (modified after Hoffman, 1988). HB= Hanson Lake block.

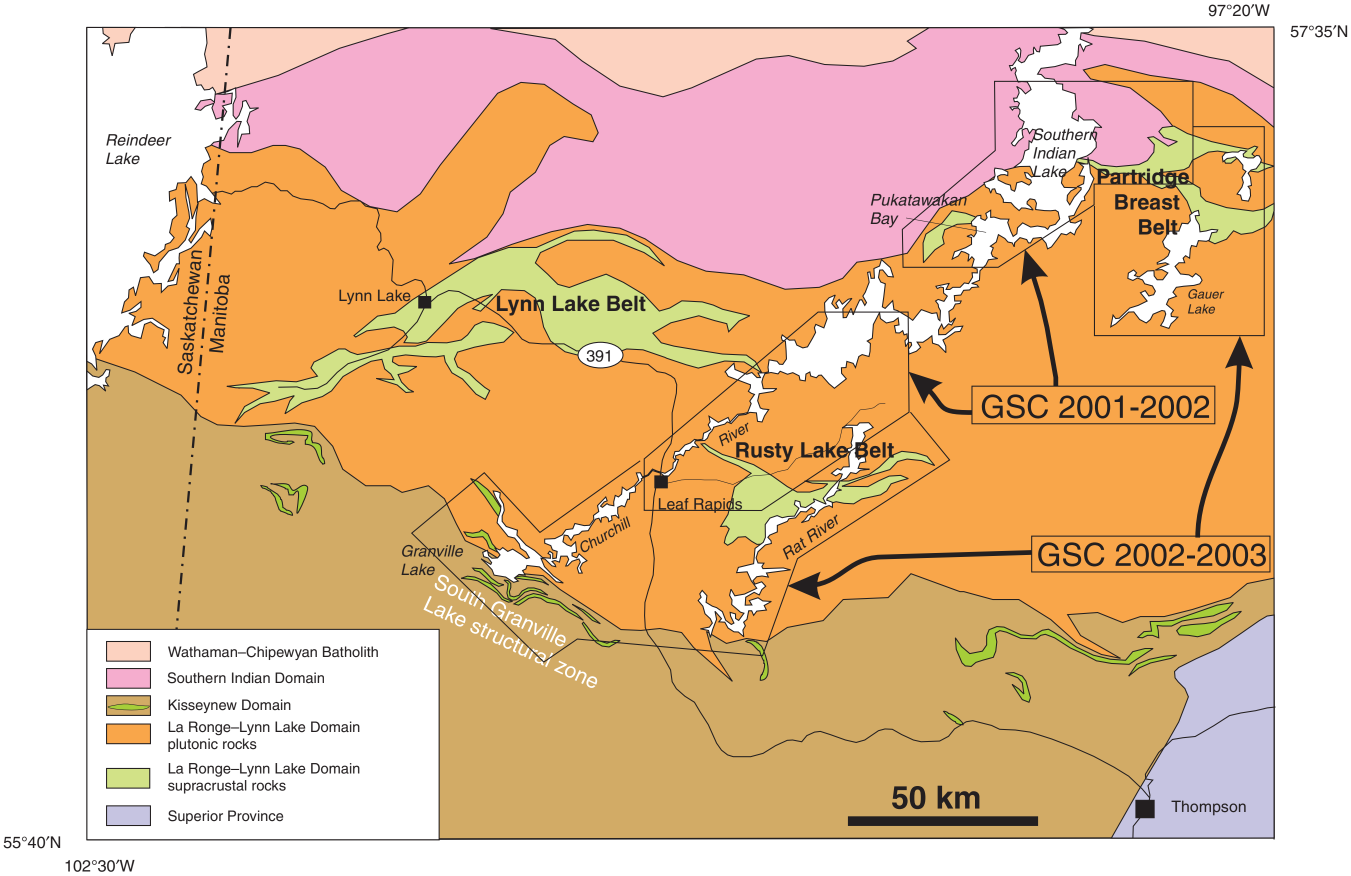

Figure 2. *Simplified geological map of the greater Lynn Lake area, showing the main lithological associations.*

subdivided into separate components based on geochemical signatures and inferred plate-tectonic setting. Field relationships suggest that the various volcano-sedimentary assemblages were aggregated into a tectonic collage before the emplacement of ca. 1876 Ma calc-alkaline plutons (Baldwin et al., 1987).

The Southern Indian Domain flanks the Lynn Lake–Rusty Lake Belt to the north and for the most part correlates with the Rottenstone Domain in Saskatchewan (Fig. 1). It is dominated by granitoid orthogneiss and sedimentary rocks which include conglomerate, greywacke, turbidite, as well as subordinate volcanic rocks. Recent work on Reindeer Lake in Saskatchewan has led to the recognition of at least two distinct sedimentary basins in the Rottenstone Domain (Table 1), the Milton Island assemblage (Corrigan et al., 1998), interpreted as a fore-arc or accretionary complex formed north of the advancing La Ronge–Lynn Lake arc; and the Park Island assemblage (Corrigan et al., 1998), interpreted as forming part of a foreland or molasse-type basin. Supracrustal rocks of the Southern Indian Domain are intruded by the Chipewyan Batholith (Fig. 1). The Chipewyan Batholith is equivalent to the Wathaman Batholith in Saskatchewan and forms part of a continental magmatic arc that was emplaced during the interval 1865–1850 Ma (Fumerton et al., 1984; Van Schmus and Schledewitz, 1986).

