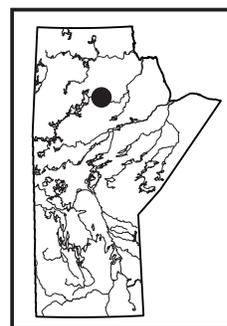


**GS-11 Bedrock geology of the Northern Indian Lake area, Manitoba
(parts of NTS 64H3, 5, 6)
by P.D. Kremer and T. Martins**



Kremer, P.D. and Martins, T. 2014: Bedrock geology of the Northern Indian Lake area, Manitoba (parts of NTS 64H3, 5, 6); in Report of Activities 2014, Manitoba Mineral Resources, Manitoba Geological Survey, p. 131–139.

Summary

This report summarizes the results of geological mapping conducted along the lower Churchill River at Northern Indian Lake in July of 2014. The area is underlain by Paleoproterozoic rocks comprising part of the Trans-Hudson orogen (THO), including metasedimentary and metavolcanic rocks of the Southern Indian domain and plutonic rocks of the Chipewyan domain. Highly deformed metavolcanic and metasedimentary rocks of the Southern Indian domain, which are preserved as large (kilometre scale) screens and xenoliths within several phases of younger felsic plutonic rocks, are tentatively correlated with continental arc volcanic rocks of the Partridge Breast Lake assemblage. The intrusive contact that marks the boundary between the Southern Indian and Chipewyan domains is exposed at Northern Indian Lake. The contact zone is marked by a narrow, localized increase in strain, affecting both the country rock and the Chipewyan batho-

lith. Previous studies at Southern Indian Lake (~80 km west of Northern Indian Lake) have identified fault-bounded remnants of latest Archean to earliest Paleoproterozoic crust, which form an important detrital and inherited component in the northeastern Southern Indian domain. Samples collected during this study for U-Pb geochronological and Sm-Nd isotopic analyses will help to further constrain the extent of crustal contamination near the southern margin of the Chipewyan domain and will lead to a better understanding of the crustal architecture underlying this portion of the THO.

Introduction

Northern Indian Lake is located along the Churchill River approximately 170 km north of Thompson, Manitoba (Figure GS-11-1). The area has seen little to no

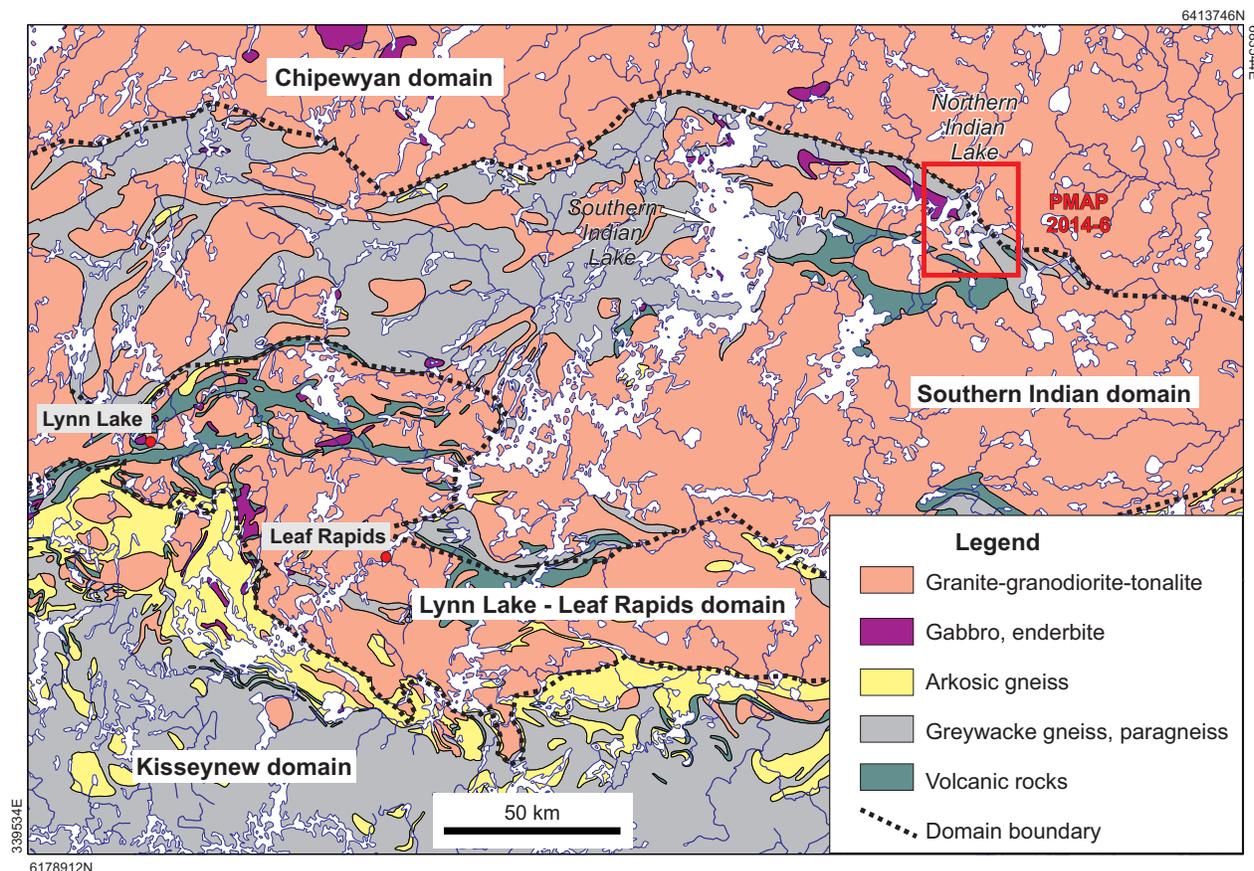


Figure GS-11-1: Simplified geology of the northern flank of the Reindeer zone of the Trans-Hudson orogen in Manitoba showing the location of the Northern Indian Lake mapping project in the red square (Kremer and Martins, 2014).

