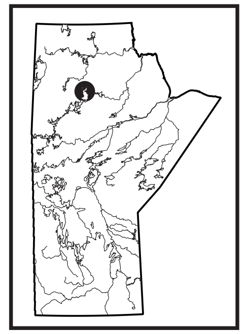
GS-6 Geological mapping in the northern basin of Southern Indian Lake, north-central Manitoba (parts of NTS 64G7, 8, 9, 10)

by T. Martins



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Summary

This report summarizes the results of geological mapping conducted within the northern basin of Southern Indian Lake in the summer of 2015. The area is underlain by Paleoproterozoic rocks of the Trans-Hudson orogen, including metamorphosed plutonic, sedimentary and volcanic rocks of the Southern Indian domain and metaplutonic rocks of the Chipewyan domain. The geology of the northern basin is dominated by granitoid plutons of variable composition (generally granitic to tonalitic) of the Southern Indian domain, which contain xenoliths of supracrustal rocks presumably derived from the Pukatawakan Bay and Partridge Breast Lake assemblages. Exposures of the Chipewyan batholith occur in the northern part of the map area.

Previous studies at Southern Indian Lake have identified exposures of late Archean to early Paleoproterozoic crust, which may have been the source of detrital and xenocrystic zircons of the same age in some of the younger Paleoproterozoic rocks in the Southern Indian domain. Samples were collected during this study to further establish the extent of this older component, thus helping to better define the crustal architecture underlying this portion of the Trans-Hudson orogen. These findings could have implications for diamond exploration in this part of northern Manitoba. This study and the results of previous work undertaken in the Southern Indian Lake area also indicate potential for a variety of other deposit types, including volcanogenic base-metal and intrusion-related gold deposits.

Introduction

The Southern Indian Lake area was the target of reconnaissance mapping in the early 20th century by the Geological Survey of Canada (GSC; McInnes, 1913). Later, geological mapping was carried out by Wright (1953) and Quinn (1960) in selected areas of Southern Indian Lake at a scale of 1:15 840. In the late 1960s, the Manitoba Geological Survey (MGS) carried out geological mapping in this area as part of the Southern Indian Lake Project (Cranstone, 1972; Thomas, 1972), and returned to this area to conduct regional mapping of the Lower Churchill River area at a scale of 1:100 000 (Lenton and Corkery, 1981). Corkery (1993) followed up with 1:50 000 scale mapping south of Partridge Breast Lake and in the area west of Gauer Lake.

Later work was undertaken as part of the GSC's Targeted Geoscience Initiative in the early 2000s, with the objective of providing an integrated and updated view on the regional geology and economic potential of the Trans-Hudson orogen (THO), including the Kisseynew, Lynn Lake–Leaf Rapids and Southern Indian domains in Manitoba, and their equivalents in Saskatchewan (e. g., Corrigan et al., 1999, 2002, 2007; Corrigan and Rayner, 2002; Maxeiner et al., 2001; Rayner and Corrigan, 2004). The MGS followed up on this work with mapping of supracrustal rocks in the Southern Indian domain at a scale of 1:25 000 and 1:50 000 (Kremer 2008a, b; Kremer 2009a, b). Granitoid rocks of the Southern Indian domain were the focus of a mapping project by the MGS in 2014 (Kremer and Martins 2014). Mapping at Southern Indian Lake continued throughout the summer of 2015 (this report; Figure GS-6-1), focusing on the northern basin of the lake and the plutonic rocks, with the aim of compiling a summary of all MGS work from previous years.

Geological setting

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-6-1). It is predominantly composed of variably migmatitic metasedimentary rocks, various granitoid units and rare belts dominated by metavolcanic rocks (Corrigan et al., 2007). The metasedimentary and metavolcanic rocks have been historically assigned to the Sickle and Wasekwan groups, respectively (Cranstone, 1972; Frohlinger, 1972). The Southern Indian domain is bounded to the south by the Lynn Lake–Leaf Rapids domain and, to the north, was intruded by the voluminous ca. 1.86–1.85 Ga Chipewyan/Wathaman batholith (Corrigan et al., 2000), which stitches the Reindeer zone to the southern margin of the Hearne craton.

Mapping, lithogeochemical and geochronological results were used to subdivide supracrustal rocks of the Southern Indian domain into two lithotectonic assemblages, namely the Pukatawakan Bay and Partridge Breast Lake assemblages (Rayner and Corrigan, 2004; Kremer, 2008a; Kremer et al., 2009a, b). The Pukatawakan Bay assemblage is composed of massive to pillowed, juvenile metabasaltic rocks and associated basinal metasedimentary rocks (Kremer, 2008a). This assemblage was intruded by the ca. 1889 ±11 Ma Turtle Island complex (Rayner and Corrigan, 2004), which provides a minimum age of deposition. The Partridge Breast Lake assemblage