TECTONOSTRATIGRAPHY

Lynn Lake–Leaf Rapids Domain

The Rusty Lake Belt (Fig. 2), which forms the main supracrustal element of the Leaf Rapids segment of the Lynn Lake–Leaf Rapids Domain, has been the focus of detailed bedrock mapping, geochemical, and petrological studies (Baldwin, 1981, 1987, 1988; Ames et al., 1990; Ames and Scoates, 1992; Ames and Taylor, 1996). Baldwin (1981) separated the Rusty Lake Belt into four fault-bounded structural components named the Ruttan, Northern, Karsakuwigamak, and Eastern blocks, which he interpreted as being stratigraphically unrelated. The Eastern and Ruttan blocks comprise mainly basaltic flows, with lesser amounts of mafic wacke, felsic breccia, polymictic conglomerate, and minor rhyolite. The Karaskuwigamak block contains a thick sequence of basal volcanic conglomerate, meta-arenite, and psammite, which is overlain by a rhyolitic sequence

Table 1. Potential tectonostratigraphic correlations along the northern Reindeer Zone.

Age (Ma)	Saskatchewan	Age (Ma)	Manitoba
1845–1830	McLennan group: conglomerate, feldspathic psammite, crossbedded arkose, arkosic sandstone, calcareous sandstone	In progress	Sickle Group: greywacke, conglomerate, crossbedded arkose, calcareous sandstone, arkosic sandstone
1855–1840	Burntwood Group: metaturbidite	1855–1840	Burntwood Group: metaturbidite
1865–1850	Wathaman Batholith	1865–1850	Chipewyan Batholith Baldock Batholith
	Intrusive contact		
1875–1865	Park Island assemblage: polymictic conglomerate, meta-arkose, psammite, calcareous psammite.	>1865(?) (in progress)	Polymictic conglomerate, meta-arkose, psammite (Pukatawakan and Partridge Breast belts)
	Unconformity		
1884–1896	Crowe Island Complex: mixed intrusive rocks and dykes of dioritic, tonalitic, granodioritic and granitic composition	In progress	Missi Falls gneiss association: mutually intrusive dioritic, tonalitic, granodioritic and granitic orthogneiss and derived migmatite
	Intrusive contact		
ca.1890–1875	Milton Island assemblage: migmatitic greywacke, psammite and psammo-pelite with sillimanite-muscovite-biotite±garnet±graphite, rare calc-silicate gneiss	In progress	Migmatitic greywacke, psammite, and semi-pelite with sillimanite-muscovite-biotite± garnet±graphite. (Zed Lake assemblage, Lynn Lake belt; upper-sequence of Northern block, Rusty Lake Belt?)
	Conformable contact		*Contact not exposed*
1910–1880	Central Metavolcanic Belt: lower sequence of mafic to ultramafic volcanic and plutonic rocks (Lawrence Point assemblage); upper sequence of felsic to intermediate volcanic rocks and sediments (Reed Lake assemblage)	1905–1878	Lynn Lake Belt; Rusty Lake Belt
>1897	Levesque Bay assemblage: MORB-type metavolcanic rocks, metapelite, calcic psammo-pelite, quartzite	In progress	Granville Lake structural zone: MORB-type basalt, tectonically interlayered metapelite and meta-arkose.

comprising massive flows, brecciated flows, ignimbrite, air-fall deposits, debris-flow deposits, volcanic conglomerate, and meta-arenite. The Northern block is dominated by sedimentary rocks which include a 'lower unit' formed of basal polymictic conglomerate and metaturbidite, as well as an 'upper unit' of tonalite-cobble conglomerate, metagreywacke, sulphide-facies iron-formation, and Fe-rich basalt. The only published age date so far in the Rusty Lake Belt is from a subaerial rhyolite from the Karsakuwigamak block, dated by U-Pb zircon at 1878 ± 3 Ma (Baldwin et al., 1987). A significantly older age (1910 +15/-10 Ma) obtained on a rhyolite from the Lynn Lake Belt has been used as a criterion to separate both belts. Our work this summer was limited to the Ruttan and Northern blocks. We have focused our attention on providing additional information by sampling volcanic and plutonic rocks for major, trace and rare-earth element geochemistry in newly excavated outcrops along the new Ruttan–South Bay road, as well as new drill core obtained since the end of the 1989–1996 EXTECH I project. We have also collected samples of sedimentary, volcanic, and plutonic rocks for U-Pb geochronology and Sm-Nd tracer isotope studies, which will provide further constraints on the absolute age of formation and model the amount of mantle-crust interaction.