exploration activity in the past several decades, and the most recent mapping at Northern Indian Lake (1:100 000 scale) was conducted in the early 1980s (Corkery and Lenton, 1990). Water levels along the lower Churchill River are regulated by Manitoba Hydro's Missi Falls Control Structure and are highly variable. At low water levels, the area is characterized by extensive and lichen-free outcrop exposed along much of the shoreline. Recent results from mapping and sampling elsewhere in the Southern Indian domain (Kremer et al., 2009a, b; Martins and Kremer, 2013) yielded anomalous values of base and precious metals, often associated with plutonic rocks that intrude the supracrustal assemblages. In the summer of 2014, the Manitoba Geological Survey initiated a 4 week, 1:50 000 scale mapping program designed to

- update the bedrock geology of the Northern Indian Lake area;
- document the nature of the boundary between the Southern Indian and Chipewyan domains;
- further assess the distribution and genetic associations of base- and precious-metal occurrences; and
- obtain a well-constrained sample suite of Paleoproterozoic supracrustal and plutonic rocks to evaluate the nature and extent of Archean crustal contamination, and provide constraints on the underlying crustal architecture in the northeastern THO in Manitoba, which may have implications for diamond exploration.

Regional geology

The Southern Indian domain is one of three major tectonostratigraphic entities that define the northern flank of the Reindeer zone of the THO in Manitoba (Figure GS-11-1). It is dominantly composed of variably migmatitic metasedimentary rocks, with rare belts dominated by metavolcanic rocks, which have been historically assigned to the Sickie and Wasekwan groups, respectively (i.e., Cranstone, 1972; Frohlinger, 1972). The Southern Indian domain is bounded to the south by the volcanic-dominated Lynn Lake–Leaf Rapids domain, and intruded to the north by the voluminous ca. 1.86–1.85 Ga Wathaman-Chipewyan batholith, which stitches the Reindeer zone to the southern margin of the Hearne craton.

Based on recent mapping, and results from litho-geochemical and geochronological analyses (Rayner and Corrigan, 2004; Kremer, 2008; Kremer et al., 2009a, b), supracrustal rocks of the Southern Indian domain have been subdivided into several distinct lithotectonic assemblages. Massive to pillowed juvenile basaltic rocks and associated basinal sedimentary rocks make up the Pukatawakan Bay assemblage (Kremer, 2008). In northeastern Southern Indian Lake, the Pukatawakan Bay assemblage is intruded by the ca. 1890 Ma Turtle Island complex, which provides a minimum age of deposition. The Turtle Island complex is similar in age to, and possibly represents

the subvolcanic equivalent of, bimodal, continental arc volcanic and volcanoclastic rocks comprising the Partridge Breast Lake assemblage. Both the Pukatawakan Bay and Partridge Breast Lake assemblages are intruded by several generations of plutonic rocks ranging in age from ca. 1880 to 1830 Ma, and are unconformably overlain by fluvial-alluvial sedimentary rocks with maximum age constraints ranging from ca. 1860 to 1830 Ma.

The Pukatawakan Bay assemblage is in fault contact with latest Archean to earliest Paleoproterozoic orthogneiss (ca. 2520–2380 Ma) in west-central Southern Indian Lake (Kremer et al., 2009a). Though exposure of this orthogneiss is limited to a group of small islands, zircons of that range define the dominant and subdominant populations in detrital zircon spectra from all Paleoproterozoic assemblages in the area. Additionally, similar age zircons are ubiquitous as inherited grains in Paleoproterozoic plutonic and volcanic rocks (Rayner and Corrigan, 2004; Kremer et al., 2009a). Late Archean to early Paleoproterozoic orthogneiss at Southern Indian Lake may represent a window of Hearne craton exposed in the internides of the THO. Alternatively, it may form part of an exotic, microcontinental fragment, similar to the Sask craton.

Bedrock geology of the Northern Indian Lake area

The lithological units identified in the Northern Indian Lake area are divided into two main groups: Southern Indian domain and Chipewyan domain. In this part of the Southern Indian domain, the metavolcanic and metasedimentary rocks are highly deformed and are preserved as large screens and xenoliths within several phases of younger felsic plutonic rocks (Figure GS-11-2). Although the majority of rocks in the Northern Indian Lake area have been subjected to metamorphic conditions, the 'meta' prefix has been omitted to improve the readability of the text.

Southern Indian domain

Partridge Breast Lake assemblage (unit 1)

Supracrustal rocks of the Southern Indian domain at Northern Indian Lake are preserved as a kilometre-scale screen and as smaller xenoliths within Paleoproterozoic intrusions (Figure GS-11-2; Kremer and Martins, 2014). Based on similarities in lithofacies, and pending analytical results, they are tentatively correlated to the Partridge Breast Lake assemblage (Kremer et al., 2009a).

Basalt (unit 1a) weathers dark grey, is strongly foliated, and occurs as both massive and pillowed flows. Massive basalt is fine to very fine grained, aphyric, and locally contains up to 10% rounded to subrounded, quartz amygdules (<1–4 cm in size), generally concentrated toward the top of individual flows (Figure GS-11-3a). Epidote alteration, consisting of subrounded to elongate