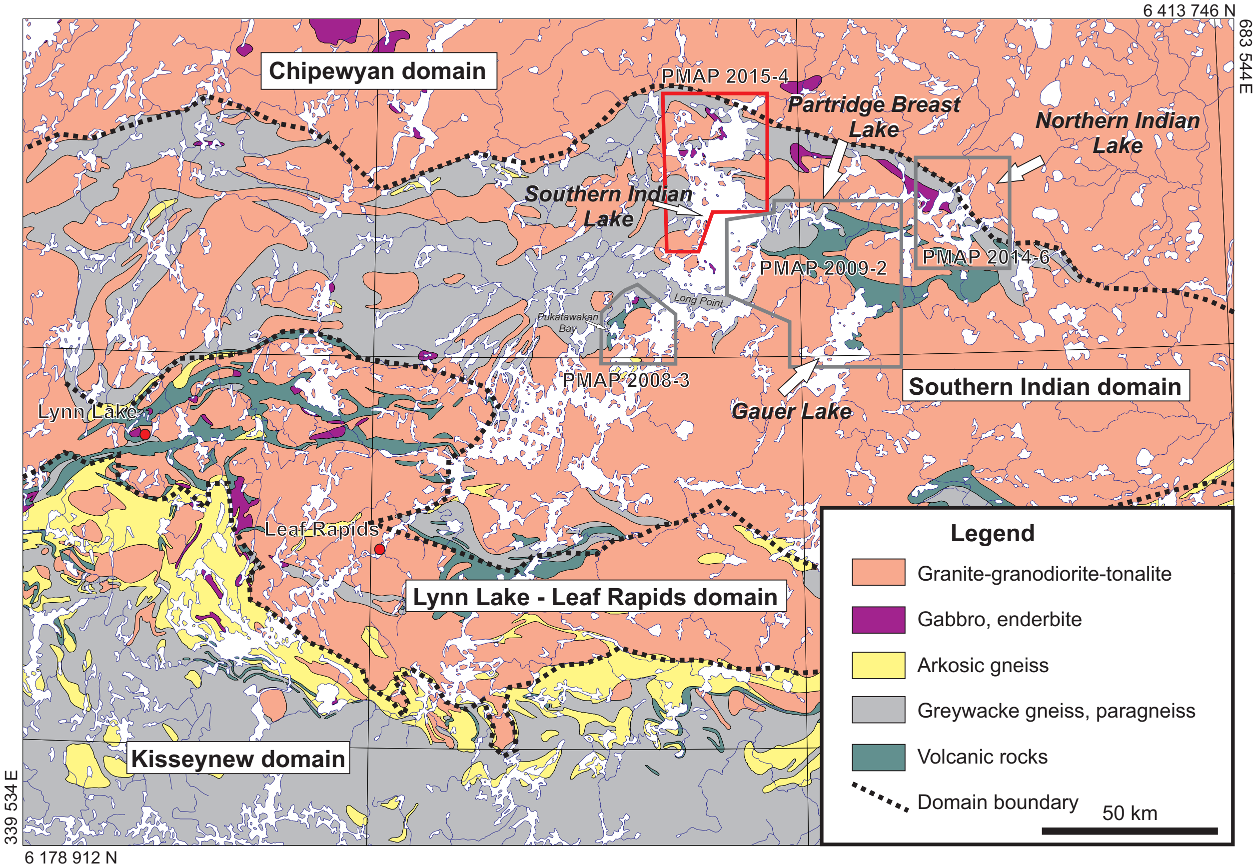

Figure GS-6-1: *Simplified regional geology of part of the Trans-Hudson orogen in northern Manitoba. Areas of recent mapping by the Manitoba Geological Survey in the Southern Indian domain area, as well as the limits of the current mapping, are outlined. Pukatawakan Bay and Partridge Breast Lake are type localities for the rock assemblages of the same name.*

is composed of bimodal continental-arc volcanic and volcaniclastic rocks and is inferred to be in fault contact with late Archean to early Paleoproterozoic orthogneiss (ca. 2520–2380 Ma) in west-central Southern Indian Lake (Kremer et al., 2009a). Exposure of this orthogneiss is limited to a group of small islands. However, the range of ages of its zircon population mimics the dominant and subdominant populations in detrital zircon histograms from all Paleoproterozoic assemblages in the area, indicating it may be more extensive than its limited exposure would suggest. Additionally, similar age zircons are ubiquitous as inherited grains in Paleoproterozoic plutonic and volcanic rocks found both at Southern Indian and Partridge Breast lakes (Rayner and Corrigan, 2004; Kremer et al., 2009a). The late Archean to early Paleoproterozoic orthogneiss at Southern Indian Lake may represent a window, or fault-bounded tectonic fragment of Hearne craton in the Reindeer zone of the THO. Alternatively, it may represent a fragment of exotic continental crust, analogous to the Sask craton (e. g., Corrigan et al., 2007).

Both the Pukatawakan Bay and Partridge Breast Lake assemblages were intruded by several generations of plutonic rocks ranging in age from ca. 1880 to 1830 Ma (Corrigan et al., 2007).