Presently, the most compelling evidence for drawing potential stratigraphic linkage of at least some components of the Rusty Lake Belt with the Lynn Lake and La Ronge belts lies in the 'upper sequence' of the Northern block (unit 'W' *in* Manitoba Energy and Mines (1986)). This unit consists of grey, tightly folded migmatitic greywacke and/or turbidite with characteristic, apatite-bearing quartzofeldspathic and quartz-rich leucosomes separated from the paleosomes by thin, biotite-rich melanosomes. Its overall composition and stratigraphic position above the volcanic rocks is analogous to the Milton Island assemblage (Corrigan et al., 1998) and its relationship to the Central Metavolcanic Belt in Saskatchewan (Table 1). We have targeted this unit for U-Pb, sensitive, high-resolution ion microprobe (SHRIMP) geochronology in order to test this hypothesis, and compare data with that of the Milton Island assemblage (Ansdell et al., 1999).

Southern Indian Domain

Most of the mapping effort in the Southern Indian Domain was concentrated on Southern Indian and Partridge Breast lakes, where we mapped a continuous transect from Pukatawakan Bay to the eastern end of Partridge Breast Lake (Fig. 3). The area is described in Frohlinger and Cranstone (1972), and in Lenton and Corkery (1981). Two areas dominated by supracrustal assemblages are further described below.

Pukatawakan Bay

Mafic volcanic rocks with pillow structures, previously described by Frohlinger and Cranstone (1972), form a relatively small occurrence of supracrustal rocks in the Pukatawakan Bay area, named here the Pukatawakan Belt. We revisited the area with the intention of documenting the various metavolcanic rocks and associated sediments, including small units of metamorphosed fluvial and near-shore marine sediments that had been historically linked with the Sickle Group. As well, plutons and other intrusive rocks were examined to provide constraints on the local and regional magmatic evolution.

The most lithologically complex and potentially oldest unit consists of migmatitic paragneiss and orthogneiss, metapelite, metagreywacke, amphibolite (metagabbro), and syenogranite. Both the ortho- and paragneisses are generally interlayered at outcrop scale and transposed parallel to the regional east-west foliation. This gneissic unit, which is relatively well exposed on the shoreline of Long Point, is locally diatexitic and hosts partially retrograded mafic granulite