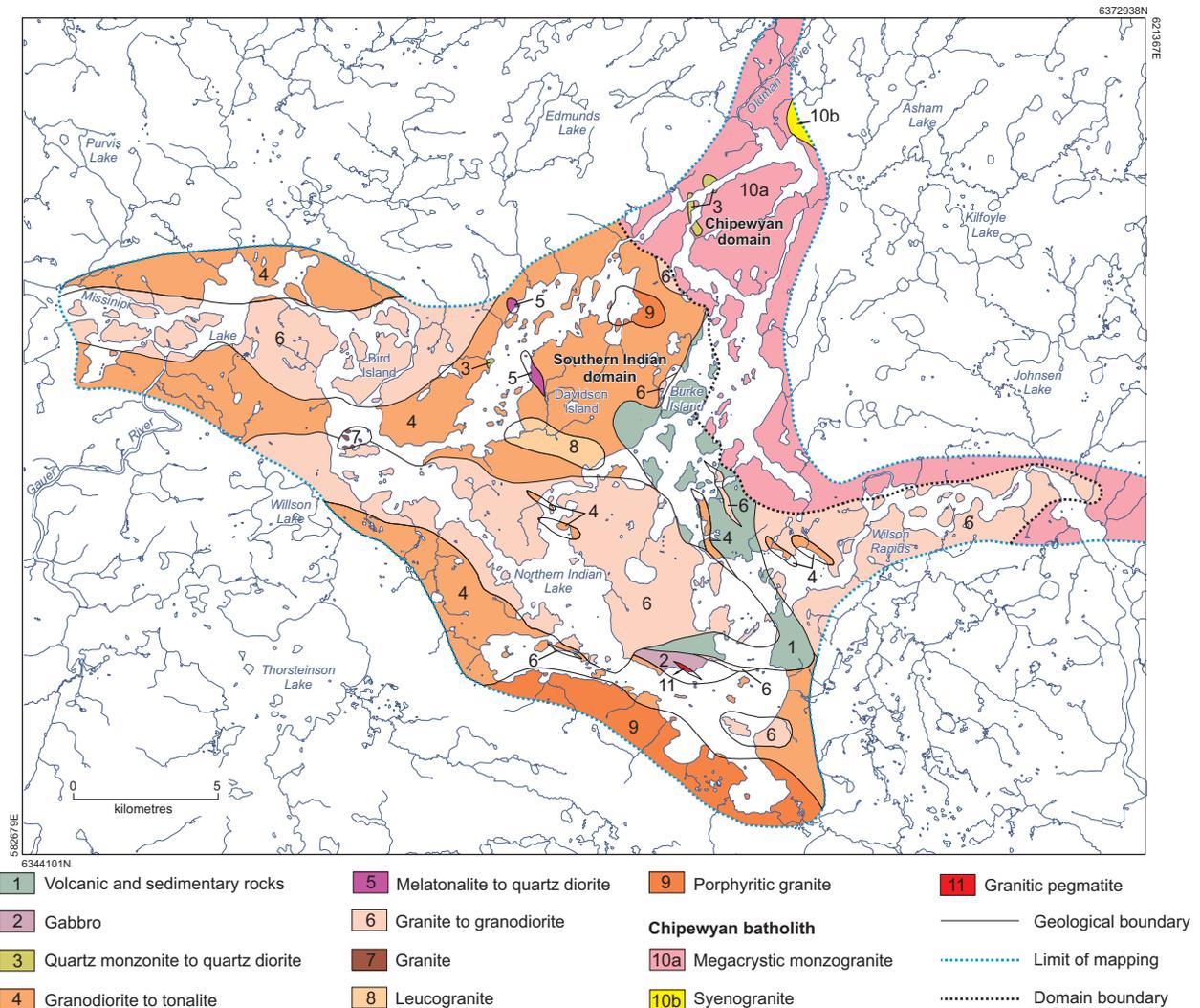


Figure GS-11-2: Simplified geology of the Northern Indian Lake area.

epidosite nodules ranging from a few centimetres up to 1 m in size (Figure GS-11-3a) is characteristic of massive basalt flows. Where identifiable, individual flows range from <1 to several metres in thickness. Flow top breccia facies are observed in a few locations. Narrow (<1 m thick) beds of fine-grained greywacke occur locally between adjacent massive flows. Pillowed basalt is aphyric and nonamygdaloidal. Pillows are highly flattened, with aspect ratios ranging between 5:1 and 20:1. Pillow selvages are thin (1 cm) and nonrecessive with little to no interpillow material present. Rare intervals of quartz-rich felsic tuff up to 5 m thick occur interlayered with basalt. Felsic tuff weathers light beige to buff and is well bedded with bed thickness ranging from <1 to 5 cm (Figure GS-11-3b).

Rare outcrops of volcanic conglomerate (unit 1b) occur on the northern shoreline, west of Wilson Rapids and the outlet to the Churchill River. Conglomerate is

massive to crudely layered, clast supported, and heterolithic (Figure GS-11-3c). Clasts are subrounded, flattened, and range in size from 3 to 50 cm. They are composed of fine-grained, aphyric to locally feldspar-phyric basaltic rocks, with lesser fine- to medium-grained, equigranular gabbro.

Feldspathic greywacke (unit 1c) is the dominant lithofacies in the northern arm of the supracrustal rocks near Burke Island. Greywacke weathers medium to dark grey, is fine to medium grained, and massive to thickly bedded. It is composed of 40–60% fine-grained biotite, 20–40% subrounded plagioclase (1–4 mm), 10–15% hornblende (only locally observed), and <5% anhedral, subrounded to rounded quartz (1–3 mm). Where present, bed thickness ranges from <50 cm to several metres thick. Primary sedimentary structures, such as graded bedding, are rare and only occur in a few exposures.