Bedrock geology of the northern basin of Southern Indian Lake

Map units identified in the northern basin of Southern Indian Lake consist mainly of metagranitoid rocks belonging to the Southern Indian and Chipewyan domains, with minor metavolcanic and metasedimentary rocks. In this part of the Southern Indian domain, the metavolcanic and metasedimentary rocks are mostly preserved as large screens and xenoliths within younger felsic metaplutonic rocks. The southern boundary of the Chipewyan domain occurs in the northeastern corner of the lake, but exposures are sparse due to extensive drift cover in this area (Figure GS-6-2). Although the majority of rocks in the Southern Indian Lake area have been metamorphosed, the ‘meta’ prefix has been omitted to improve the readability of the text. Described mineral modal abundances are based on visual estimates from outcrop and hand samples. The unit numbers in this report

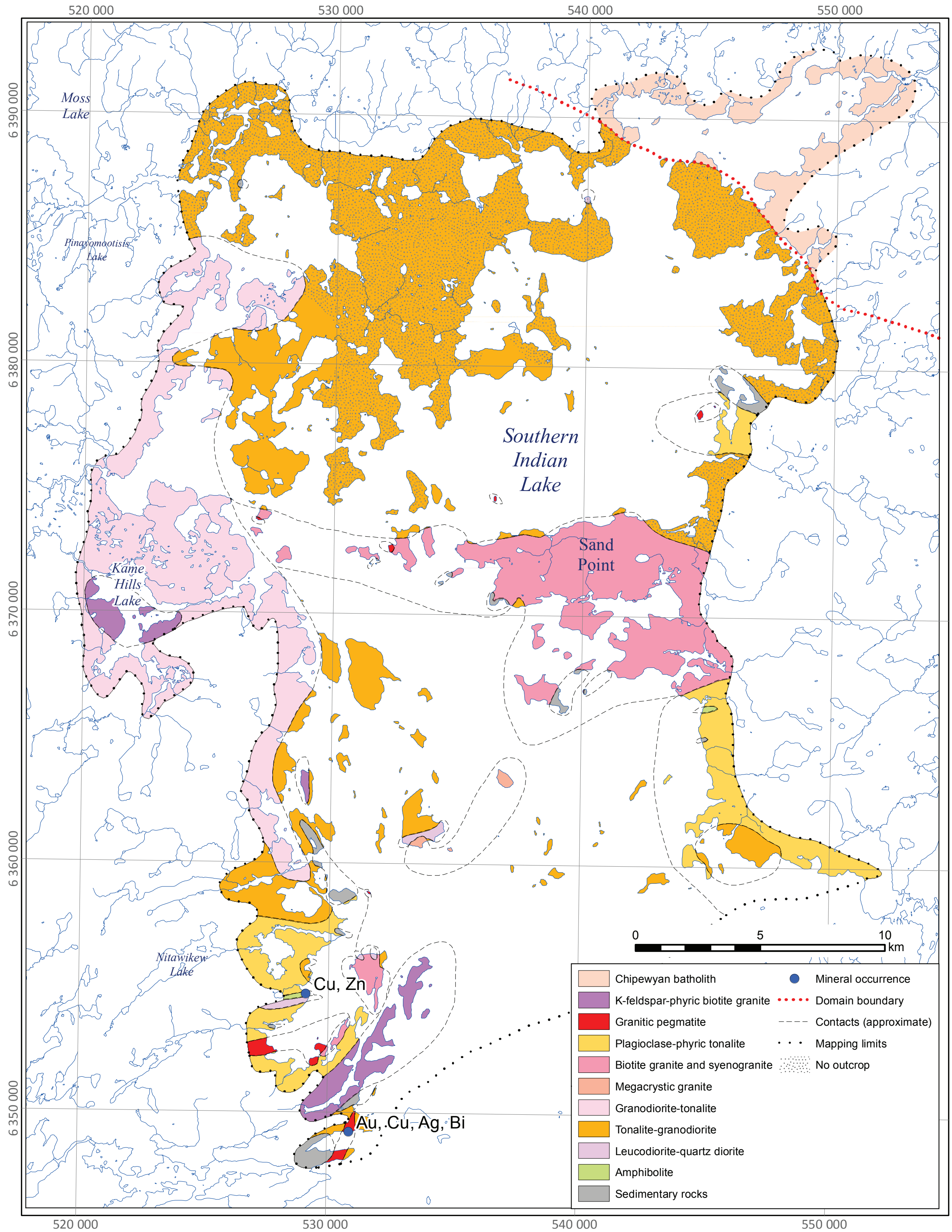

Figure GS-6-2: *Simplified geology of the northern basin of Southern Indian Lake.*

correspond to those on Preliminary Map PMAP2015-4 (Martins, 2015) and Figure GS-6-2 represents a simplified version of this map.

Southern Indian domain

Paragneiss (unit 1)

Paragneiss was identified at three locations in the map area: one isolated outcrop in the northwestern corner of the map and two outcrops spatially associated with feldspathic greywacke of unit 3 (Figure GS-6-2). The paragneiss shows a strong compositional banding, interpreted to reflect primary layering, wherein leuco- and mesocratic lenticular layers of plagioclase and quartz alternate with locally thinner melanocratic layers of biotite and, in some areas, garnet (Figure GS-6-3a). The paragneiss weathers dark grey and is fine to medium grained. Migmatitic mobilizate, narrow granitic to granodioritic layers and in situ neosome occur parallel to the compositional banding. Based on field characteristics, this unit is similar to the quartzofeldspathic garnet-biotite gneiss located south of Long Point (Figure GS-6-1), as described by Kremer (2008a).