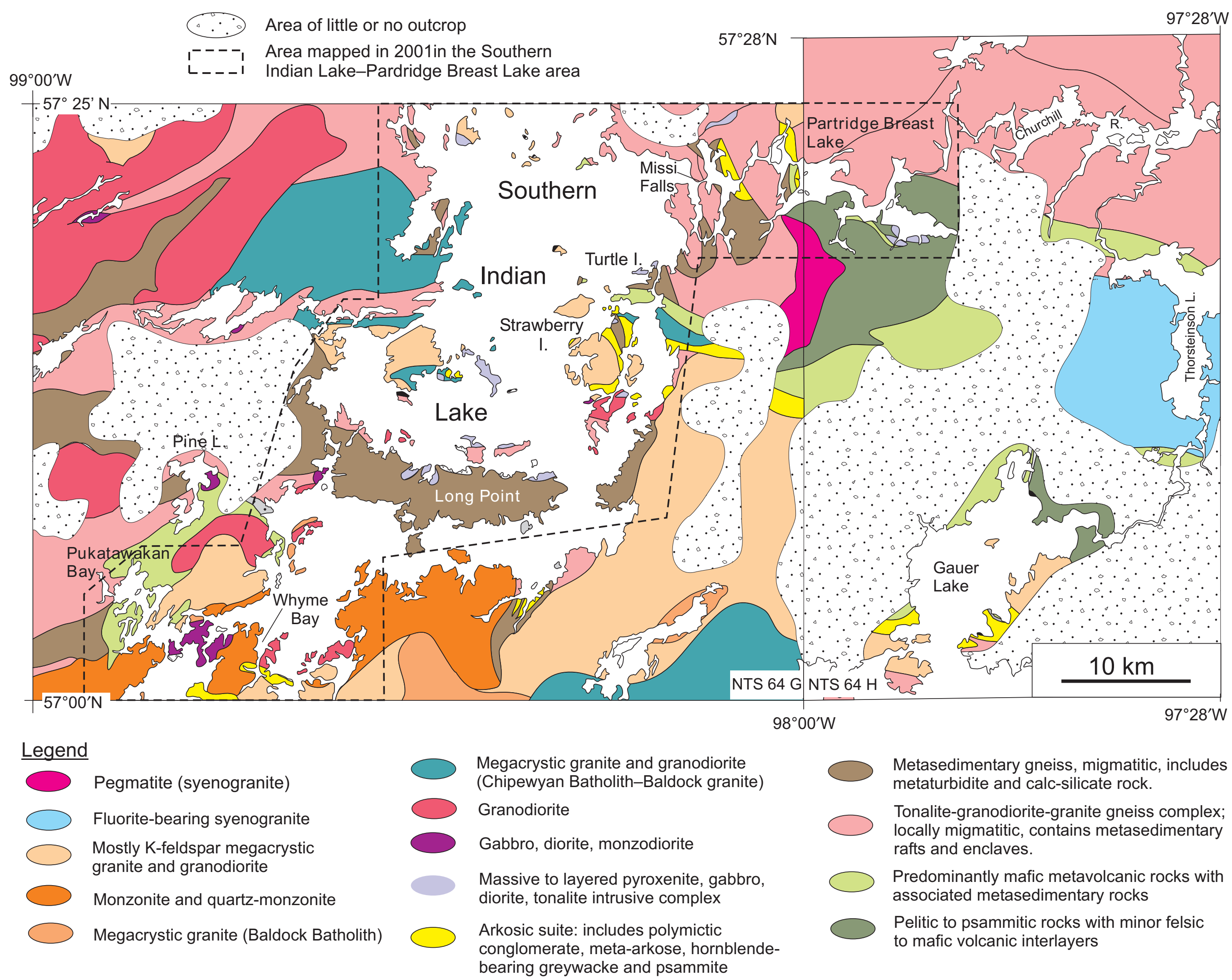

Figure 3. *Simplified geological map of the Pukatawakan Bay–Partridge Breast Lake area (*modified after *Manitoba Energy and Mines, 1987, 1990).*

boudins (Fig. 4). This elevated metamorphic facies is atypical for this part of the Trans-Hudson Orogen, is inconsistent with the metamorphic facies in surrounding supracrustal rocks, and suggests that this gneissic assemblage may be older (?Archean), or a fault-bounded sliver.

Lying structurally above this north-dipping gneissic unit is a narrow layer (few tens of metres) of amphibolite-facies garnet-sillimanite-biotite metapelite. This unit is conformably overlain by amphibolite-facies mafic metavolcanic rocks with locally preserved pillow structures (Fig. 5) that indicate younging to the north, up structural section. The mafic volcanic rocks are for the most part riddled with calc-silicate alteration veins. On most outcrops, the altered veins were subsequently transposed, now forming bands parallel to the regional foliation, giving the rock a distinctive light green and black colour. Similar rocks are common in the La Ronge Belt and Levesque Bay assemblage, where they represent altered, deformed, and metamorphosed basaltic flows and sills (Corrigan et al., 1998). Most of the mafic volcanic rocks in the Pukatawakan Bay area are interlayered at outcrop scale with psammite as well as sulphide and silicate-facies iron-formation. Rare volcanic rocks of intermediate composition occur most commonly as thin interlayers within the mafic pile. Concordant, metagabbro dykes intrude the mafic volcanic rocks and associated sediments.

Figure 4. *Outcrop photograph showing boudins of mafic granulite (small fragments next to hammer) and garnet-clinopyroxene rock in a diatexitic metapelite matrix; north shore of Long Point.*

Pink to pale beige, magnetite-bearing meta-arenites and calc-arenites preserve many primary features including compositional banding, laminated beds, and crossbeds, and have historically been interpreted as potential Sickle Group equivalents (Frohlinger and Cranstone, 1972). In this area, they are uniquely preserved as small screens and enclaves in K-feldspar megacrystic monzogranite (Fig. 6). It is noteworthy that this arkosic suite is located at a similar tectonostratigraphic level, and is compositionally similar to the Park Island assemblage of the Reindeer Lake area, with which it may correlate (Table 1).

All the Pukatawakan Belt rocks described above are intruded by a number of plutons that are likely related to the Wathaman–Chipewyan suite. These form large, compositionally homogeneous, nonmigmatitic bodies that range in composition from gabbroic to monzodioritic to syenogranitic, but are dominated by K-feldspar megacrystic, hornblende-bearing monzogranite. Although none of these intrusions have yet been dated, most are similar in texture and composition to plutonic rocks from the Big Sand Lake area, located about 60 km northwest of Pukatawakan Bay, which yielded U-Pb zircon ages of 1857 ± 9 Ma and 1854 ± 12 Ma (Van Schmus and Schledewitz, 1986). One large gabbroic to monzodioritic intrusion related to this suite, located between Pukatawakan Bay and Whyme Bay, locally contains up to 2% disseminated chalcopyrite and pyrite. The K-feldspar megacrystic monzogranite on the west shore of Whyme Bay (Fig. 6), was sampled for U-Pb dating.

Figure 5. *Pillow structures in mafic volcanic rocks of the Pukatawakan Belt. Light patches and streaks represent calc-silicate alteration. Pencil for scale.*

Figure 6. *Coarse-grained hornblende monzogranite intruding laminated meta-arkose. Photograph taken on western shore of Whyme Bay. Pocket knife for scale.*

Missi Falls–Partridge Breast Lake area

The Partridge Breast Belt (Fig. 3) contains the largest volume of metavolcanic rocks within the Southern Indian Domain. We re-examined it on the shoreline and islands of Southern Indian Lake, as well as along the lower Churchill River system, from Southern Indian Lake to the east end of Partridge Breast Lake. In essence, the local geology can be subdivided into three rock associations of different composition and age. One of the three 'packages', named herein the 'Missi Falls gneiss association', consists mainly of banded orthogneiss of tonalitic, trondjheimitic, granodioritic, and syenogranitic composition (Fig. 7), and shares some similarities with the orthogneiss described in the 'Pukatawakan Bay' section above. A similar dioritic to granitic orthogneiss assemblage was identified in the Southern Indian Domain extension in Saskatchewan (Rottenstone Domain) and named the "Crowe Island Complex" (Corrigan et al., 1998). A monzogranitic component of the Missi Falls gneiss association has been sampled for U-Pb zircon dating.