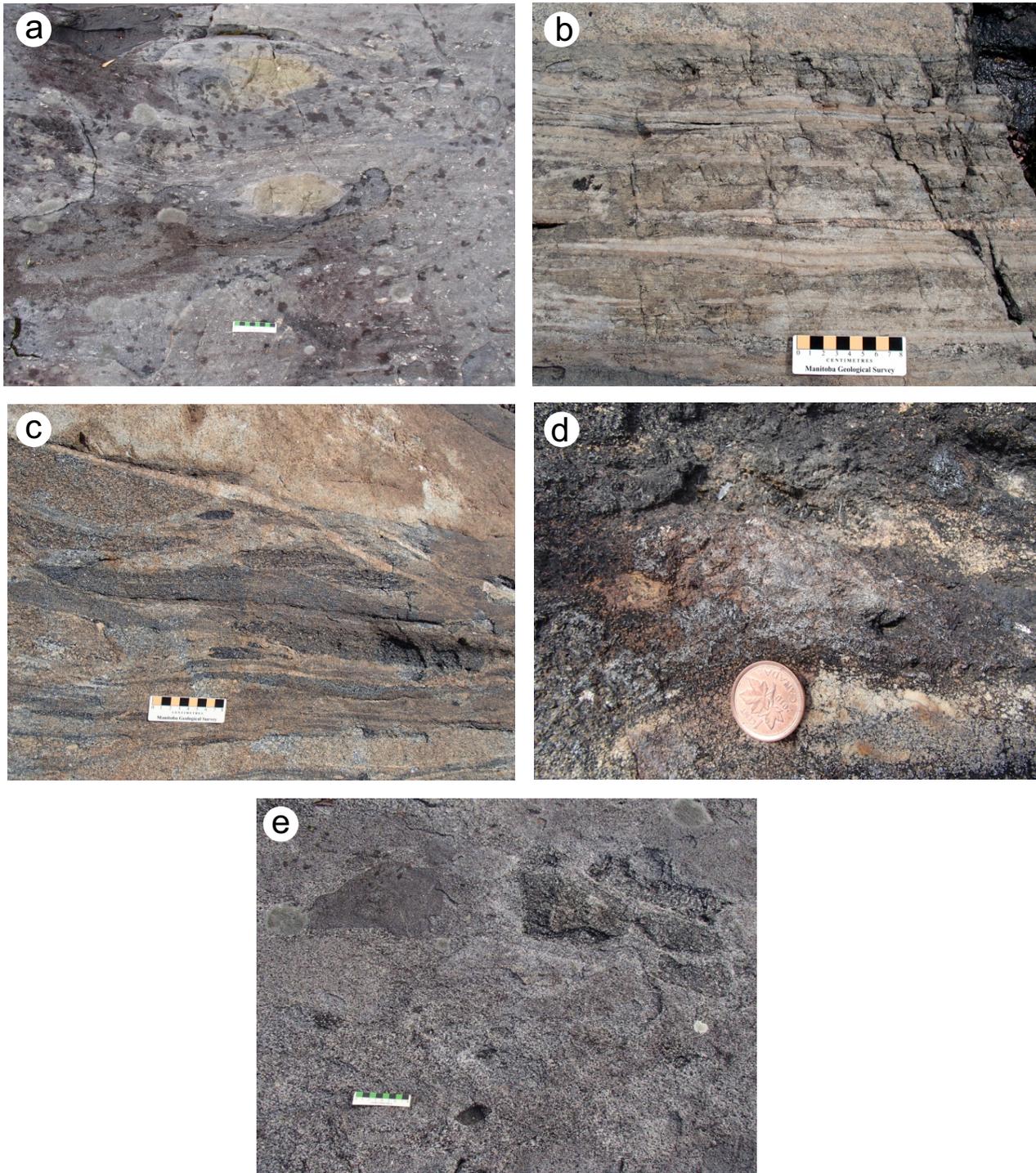


Figure GS-11-3: Outcrop photographs of the Partridge Breast Lake assemblage at Northern Indian Lake: **a)** dark grey amygdaloidal basalt, with subrounded to elongate epidosite nodules; **b)** well-bedded light beige to buff felsic tuff; **c)** massive heterolithic conglomerate; **d)** garnet and sillimanite porphyroblasts in pelitic to semipelitic schist; **e)** cognate xenoliths in gabbro.

At a single outcrop southwest of Burke Island, greywacke is interbedded with alternating psammitic and pelitic layers and a single layer of conglomerate (unit 1d). The greywacke weathers medium to dark grey and is fine to medium grained. Pelitic layers contain garnet and sillimanite porphyroblasts (Figure GS-11-3d). Granitoid injections, possibly derived from migmatitization of the metasedimentary rocks, are observed at this location.

Gabbro (unit 2)

Exposures of gabbro occur in spatial association with volcanic and sedimentary rocks of the Southern Indian domain. The best exposure occurs along the shoreline south of mafic volcanic rocks (unit 1a) in the southern portion of the map area. Gabbro is medium to coarse grained, mesocratic, massive and equigranular. It contains approximately 50% euhedral to subhedral plagioclase (2–6 mm), 45–50% hornblende (2–8 mm) and locally up to 5% quartz. Gabbro contains cognate xenoliths

of mesocratic to melanocratic gabbro ranging in size from 2 to 50 cm (Figure GS-11-3e). Rare dikes of fine- to medium-grained leucogabbro to quartz diorite cut mesocratic gabbro.

Quartz monzonite to quartz diorite (unit 3)

This unit occurs as xenoliths in the Chipewyan batholith, particularly along the Oldman River, in the northern part of the map area, and to a lesser extent in plutonic rocks of the Southern Indian domain. Quartz monzonite to diorite is medium to very coarse grained, melanocratic, and porphyritic (with plagioclase or K-feldspar phenocrysts). The groundmass is mostly composed of biotite and hornblende (30–40%), quartz (10%), and contains trace amounts of sulphides (Figure GS-11-4a).

Granodiorite to tonalite (unit 4)

The rocks assigned to this unit are white to beige, medium to coarse grained, and strongly foliated (Figure GS-11-4b). Tonalite is composed of plagioclase (40%),