Siliceous mudstone (unit 2)

Siliceous mudstone (locally ferruginous) is found in one isolated outcrop on the eastern shore of Southern Indian Lake and in several outcrops in the southwestern corner of the map area (Figure GS-6-2). This unit is thinly laminated (Figure GS-6-3b) with compositional layering consisting of alternating layers of mafic material (biotite and amphibole and locally mostly magnetite) with leucocratic layers (mostly feldspar and quartz), and is intruded by granitic to granodioritic dikes. It is interpreted to have derived from mudstone due to its magnetite content. Also based on its magnetite-rich composition, this unit is comparable to the magnetite-bearing greywacke-mudstone turbiditic sedimentary rocks mapped at Whyme Bay (Kremer, 2008a).

Feldspathic greywacke (unit 3)

Feldspathic greywacke occurs interbedded with aluminous greywacke and is found mostly as xenoliths within granitoid units in the map area. This rock is generally bedded (most beds are <20 cm thick), foliated, nonmagnetic and contains 10–20% leucosome. The feldspathic greywacke (unit 3a) is grey, massive to vaguely bedded and locally contains garnet. These rocks are similar to the ‘psammite to psammopelite’ sedimentary unit of the Pukatawakan Bay assemblage (Kremer, 2008a, b). The aluminous greywacke (unit 3b) is medium grey, fine grained, and contains garnet and sillimanite (Figure GS-6-3c). Garnet and sillimanite in these units are thought to have been formed during peak, upper-amphibolite–facies metamorphism (Kremer, 2008a). Polymictic clast-supported conglomerate (unit 3c) occurs in two outcrops in the central area of the lake. Although moderately to strongly deformed (Figure GS-6-3d), the conglomerate appears to be well sorted and contains subrounded to subangular clasts 2–20 cm long. The clasts consist of granitic and volcanic rocks, similar to those observed in conglomerate mapped at Whyme Bay (Kremer, 2008a). In this unit, the main foliation (S_1) is folded by steeply dipping isoclinal F_2 folds, with a northeast-striking S_2 axial-plane foliation. This is in accordance with the structural history described in previous work (Kremer, 2008a).

Amphibolite (unit 4)

Amphibolite was observed at four locations, mainly occurring as xenoliths within granitoid units. It is typically fine grained and foliated, such that primary features are difficult or impossible to discern. Light grey-green zones of calcsilicate (epidote) alteration occur in most exposures. At one outcrop, the calcsilicate alteration is accompanied by gossan (Figure GS-6-3e) derived from oxidation of disseminated sulphides, namely pyrite, chalcopyrite and pyrrhotite, which locally account for up to 20% of the rock.

Pyroxenite (unit 5)

A pyroxenite dike cuts feldspathic greywacke of unit 3 in one location. The dark green, medium- to coarse-grained pyroxenite is composed mainly of orthopyroxene, biotite and hornblende, and accessory plagioclase. The contact of the dike is sharp and a 2–3 cm chilled margin is observed.

Leucodiorite to quartz diorite (unit 6)

Leucodiorite to quartz diorite occurs rarely in the map area (Figure GS-6-2). The rock is mottled black and white to dark grey on fresh surfaces, massive to weakly foliated, medium to coarse grained, and weakly magnetic. It is mainly homogeneous but locally contains cognate xenoliths. Mineral composition of this unit is mostly plagioclase (40–50%), biotite and hornblende (30–35%), and quartz (10–15%).

Tonalite-granodiorite (unit 7)

Tonalite-granodiorite is the largest map unit and occurs in the central area of the map. These rocks are white to beige, medium to coarse grained, moderately to strongly foliated, and contain a wide variety of partially digested xenoliths (Figure GS-6-3f). The tonalite is composed of plagioclase (<40%), quartz (30–40%), variable amounts of biotite and hornblende (up to 15%), K-feldspar (<5%), and locally disseminated sulphide