Another distinct lithological assemblage consists of predominantly mafic volcanic rocks with minor intermediate and felsic components, associated with clastic sedimentary rocks. A related sequence of mafic volcanic rocks on Turtle Island (Fig. 3) consists of fine- to medium-grained, dark green to black, highly strained mafic volcanic rocks, similar to the one described in the 'Pukatawakan Bay' section. It is stratigraphically interlayered with metapelitic horizons a few tens of metres thick. On their southern flank, both the volcanic and pelitic rocks are structurally overlain by pink to grey meta-arkose and polymictic conglomerate containing mostly fine- to medium-grained, pebble- to cobble-sized granitic to syenitic clasts (Fig. 8). The overall range in composition and textures in the mafic volcanic rocks, as well as the presence of meta-arkosic rocks and conglomerate immediately to the south of these, is reminiscent of the same association in the Pukatawakan Bay area suggesting a continuity, albeit disrupted by later plutonism.

Figure 7. *Outcrop photograph showing highly strained, banded granite and tonalite from the Missi Falls gneiss association intruded by megacrystic granite. Photograph taken on south shore of large island east of Bear Narrows, Southern Indian Lake. Area of photograph is about 2 m across.*

Mafic volcanic rocks are also well exposed on a large island at the western end of Partridge Breast Lake. At that location, two distinct north-trending basaltic flows, with individual thickness of approximately 5 m and 20 m, appear to sit concordantly within a heterogeneous metasedimentary assemblage that includes metapelite, crossbedded meta-arkose, thin polymictic conglomerate, and debris flows. One of the volcanic layers contains abundant carbonate alteration, whereas the other is silicified, giving the mafic rock a more felsic appearance. The debris flow contains subangular, boulder-sized and smaller volcanic and volcaniclastic rock fragments of mafic to intermediate composition (Fig. 9). Polymictic conglomerate and metapsammite occur either as thin interlayers with the volcanic rocks or as relatively thick beds without volcanic interlayers. Clasts in the conglomerate

Figure 8. *Polymictic conglomerate with subangular to subrounded felsic clasts. North shore of Strawberry Island. Pencil for scale.*

Figure 9. *Large clast of felsic tuff breccia in debris-flow horizon immediately below a mafic flow. North shore of island on the west side of Partridge Breast Lake. Hammer for scale.*

are subrounded to well rounded and are mainly of fine-grained igneous origin. A SHRIMP study of detrital zircons from a thick conglomerate unit is presently underway.

A third lithological association consists of plutons that intrude the Missi Falls gneiss association and Partridge Breast Belt supracrustal rocks. Two different 'suites' are noted. One suite (unit 'D' *in* Manitoba Energy and Mines (1987, 1990)) consists of mixed intrusions of ultramafic to tonalitic composition which occur as small to medium-sized plutons with characteristic L>>S fabrics. One of the better exposed of these occurs on the north shore of Turtle Island (Fig. 3). It contains recrystallized, but relatively well preserved igneous layering on a metre- to centimetre-scale, with individual layers ranging from pyroxenite-hornblendite, metagabbro, leucogabbro, diorite, quartz-diorite, to tonalite. There is local evidence for multiple injection in a dynamic magma chamber, as indicated by the presence of pseudo-crossbeds in rhythmically layered diorite (Fig. 10), numerous cognate xenoliths (Fig. 11), and ultramafic veinlets cutting earlier fabrics. Similar, but more homogeneous gabbroic and dioritic sheets intrude supracrustal rocks in the Partridge Breast Lake area. For reference, we have unofficially named this suite 'Turtle Island'. A quartz diorite from the Turtle Island pluton was sampled for U-Pb geochronology.

The other 'suite' consists of much larger, more compositionally homogeneous, coarse-grained to K-feldspar megacrystic biotite±hornblende monzodiorite plutons (Fig. 12). They generally consist of igneous minerals and are not lineated, in contrast to the Turtle Island 'suite'. Their textural, compositional, and structural similarities with plutons

Figure 10. Outcrop photograph showing rhythmic igneous layering in metagabbro and/or leucogabbro. Note the disrupted layering and crossbedded effect just below the geological hammer. North shore of Turtle Island, Southern Indian Lake.

***Figure 11.** Angular xenoliths of pyroxenite (dark) and diorite (light grey) in a homogeneous metagabbro dyke cutting rhythmic layering (not shown). Light-coloured lines oriented subparallel to the hammer handle are glacial striations. Hammer for scale. North shore of Turtle Island, Southern Indian Lake.*

***Figure 12.** Megacrystic hornblende monzogranite likely related to the Chipewyan Batholith. Note the excellent preservation of igneous textures, including zoning in feldspar. Photograph taken on western shoreline of Strawberry Island, Southern Indian Lake. Coin is 2.5 cm across.*

of the Chipewyan Batholith suggests they are likely related. Representative samples from both suites were collected for geochemical characterization.