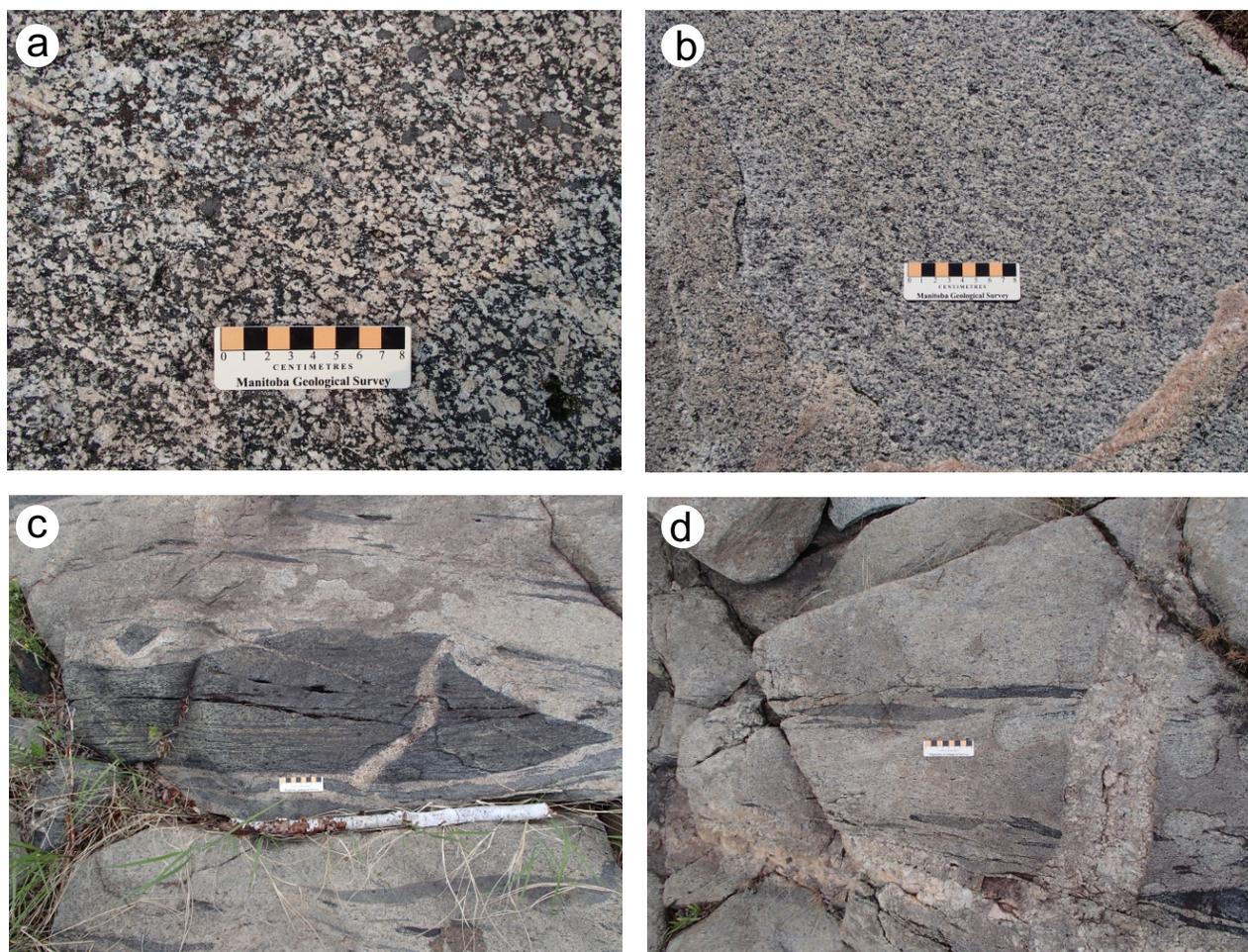


Figure GS-11-4: Outcrop photographs from the Northern Indian Lake area: **a)** xenoliths of porphyritic quartz monzonite in the Chipewyan batholith; **b)** foliated hornblende-biotite tonalite (unit 4); **c)** and **d)** resorbed xenoliths in hornblende-biotite tonalite.

quartz (30–40%), biotite and hornblende aggregates (up to 15%), K-feldspar (<5%) and trace amounts of titanite and disseminated sulphide and magnetite. Tonalite is massive to locally porphyritic. Partially digested xenoliths of metasedimentary and gabbroic rocks (units 1 and 2) are common in tonalite, but do not occur in all exposures. The xenoliths account for up to 60% of some exposures. The xenoliths vary from angular to rounded, are highly flattened, and vary in size from 5 to 75 cm (Figure GS-11-4c, d). Locally, dikes of unit 6 crosscut the tonalite. Tonalite is also cut by pegmatite dikes up to 30 cm wide, which contain up to 10% magnetite locally.

Melatonalite to quartz diorite (unit 5)

Exposures of melatonalite are restricted to a few outcrops northwest of Davidson Island. This unit is fine to medium grained, homogeneous, and massive to weakly foliated. It is composed of 20–30% quartz, 35–45% biotite-hornblende and 35% plagioclase. Field relationships between melatonalite and the surrounding tonalite to granodiorite (unit 4) could not be determined. Melatonalite may represent a younger phase intruding tonalite; alternatively, it could occur as xenoliths, similar to quartz diorite (unit 3).

Granite to granodiorite (unit 6)

This unit covers almost one third of the map area and dominates in the central area of the lake. Based on field relationships it is considered younger than the granodiorite to tonalite unit (xenoliths of unit 4 are found throughout). The rocks that comprise this unit vary in composition from granitic to granodioritic. They are leucocratic (white to pale pink), fine to medium grained, homogeneous, weakly to moderately foliated, and magnetic. They are dominantly biotite bearing, but small amounts of hornblende occur locally. Overall this unit is composed of plagioclase (30–40%), quartz (25–40%), K-feldspar (10–15%) and biotite-hornblende (up to 15%). Disseminated sulphides, namely chalcopyrite, pyrite and minor pyrrhotite, occur throughout. Pyrite, chalcopyrite and rare pyrrhotite also occur in fractures (Figure GS-11-5a) or in discrete stringers associated with epidote and magnetite. Typically, a higher amount of sulphides is also associated with a higher percentage of magnetite (locally up to 3%). A sample of this material was collected for assay. The unit is cut by pegmatite composed of quartz, K-feldspar, plagioclase, biotite and magnetite. The pegmatite dikes vary in width from a few centimetres to a maximum width of 2 m and have general trends of 200 and 316° with steep dips (68–82°).