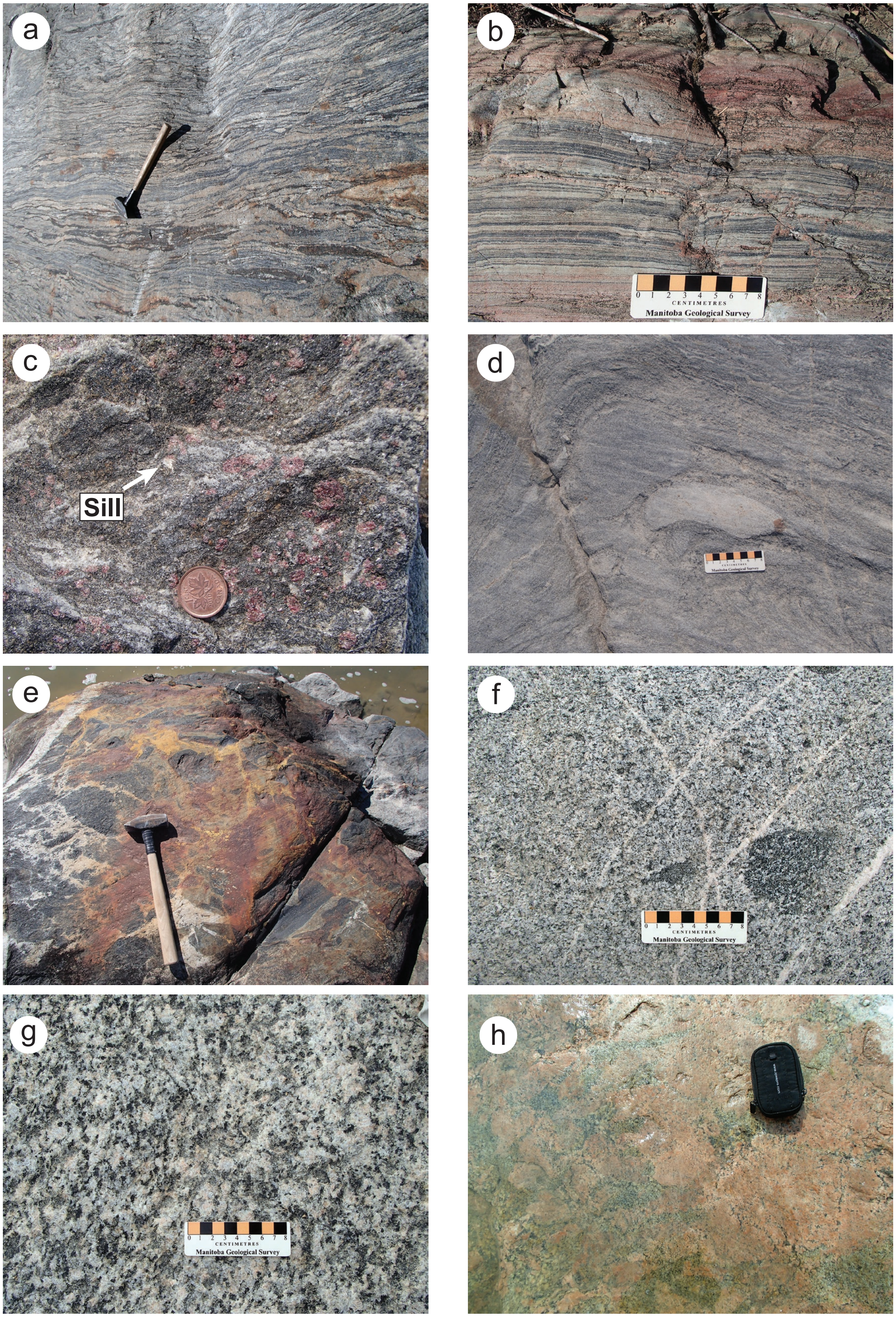

Figure GS-6-3: *Outcrop photographs of map units in the northern basin of Southern Indian Lake:* ***a)*** *paragneiss showing strong compositional banding (unit 1);* ***b)*** *thinly bedded mudstone (unit 2);* ***c)*** *aluminous greywacke (unit 3b) with garnet and sillimanite (Sill);* ***d)*** *local F_1 isoclinal fold in conglomerate (unit 3c) with subangular clasts;* ***e)*** *altered and oxidized amphibolite (unit 4);* ***f)*** *partially digested xenoliths in tonalite-granodiorite (unit 7);* ***g)*** *granodiorite-tonalite (unit 8), which is locally sulphide bearing and interpreted to postdate similar rocks of unit 7;* ***h)*** *megacrystic granite (unit 9) containing K-feldspar crystals up to 8 cm in size (camera bag is 12 cm long).*

and magnetite. The granodiorite has a very similar composition, with the most notable variation being the amount of K-feldspar (10–15%). The xenoliths vary from angular to rounded, are elongated, and vary in size from 10 to 30 cm. In some areas, granodiorite dikes crosscut the tonalite. This unit is also cut by granitic pegmatite dikes and may be comparable to the older 'granodiorite to tonalite (unit 4)' of Northern Indian Lake (Kremer and Martins, 2014).

Granodiorite-tonalite (unit 8)

Beige to light pink granodiorite occurs on the western shore of the lake. These rocks are medium to coarse grained, weakly to moderately foliated, magnetic, and locally rusty due to weathering of disseminated sulphides (Figure GS-6-3g). This unit is mineralogically similar to unit 7; it contains plagioclase (30–40%), quartz (25–40%), K-feldspar (10–15%), biotite-hornblende (up to 15%) and magnetite (1–2%), with trace amounts of disseminated chalcopyrite, pyrite and minor pyrrhotite. This unit is interpreted to postdate the previously described tonalite-granodiorite (unit 7) based on field relationships (xenoliths of unit 7 occur throughout unit 8) and it is tentatively compared to 'unit 6' at Northern Indian Lake (Kremer and Martins, 2014).

Megacrystic granite (unit 9)

Megacrystic granite outcrops mainly in the central part of the map area (Figure GS-6-2). It is pink, coarse to very coarse grained, weakly magnetic and massive. This unit is characterized by K-feldspar crystals up to 8 cm in size in a medium-grained groundmass of quartz, K-feldspar and plagioclase (Figure GS-6-3h). The bulk-mineral assemblage of this unit comprises K-feldspar (40–50%), quartz (25–35%), plagioclase (10–30%) and biotite (<5%).The megacrystic granite is interpreted to postdate the biotite-hornblende tonalite of unit 7 because it contains xenoliths of the tonalite.