ECONOMIC POTENTIAL

A detailed account of the geology, geochemistry, alteration, and lithotectonic framework of the Ruttan Cu-Zn VMS deposit in the Rusty Lake Belt is provided in Ames et al. (1990), Ames (1991, 1996), Ames and Scoates (1992), and Ames and Taylor (1996). As a follow-up on their work, we have undertaken further studies based predominantly on recent drill core from east of the Ruttan mine, recovered between 1996 and 2001, as well as from core samples recovered from elsewhere in the Rusty Lake Belt, outside of the mine area. The reader is referred to Barrie and Taylor (2001) for a detailed report. Our preliminary investigation also shows a potential for shear-zone-hosted Au deposits in the Rusty Lake Belt, similar to those in the La Ronge and Lynn Lake belts (Lafrance, 1999; Beaumont-Smith and Rogge, 1999).

Other targets of potential interest consist of a gabbro-monzodiorite with disseminated sulphides in the Pukatawakan Bay area, as well as layered mafic-ultramafic-intermediate intrusions in the Turtle Island area. The gabbro-monzodiorite intrusion, which occurs between Pukatawakan Bay and Whyme Island, is very poorly exposed, but one small outcrop on the shore of Southern Indian Lake contained disseminated sulphides which locally form up to 5 mm clots containing about 50:50 mixed chalcopyrite and another sulphide, possibly pyrite. The mafic-ultramafic-intermediate layered intrusion on the north shore of Turtle Island contains only a small proportion of ultramafic rock and contains only minor sulphides; however, it shows evidence of multiple injection in a dynamic, mafic magma system, a feature considered significant in PGE exploration.

DISCUSSION

Field observations and systematic sampling of supracrustal and plutonic rocks for geochronology and geochemistry along this transect are providing new constraints towards a better understanding of the tectonostratigraphic framework of the Leaf Rapids and Southern Indian domains, as well as establishing potential links with components of the north-western Reindeer Zone in Saskatchewan (Table 1). Based on a single U-Pb analysis in each of the Rusty Lake and Lynn Lake belts, they had been interpreted as separate entities (i.e. Baldwin et al., 1987); however, caution should be exercised until more radiogenic ages become available. Our preliminary observations suggest that the belts may not necessarily be exotic with respect to one another. For example, in a recent study, Maxeiner and Demmans (2000) demonstrated continuity of the Lynn Lake and La Ronge belts, which also implies that the Milton Island assemblage should likely have a lithological equivalent in Manitoba. A potential candidate is the Zed Lake assemblage, which flanks metavolcanic rocks of the Lynn Lake Belt to the north (Gilbert et al., 1980). As mentioned earlier in this paper, the ‘upper sequence’ of the Northern block also shares many similarities with the Milton Island assemblage, providing a potential link and perhaps establishing regional continuity. Uranium-lead dating and systematic geochemical characterization of supracrustal and plutonic components of the Lynn Lake and Rusty Lake belts (in progress) will help resolve these questions.

Preliminary investigations of supracrustal assemblages in the Pukatawakan Bay and Missi Falls–Partridge Breast Lake areas have yielded important information on their respective stratigraphies and highlighted potential links. Volcanic rocks from Pukatawakan Bay and the Turtle Island area (Fig. 3) share numerous features and likely represent lateral equivalents, disrupted and physically separated by plutons related to the ca. 1.86–1.85 Ga Chipewyan suite. They are mainly represented by mafic volcanic rocks and with one exception show similar alteration features. Felsic to intermediate components are relatively rare. In the Partridge Breast Lake area, however, stratigraphic interlayering of the mafic volcanic rocks with crossbedded meta-arkose, psammite, and polymictic conglomerate distinguishes this volcanic sequence from those of the Pukatawakan Bay and Turtle Island area.

Historically, meta-arkose and conglomerate from the Pukatawakan Bay and Partridge Breast Belt area (Fig. 3) had been tentatively named “Sickle-type” (Cranstone, 1972). A direct correlation with the Sickle Group had been questioned by Lenton and Corkery (1981), who preferred the term “arkosic suite” until an unequivocal correlation is established. According to compilation maps NTS 64 F and 64 G (Manitoba Energy and Mines, 1989, 1990), the “arkosic suite” is interpreted to occur, although discontinuously, throughout Southern Indian Domain as far west as Reindeer Lake. At that location, it correlates with the Park Island assemblage (Table 1), whose deposition was constrained by U-Pb zircon at ca. 1.87–1.86 Ga, with the minimum age provided by the crosscutting Wathaman Batholith (Corrigan et al., 1999). In the Pukatawakan Bay area, ‘Chipewyan-type’ plutons intrude rocks of the ‘arkosic suite’, indicating a more likely correlation with the Park Island assemblage than the ca. 1.84–1.83 Ga Sickle Group.