Granite (unit 7)

Fine-grained granite occurs in the western portion of Northern Indian Lake, along the contact between tonalite

and granodiorite. This granite weathers light to medium grey, is fine grained, massive and homogeneous. It contains 40% subhedral quartz up to 1.5 mm, 30% subhedral to euhedral plagioclase, 20% K-feldspar, and 10% randomly oriented to weakly foliated biotite with local hornblende. Granite contains abundant subangular to subrounded xenoliths of granodiorite up to 2 m in size. This unit is petrographically similar and possibly cogenetic with subhorizontal dikes of fine-grained granite observed in the Chipewyan batholith (see below).

Leucogranite (unit 8)

Leucogranite is well exposed in a recently burned area on the northwestern shore of Davidson Island. Leucogranite weathers light grey, is fine to medium grained, and grades locally into pegmatite. Leucogranite is composed of 30–40% quartz, 25–35% K-feldspar, 25–30% plagioclase, <10% biotite, and is nonmagnetic. It contains several xenoliths of medium grey weathering gabbro, with up to 40% hornblende phenocrysts (0.5–1 cm) in a fine-grained groundmass. Xenoliths of this type were not observed in other plutonic rocks in the area. Potassium alteration haloes up to 1 cm thick are associated with a distinct fracture set in leucogranite.

Porphyritic granite (unit 9)

The porphyritic granite occurs mostly in the southern part of the map area, with a smaller occurrence close to the boundary of the Chipewyan domain to the northeast (Figure GS-11-2). This granite is pink when fresh, medium to coarse grained, massive to moderately foliated, and homogeneous. It contains K-feldspar phenocrysts varying in size from 0.3 to 1 cm (Figure GS-11-5b), and typically contains 30–40% quartz, 20–30% K-feldspar, 5–10% biotite, trace amounts of magnetite and plagioclase. Locally this unit is cut by granitic pegmatite dikes up to 2 m wide of simple mineralogy (mainly quartz, K-feldspar, plagioclase and biotite).

Granitic pegmatite (unit 11)

Various granitic pegmatite bodies cut all of the units in the Southern Indian domain. No pegmatite bodies were identified cutting the rocks from the Chipewyan domain. The main trends are 100°, 140° and from 180 to 190°, with dips varying from 63 to 86°. Most pegmatite bodies are generally <2 m in thickness, with rare pegmatite >5 m thick. The pegmatite bodies are unzoned or have very crude zonation, and their mineralogy is simple. The major mineral phases are quartz, K-feldspar, plagioclase and biotite. Garnet and magnetite (up to 2 cm) are accessory mineral phases (Figure GS-11-5c). Graphic texture and comb texture are present in some outcrops.

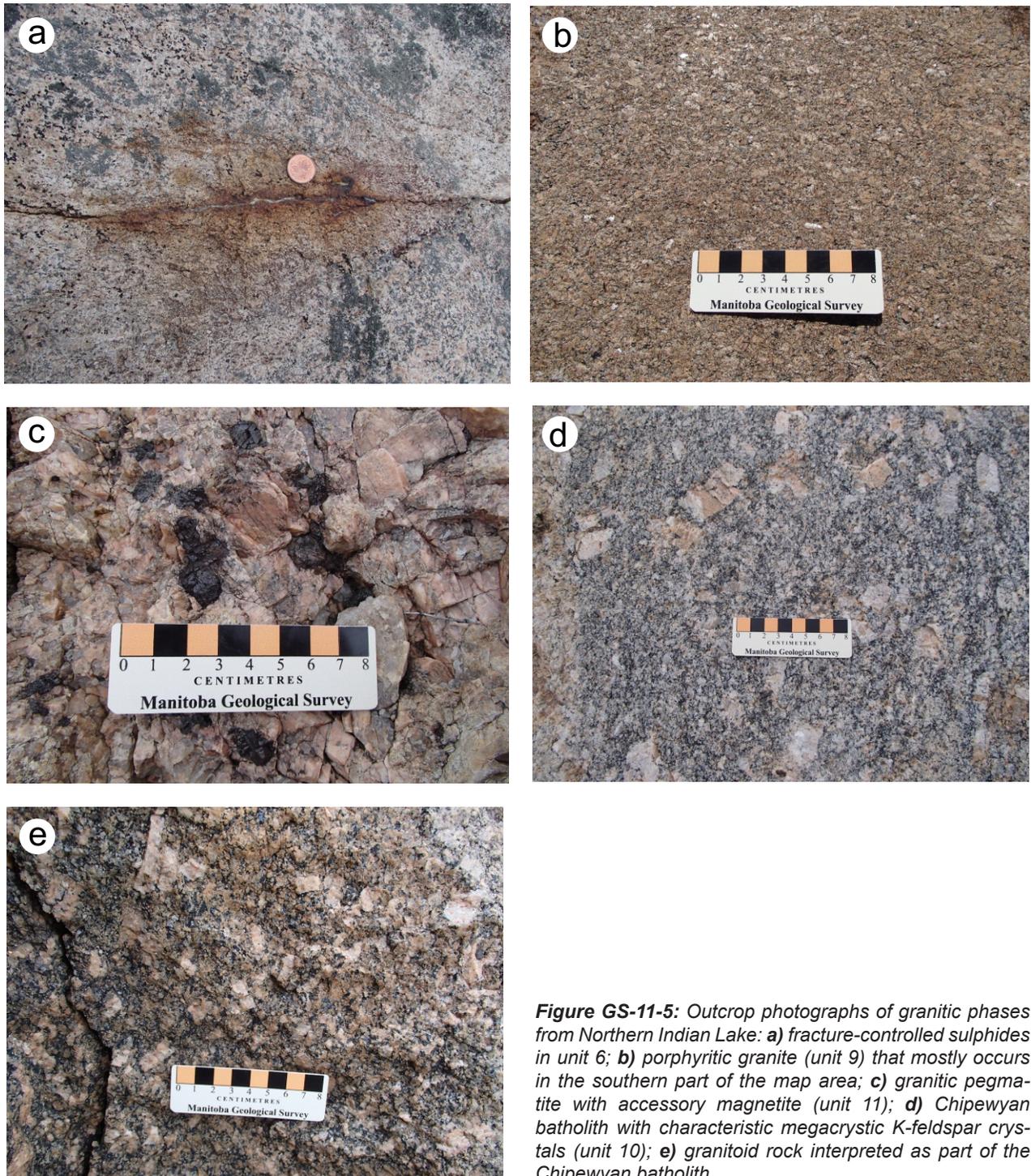


Figure GS-11-5: Outcrop photographs of granitic phases from Northern Indian Lake: **a)** fracture-controlled sulphides in unit 6; **b)** porphyritic granite (unit 9) that mostly occurs in the southern part of the map area; **c)** granitic pegmatite with accessory magnetite (unit 11); **d)** Chipewyan batholith with characteristic megacrystic K-feldspar crystals (unit 10); **e)** granitoid rock interpreted as part of the Chipewyan batholith.