Biotite granite and syenogranite (unit 10)

Outcrops of biotite granite and syenogranite occur around Sand Point and in the west-central area of the map (Figure GS-6-2). The granitic rocks, which are the most abundant, are greyish pink when fresh and beige when weathered, nonmagnetic to weakly magnetic, medium grained, massive, equigranular and homogeneous. A few outcrops contain xenoliths of unit 3 and other supracrustal rocks belonging to the Southern Indian domain. The granite's typical mineral composition is quartz (30–40%), K-feldspar (<40%), biotite (2–5%), plagioclase and trace magnetite. The syenogranite is locally interlayered with rocks of more granitic composition. It is brick red when fresh and pink when weathered, magnetic, and medium grained to locally coarse grained or pegmatitic (Figure GS-6-4a). It also contains biotite and is locally hornblende phyric, with the orientation of phenocrysts defining a southwest-trending fabric. Syenitic rocks of unit 10 are predominantly composed of K-feldspar (40–50%), quartz (10–20%), plagioclase (5–10%), biotite (5–8%), and locally hornblende (up to 5%) and magnetite (1–2%).

Plagioclase-phyric tonalite (unit 11)

Tonalite of unit 11 is predominantly found along the eastern shore of Southern Indian Lake (Figure GS-6-2). It is leucocratic (beige when fresh and white when weathered), medium to coarse grained, nonmagnetic and weakly foliated. The rock is characterized by plagioclase phenocrysts up to 1 cm across in a medium-grained groundmass (Figure GS-6-4b). Overall, this unit is composed of plagioclase (30–40%), quartz (30–35%), biotite and hornblende (5–8%), K-feldspar (<5%), and trace sulphides (possibly pyrite and chalcopyrite). Xenoliths of tonalite from unit 7 occur throughout the plagioclase-phyric tonalite, along with feldspathic and aluminous greywackes of unit 3. The plagioclase-phyric tonalite (unit 11) is therefore considered younger than the previously described tonalite of unit 7. The unit is also intruded by granitic pegmatite dikes (unit 12), which vary in width from a few centimetres to 7 m and which have variable trends with steep dips.

Granitic pegmatite (unit 12)

Granitic pegmatites are abundant and intrude most of the units found at Southern Indian Lake. As reported for Northern Indian Lake, no pegmatite bodies were observed in rocks of the Chipewyan domain (Kremer and Martins, 2014). The pegmatite bodies are albite dominant (white pegmatite bodies) or K-feldspar dominant (pink pegmatite bodies). Their strike is variable, but main strikes are oriented north-northeast, south-southeast and southwest, and are steeply dipping. Most of the pegmatite bodies are <2 m thick, unzoned or very crudely zoned, and mineralogically simple. Characteristic textures of granitic pegmatite, such as graphic texture (Figure GS-6-4c), comb texture (perpendicular growth to the margins of the dikes) and line rock (rhythmical banding) are observed in most of the pegmatite bodies.

White pegmatite is mostly composed of albite, quartz and K-feldspar, along with common accessory biotite, garnet and apatite. Green apatite is typically associated with white pegmatite and occurs either isolated within the pegmatite or is closely associated with concentrations of biotite (Figure GS-6-4d).

Pink pegmatite is mostly composed of K-feldspar, quartz, albite and biotite. Garnet and magnetite (crystals up to 3 cm; Figure GS-6-4e) are accessory phases. In the southwestern part of the mapping area, a small outcrop of pink pegmatite crosscutting feldspathic greywacke (unit 3a) contains bornite, chalcocite, malachite and