ACKNOWLEDGMENTS

Fieldwork this summer was facilitated by the cheerful assistance of Philippe St-Germain, Sonia Préfontaine, Gordon McKercher, and Justin Laberge. Chris Beaumont-Smith, Herman Zwanzig, and Tim Corkery are thanked for an introduction to the local geology and invaluable logistical help. Craig Taylor from Hudson Bay Exploration and Development is thanked for providing access to the Ruttan property. Field logistics were greatly helped with the excellent service provided by Transwest Air and RND Aviation. John Percival and Marc St-Onge are thanked for thoughtful reviews of the manuscript.

REFERENCES

Ames, D.E.

1991: The Ruttan Cu-Zn deposit and depositional environment: an update; *in* Report of Activities 1991; Manitoba Energy and Mines, Mineral Division, p.106–107.

1996: Stratigraphic and tectonic setting of the Paleoproterozoic Ruttan Cu-Zn VHMS deposit, Rusty Lake belt, Trans-Hudson Orogen; *in* EXTECH I: A Multidisciplinary Approach to Massive Sulphide Research in the Rusty Lake–Snow Lake Greenstone Belts, Manitoba, (ed.) G.F. Bonham-Carter, A.G. Galley, and G.E.M. Hall; Geological Survey of Canada, Bulletin 426, p. 15–43.

Ames, D.E. and Scoates, J.S.

1992: Geology, preliminary map of the geological setting of the Ruttan Cu-Zn deposit, Rusty Lake Belt, Manitoba; Geological Survey of Canada, Open File 2571, scale 1:5 000 and notes.

Ames, D.E. and Taylor, C.

1996: Geology of the West Anomaly orebody, Ruttan volcanic-hosted massive sulphide deposit, Proterozoic Rusty Lake Belt; *in* EXTECH I: A Multidisciplinary Approach to Massive Sulphide Research in the Rusty Lake–Snow Lake Greenstone Belts, Manitoba, (ed.) G.F. Bonham-Carter, A.G. Galley, and G.E.M. Hall; Geological Survey of Canada, Bulletin 426, p. 45–76.

Ames, D.E., Scoates, J.S., and Franklin, J.M.

1990: Preliminary report on the geological setting of the Ruttan base metal deposit and associated hydrothermal alteration, Rusty Lake volcanic belt, Manitoba (NTS 64B/5); *in* Report of Activities 1990: Manitoba Energy and Mines, Minerals Division, p. 178–186.

Ansdell, K.M. and Yang, H.

1995: Detrital zircons in the McLennan Group meta-arkoses and MacLean Lake Belt, western Trans-Hudson Orogen; *in* Trans-Hudson Orogen Transect, (ed.) Z. Hajnal and J. Lewry; LITHOPROBE Report no. 48, University of British Columbia, Vancouver, British Columbia, p. 190–197.

Ansdell, K.M., Corrigan, D., Stern, R., and Maxeiner, R.

1999: Shrimp U-Pb geochronology of complex zircons from Reindeer Lake, Saskatchewan: implications for timing of sedimentation and metamorphism in the northwestern Trans-Hudson Orogen; Geological Association of Canada–Mineral Association of Canada, Joint Annual Meeting, May 26–28, Sudbury, Program with Abstracts, p. 3.

Baldwin, D.A.

1981: Mineral deposits in the Ruttan Lake, Karsakuwigamak Lake, Muskayk Lake areas, Manitoba; Manitoba Mineral Resources Division, Open File Report OF81-4, 59 p.

1987: Physical geology of the northwest segment of the Karsakuwigamak Block, Proterozoic Rusty Lake metavolcanic belt, Northern Manitoba; Ph.D. thesis, University of Manitoba, Winnipeg, Manitoba, 438 p.

1988: Geology of the southern part of the Rusty Lake volcanic belt; Manitoba Energy and Mines, Geological Report GR86-1, p. 1–90.

Baldwin, D.A., Syme, E.C., Zwanzig, H.V., Gordon, T.M., Hunt, P.A., and Stevens, R.P.

1987: U-Pb zircon ages from the Lynn Lake and Rusty Lake metavolcanic belts, Manitoba: two ages of Proterozoic magmatism; Canadian Journal of Earth Sciences, v. 24, p. 1053–1063.

Barrie, C.T. and Taylor, C.F.

2001: Geology, alteration mineralogy, geochemistry, and VMS potential of the Ruttan mine area and the Southern Rusty Lake Volcanic Belt, Manitoba; Manitoba Mines Branch, Open File Report, 45 p.

Beaumont-Smith, C.J. and Rogge, D.M.

1999: Preliminary structural analysis and gold metallogeny of the Johnson Shear Zone, Lynn Lake greenstone belt (parts of NTS 64C-10, -11, -15); *in* Report of Activities, 1999; Manitoba Industry, Trade and Mines, Geological Services, p. 61–66.

Corrigan, D.

2000a: Geology, Central Reindeer Lake, Saskatchewan; Geological Survey of Canada, Open File 3750, scale 1:100 000.

2000b: Geology, Milton Island area, Reindeer Lake South, Saskatchewan; Geological Survey of Canada, Open File 3881, scale 1:50 000.

2001: Geology, Northern Reindeer Lake, Saskatchewan; Geological Survey of Canada, Open File 3881, scale 1:100 000.

Corrigan, D., MacHattie, T.G., and Chakungal, J.