Chipewyan domain

Chipewyan batholith (unit 10)

The Chipewyan batholith is distinguished by its megacrystic K-feldspar crystals. This granitic body is thought to be mostly homogeneous, but at Northern Indian Lake a few different phases of granitoid were identified and interpreted to be part of the Chipewyan batholith (MacHattie, 2001). The main phase of this batholith

is characterized by a medium-grained groundmass and K-feldspar megacrysts up to 4 cm (Figure GS-11-5d). It is weakly to moderately magnetic, weakly foliated and homogeneous. Locally the K-feldspar phenocrysts have a preferred orientation. The estimated average composition is quartz (30–40%), biotite (5–10%), pyrite and rare chalcopyrite (<1%), magnetite (<1%), trace amount of apatite and plagioclase feldspar. It contains xenoliths of unit 3 and very rare xenoliths of sedimentary rock interpreted to

be from the Partridge Breast Lake assemblage (unit 1d). A very similar granitoid rock with phenocrysts of K-feldspar, but not megacrystic, was considered a phase of the Chipewyan batholith, but not separated into a different map unit (Figure GS-11-5e). These two phases occur together in several outcrops, but temporal relationships are difficult to determine. Local subhorizontal sheets of fine-grained granite occur within the Chipewyan batholith. This granite weathers brownish grey, it is homogeneous, equigranular and weakly foliated. Mineralogically it is distinguished from the Chipewyan batholith by the presence of titanite (<1%), a K-feldspar content varying from 15 to 25% and a combination of biotite and hornblende up to 15%. A syenogranitic phase (unit 10b), which is restricted to a few outcrops east of Oldman River, and tentatively assigned to the Chipewyan batholith, is fine to medium grained and composed of 60–70% euhedral to subhedral K-feldspar, 20–30% anhedral to subhedral quartz, 10% plagioclase, and <5–10% biotite and trace magnetite.

Discussion

The boundary between the Southern Indian domain and the Chipewyan batholith of the Chipewyan domain is well exposed at Northern Indian Lake. Where the contact is exposed, it is marked by a localized increase in strain in both the country rocks (supracrustal and felsic plutonic rocks of the Southern Indian domain) and the Chipewyan batholith. Finite strain decreases away from, and is restricted to within a few metres of, the contact. Although the strain gradient toward the domain boundary is present at several locations, there is no evidence for shearing or displacement, as reported elsewhere in the southern margin of the Chipewyan domain (Lafrance and Varga, 1996; Corrigan et al., 2005). The high strain at Northern Indian Lake is represented by flattening with an absence of any discernible simple shear component on both horizontal and vertical planes. Crosscutting dikes of megacrystic granite, presumably related to the Chipewyan batholith, occur at several locations in the Southern Indian domain and increase in abundance toward the domain boundary. Additionally, xenoliths of rock types assigned to the Southern Indian domain commonly occur within the Chipewyan batholith. Based on this field evidence, the contact between the Chipewyan and Southern Indian domains is interpreted as purely intrusive. The observed increase in strain along the boundary zone may be attributed to forceful intrusion of the Chipewyan batholith into rocks of the Southern Indian domain; alternatively, it may have resulted from localization of strain along the contact during deformation that postdates emplacement of the Chipewyan batholith.

A comprehensive suite of samples spanning the entire range of supracrustal and plutonic rocks was collected during the course of mapping. Thin section petrography and whole rock lithogeochemical analyses will be

conducted on each rock type to further characterize and classify the rocks at Northern Indian Lake, in addition to U-Pb geochronology on select plutonic samples. In west-central Southern Indian Lake (approximately 100 km west-southwest of Northern Indian Lake), a window of latest Archean to earliest Paleoproterozoic gneiss is exposed (Kremer et al., 2009a), and similarly aged zircons are common as inherited grains in younger Paleoproterozoic plutonic rocks in the area (Rayner and Corrigan, 2004). The samples collected at Northern Indian Lake for U-Pb geochronology, coupled with Sm-Nd tracer isotope analyses, will help determine if this contamination continues toward the northeast, up to the boundary between the Southern Indian and Chipewyan domains.

Economic considerations

Mapping and sampling elsewhere in the Southern Indian domain has documented several occurrences of base and precious metals. A granodiorite located south of Partridge Breast Lake (approximately 40 km west of Northern Indian Lake) contains significant iron-staining that appears to be fracture-controlled to pervasive; however fresh visible sulphide is scarce. A sample collected from this location for assay in 2008 yielded 1.36% Zn, despite lacking visible sulphide. Fracture-controlled sulphide also occurs in granodiorite (unit 6) in the Northern Indian Lake area. These structures host stringers, blebs and disseminations of pyrite, chalcopyrite and pyrrhotite associated with quartz and magnetite, perhaps indicating potential for porphyry-style mineralization.