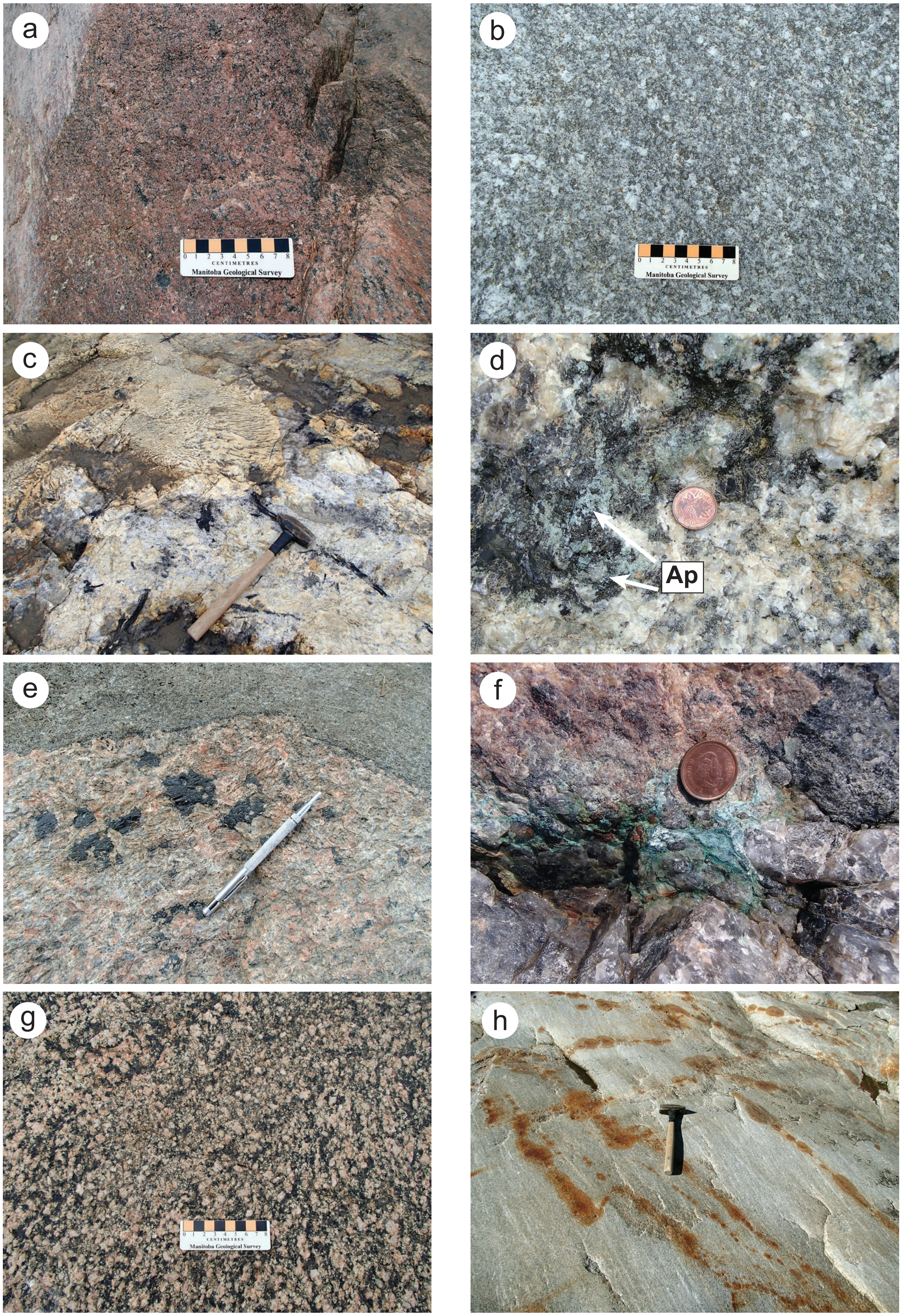

Figure GS-6-4: *Outcrop photographs of rock units mapped in the northern basin of Southern Indian Lake:* ***a)*** *brick-red syenogranite (unit 10);* ***b)*** *undeformed plagioclase-phyric tonalite (unit 11);* ***c)*** *graphic texture in a feldspar grain from a white pegmatite (unit 12);* ***d)*** *apatite (Ap) intergrown with biotite in a white pegmatite body (unit 12);* ***e)*** *example of large magnetite crystals in a pink pegmatite (unit 12);* ***f)*** *pink pegmatite (unit 12) with fracture-controlled copper sulphide and oxide minerals;* ***g)*** *K-feldspar–phyric biotite granite (unit 13) possibly associated with the Chipewyan batholith (unit 14);* ***h)*** *example of fracture-controlled gossans in tonalite (unit 11), suggesting the presence of sulphide minerals.*

azurite (Figure GS-6-4f). These copper sulphide and oxide minerals are found within a 30–40 cm long south-southeast trending fracture.

K-feldspar–phyric biotite granite (unit 13)

Biotite granite with phenocrysts of K-feldspar, very similar in texture to the Chipewyan batholith (unit 14), occurs mostly in the southwestern and western parts of the map area (Figure GS-6-2). This unit is pink when fresh, weakly magnetic, massive to weakly foliated and contains rare xenoliths of metasedimentary rocks. It is characterized by a medium-grained groundmass with K-feldspar phenocrysts (Figure GS-6-4g). The estimated bulk mineralogy of the rock comprises K-feldspar (30–40%), quartz (20–30%), biotite and hornblende (10–12%), plagioclase, and trace magnetite.

This granite is interpreted as a satellite pluton of the Chipewyan batholith. A similar interpretation was made by Kremer et al. (2009a) for foliated K-feldspar–megacrystic granite exposed on the southern shore of Gauer Lake (Figure GS-6-1). Such plutons may represent younger phases of the Chipewyan batholith. This scenario would be consistent with the findings of Rayner and Corrigan (2004), who identified a younger phase (1829 +/-1 Ma) of a monzogranite on the western shore of Whyme Bay that is mesoscopically indistinguishable from the Chipewyan batholith. Alternatively, the granite of unit 13 may be part of a separate igneous event that produced plutons of similar composition to the Chipewyan batholith.

Chipewyan domain

Chipewyan batholith (unit 14)

The Chipewyan batholith is distinguished by its characteristic texture of megacrystic K-feldspar crystals. The batholith has been described as homogeneous (e. g., Fumerton et al., 1984; MacHattie, 2001), but at least two different phases of granitoid were identified at Northern Indian Lake and are interpreted as part of the Chipewyan batholith (Kremer and Martins, 2014). This batholith is only exposed at a few locations in the northeastern corner of the 2015 map area and its contact with the Southern Indian domain is not exposed. This contact, representing the domain boundary (Martins, 2015), is inferred to correspond with an abrupt change in total-field magnetic intensity (Canadian Aeromagnetic Data Base, 2015).