2000: The nature of the Wathaman Batholith and its relationship to the Archean Peter Lake Domain along the Reindeer Lake transect, Saskatchewan; Geological Survey of Canada, Current Research 2000-C13, 10 p.

Corrigan D., Maxeiner, R., Bashforth, A., and Lucas, S.

1998: Preliminary report on the geology and tectonic history of the Trans-Hudson Orogen in the northwestern Reindeer Zone, Saskatchewan; *in* Current Research, Part C; Geological Survey of Canada, Paper 98-1C, p. 95–106.

Corrigan, D., Pehrsson, S.J., MacHattie, T.G., Piper, L., Wright, D., Lassen, B., and Chakungal, J.

1999: Lithotectonic framework of the Trans-Hudson Orogen in the northwestern Reindeer Zone, Saskatchewan: An update from recent mapping along the Reindeer Lake Transect; *in* Current Research, Part C; Geological Survey of Canada, Paper 99-C, p. 169–178.

Cranstone, J.R.

1972: Geology of the Southern Indian Lake area, northeastern portion; Manitoba Mines Branch, Publication 71-2J, 82 p.

Frohlinger, T.G. and Cranstone, J.R.

1972: Pine Lake; Manitoba Mines, Resources and Environmental Management, Mines Branch, Map 71-2-16; scale 1:50 000 (accompanies publications 71-2I and 71-2J).

Fumerton, S.L., Stauffer, M.R., and Lewry, J.F.

1984: The Wathaman Batholith: largest known Precambrian pluton; Canadian Journal of Earth Sciences, v. 21, p. 1082–1097.

Gilbert, H.P., Syme, E.C., and Zwanzig, H.V.

1980: Lynn Lake area, Map GP80-1-6; Manitoba Mineral Resources Division, Geological Paper GP80-1; scale 1:100 000.

Hoffman, P.F.

1988: United plates of America, the birth of a craton: Early Proterozoic assembly and growth of Proterozoic Laurentia; Annual Review of Earth and Planetary Sciences, v. 16, p. 543–603.

Lafrance, B.

1999: Gold studies in the Byers Fault-Waddy Lake area, La Ronge Domain; *in* Summary of Investigations 1999; Saskatchewan Geological Survey, Saskatchewan Energy and Mines, Miscellaneous Report 99-4.2, p. 202–207.

Lenton, P.G. and Corkery, M.T.

1981: The Lower Churchill River project (interim report); Manitoba Energy and Mines, Open File OF81-3, 23 p.

Manitoba Energy and Mines

1986: Uhlman Lake; Manitoba Energy and Mines, Bedrock Geology Compilation Series, NTS 64B, scale 1:250 000.

1987: Northern Indian Lake; Manitoba Energy and Mines, Bedrock Geology Compilation Series, NTS 64H, scale 1:250 000.

1989: Bedrock Geology Compilation Map Series, Brochet, NTS 64F, Manitoba Energy and Mines, scale 1:250 000.

1990: Big Sand Lake; Manitoba Energy and Mines, Bedrock Geology Compilation Series, NTS 64G, scale 1:250 000.

Maxeiner, R.O.

1997: Geology of the Lawrence Bay (Reindeer Lake) Area, Northeastern La Ronge Domain; *in* Summary of Investigations 1986, Saskatchewan Geological Survey, Saskatchewan Energy and Mines, Miscellaneous Report 86-4, p. 3–17.

1998: Geology of the Birch Point (Reindeer Lake) area, northeastern La Ronge Domain; *in* Summary of Investigations 1998; Saskatchewan Geological Survey, Saskatchewan Energy and Mines, Miscellaneous Report 98-4, p. 81–99.

Maxeiner, R.O. and Demmans, C.J.
2000: The final pieces of the 'bridge': Geology of the Southern Reindeer Lake and Laurie Lake areas; *in* Summary of Investigations 2000; Saskatchewan Geological Survey, Saskatchewan Energy and Mines, Miscellaneous Report 2000-4.2, p. 31–50.

Syme, E.C.
1985: Geochemistry of metavolcanic rocks in the Lynn Lake Belt; Manitoba Energy and Mines, Geological Report GR85-1, 84 p.

Van Schmus, W.R. and Schledewitz, D.C.P.
1986: U-Pb zircon geochronology of the Big Sand Lake area, northern Manitoba; *in* Report of Field Activities, 1986; Manitoba Energy and Mines, Minerals Division, p. 207–210.

Zwanzig, H.V.
2000: Geochemistry and tectonic framework of the Kisseynew Domain-Lynn Lake Belt boundary (part of NTS 63P/13); *in* Report of Activities 2000; Manitoba Industry, Trade and Mines, Manitoba Geological Survey, p. 91–96.

Zwanzig, H.V., Syme, E.C., and Gilbert, H.P.
1999: Updated trace element geochemistry of ca. 1.90 Ga Metavolcanic rocks in the Paleoproterozoic Lynn Lake Belt; Manitoba Industry, Trade and Mines, Geological Services, 46 p. + accompanying map and diskette.

Geological Survey of Canada Project 010005