Bimodal arc volcanic rocks of the Partridge Breast Lake assemblage have temporal links to volcanic rocks in the Lynn Lake–Leaf Rapids domain, which host the Ruttan and Fox Lake volcanogenic massive sulphide (VMS) deposits. Frohlinger (1972) reported assay results up to 2.2% Cu from a narrow, 1.2 m long malachite-rich fracture in arc volcanic rocks of the Partridge Breast Lake assemblage in west-central Southern Indian Lake. North of Partridge Breast Lake, values up to 6.85% Cu were reported from garnet-biotite schist with laminated pyrite, pyrrhotite and chalcopyrite stringers (Assessment File 71519, Manitoba Mineral Resources, Winnipeg), perhaps representing metamorphosed VMS-style mineralization.

An interesting association of sulphide and pegmatite is present in the Southern Indian domain. In the northeastern portion of Southern Indian Lake, a pegmatite containing pale, euhedral beryl crystals up to 2 cm, surrounded by fine to very fine grained, massive to semimassive sulphide, yielded assay results up to 1.5 g/t Au and 0.4 wt. % Zn (Kremer et al., 2009b, c); the nature and significance of this association remains unknown.

MacHattie (2001) reported Nd tracer isotope data across the Wathaman batholith (the equivalent of the Chipewyan batholith in Saskatchewan) that showed increasing crustal contamination northward in the direction

of the Hearne craton (ϵ_{Nd}^1 values ranging from +2 in the south to -7 in the north). The study at Northern Indian Lake will attempt to determine the nature and distribution of crustal contamination, and whether a similar progression occurs toward the southwest, where Archean rocks comparable in age to parts of the Sask craton are exposed at Southern Indian Lake (Rayner and Corrigan, 2004; Kremer et al., 2009a). The margins of Archean cratons are considered important regional vectors for diamond exploration. The diamondiferous Pikoo kimberlite, discovered in 2013 by North Arrow Minerals Inc., is located in east-central Saskatchewan and, along with the Fort à la Corne kimberlite field, marks the second major diamond occurrence in areas thought to be underlain at depth by the mostly buried Sask craton. Results from this study will help to better constrain the Archean crustal architecture in northern Manitoba and could have significant bearing on diamond exploration in the region.

Acknowledgments

The authors thank C. Epp and R. Hiebert for providing enthusiastic field assistance and help with sample preparation. Logistical support provided by N. Brandson and E. Anderson is truly appreciated. The authors would also like to acknowledge B. Lenton and P. Lenton for their help preparing figures and maps. Both C. Couëslan and S. Anderson are acknowledged for improving this report with their comments.

References

- Corkery, M.T. and Lenton, P.G. 1990: Geology of the lower Churchill River region; Manitoba Energy and Mines, Minerals Division, Geological Report GR85-1, 9 maps.
- Corrigan, D., Hajnal, Z., Nemeth, B. and Lucas, S.B. 2005: Tectonic framework of a Palaeoproterozoic arc-continent to continent-continent collisional zone, Trans-Hudson Orogen, from geological and seismic reflection studies; Canadian Journal of Earth Sciences, v. 42, p. 421–434.
- Cranstone, J.R. 1972: Geology of the Southern Indian Lake area, northeastern portion; Manitoba Department of Mines, Resources and Environmental Management, Mines Branch, Publication 71-2J, 82 p.
- Frohlinger, T.G. 1972: Geology of the Southern Indian Lake area, central portion; Manitoba Department of Mines, Resources and Environmental Management, Mines Branch, Publication 71-2I, 91 p.
- Kremer, P.D. 2008: Geological investigations of the Pukatawakan Bay belt, Southern Indian Lake, Manitoba (part of NTS 64G2); *in* Report of Activities 2008, Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, p. 87–98.
- Kremer, P.D. and Martins, T. 2014: Geology of the Northern Indian Lake area, Manitoba (parts of NTS 64H3, 5, 6); Manitoba Mineral Resources, Manitoba Geological Survey, Preliminary Map, PMAP2014-6, scale 1:50 000.
- Kremer, P.D., Rayner, N. and Corkery, M.T. 2009a: New results from geological mapping in the west-central and northeastern portions of Southern Indian Lake, Manitoba (parts of NTS 64G1, 2, 8, 64H4, 5); *in* Report of Activities 2009, Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, p. 94–107.
- Kremer, P.D., Rayner, N. and Corkery, M.T. 2009b: Geology, geochemistry and geochronology of Southern Indian Lake, Northern Manitoba; Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, Geoscientific Presentation PRES2009-13, oral presentation at Manitoba Mining and Minerals Convention 2009, Winnipeg, Manitoba, November 19–21, URL <<http://www.gov.mb.ca/iem/geo/mgstracker/images/region1/PRES2009-13.pdf>> [October 2014].
- Kremer, P.D., Rayner, N. and Corkery, M.T. 2009c: Geology, geochemistry and geochronology of the Southern Indian Lake area, Northern Manitoba; Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, Geoscientific Presentation PRES2009-14, poster presented at Manitoba Mining and Minerals Convention 2009, Winnipeg, Manitoba, November 19–21.
- Lafrance, B. and Varga, M. 1996: Structural studies of the Parker Lake shear zone and the Reilly Lake shear zone, Reindeer Lake; *in* Summary of Investigations 1996, Saskatchewan Geological Survey, Saskatchewan Energy and Mines, Miscellaneous Report 96-4, p. 119–124.
- MacHattie, T.G. 2001: Petrogenesis of the Wathaman batholith and La Ronge domain plutons in the Reindeer Lake area, Trans-Hudson Orogen, Saskatchewan; MSc thesis, Memorial University, St. John's, Newfoundland.
- Martins, T. and Kremer, P.D. 2013: Rare-metals scoping study of the Trans-Hudson orogen, Manitoba (parts of NTS 64G08, 09, 64G03, 04, 05, 06, 64B11); *in* Report of Activities 2013, Manitoba Mineral Resources, Manitoba Geological Survey, p. 114–122.
- Rayner, N. and Corrigan, D. 2004: Uranium-lead geochronological results from the Churchill River–Southern Indian Lake transect, northern Manitoba; Geological Survey of Canada, Current Research 2004-F1, 14 p.

¹ All epsilon Nd values were calculated at the known or inferred age of crystallization.