The outcrops observed at Southern Indian Lake are medium-grained granite with K-feldspar megacrysts up to 4 cm. The granite is weakly to moderately magnetic, weakly foliated (locally the K-feldspar phenocrysts have a preferred orientation) and overall homogeneous. The estimated average composition is quartz (30–40%), K-feldspar (30–40%), biotite (5–10%), pyrite and rare chalcopyrite (<1%), magnetite (<1%), trace apatite and plagioclase.

Discussion

The boundary between the Southern Indian domain and the Chipewyan batholith of the Chipewyan domain is not exposed at Southern Indian Lake, and was defined based on interpretation of aeromagnetic data (Martins, 2015). Based on field evidence at Northern Indian Lake, the contact between the Chipewyan and Southern Indian domains was interpreted as intrusive (Kremer and Martins, 2014). Crosscutting dikes of K-feldspar–phyric biotite granite, presumably related to the Chipewyan batholith, occur at several locations in the Southern Indian domain (e. g., unit 13 described in this report).

A comprehensive suite of samples was collected during the course of this year's mapping for thin-section petrography, whole-rock lithogeochemical analyses and isotopic studies. These results will help to further characterize, classify and compare the plutonic and supracrustal rocks within the northern basin of Southern Indian Lake in relation to those at, Partridge Breast and Northern Indian lakes, and other locations in the Southern Indian Lake area (Kremer, 2008a; Kremer et al., 2009a; and Kremer and Martins, 2014).

Forthcoming results of isotopic work carried out on selected samples will be used to identify any additional occurrences of Archean to earliest Paleoproterozoic crust in the northern part of Southern Indian Lake. To date, zircon of this age has only been identified in orthogneiss in the west-central area of the lake (Kremer et al., 2009a) and as inherited grains in younger Paleoproterozoic plutonic rocks in the area (Rayner and Corrigan, 2004). The orthogneiss may represent a relatively small, tectonic wedge of Archean to earliest Proterozoic crust. Alternatively, the orthogneiss, in addition to the common xenocrystic and detrital zircons of similar age throughout this portion of the THO, could indicate that the extent of late-Archean crust is much greater than is presently known (Corrigan et al., 2007). Results from the isotopic analyses will contribute to resolving this question.

Economic considerations

The Southern Indian Lake area has seen little exploration activity in the past decades, despite the recent identification of several potential mineral exploration targets (e. g., Corrigan et al., 2007; Kremer et al., 2009a). The potential for volcanogenic massive sulphide (VMS) deposits at the regional scale has been established by temporal links between the bimodal arc-volcanic rocks of the Partridge Breast Lake assemblage at Southern Indian Lake and volcanic rocks in the Lynn Lake–Leaf Rapids domain (Corrigan and Rayner, 2002), which host the Ruttan and Fox Lake VMS deposits. Moreover, 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.

Base-metal potential is further evidenced by assay results of up to 2.2% Cu from a narrow fracture in volcanic rocks observed at Whyme Bay (Frohlinger, 1972). Malachite showings also occur near the base of the clastic sedimentary sequence around Partridge Breast Lake (Kremer et al., 2009a). In the Partridge Breast Lake area, the margin of a weakly gossanous tonalitic intrusion cutting a clastic sedimentary sequence also yielded anomalous Zn values (1.36%), perhaps indicating potential for sediment-hosted Zn mineralization (Kremer et al., 2009a). Gossanous patches in plagioclase-phyric tonalite (unit 11; Figure GS-6-4h) and supracrustal rocks at several locations in the Southern Indian domain suggest the presence of disseminated sulphides.

Of particular note this field season was the identification of a gossanous outcrop of epidote-altered amphibolite that contained disseminated pyrite, chalcopyrite and pyrrhotite, and returned assay values of 476 ppm Cu and 152 ppm Zn. Malachite, azurite, bornite and chalcocite were also identified in 2015 within a narrow fracture in pink pegmatite (Figure GS-6-4f). A grab sample of this material yielded values of 4.7 g/t Au, >1% Cu , 4.6g/t Ag, 2200 ppm Bi, >0.5% Pb and 736 ppm Se. This outcrop is the second gold occurrence at Southern Indian Lake associated with pegmatite. The Au-Cu-Ag, Bi geochemical signature of this occurrence (Figure GS-6-2) is similar to that of other intrusion-related gold systems, for example in the Fairbanks district of Alaska (namely the Fort Knox and the Pogo deposits). The Au-Bi association is particularly interesting given its similarity to that of the Pogo deposit, where mineralized intervals contain elevated Ag, Te, Bi, As, Sb, Cu, Pb, Mo and/or Co, and exhibit a strong correlation between Au and Bi (Smith et al., 1999).

Unusual polymetallic Be-Au-Zn-Bi mineralization associated with a pegmatite on Turtle Island (central area of Southern Indian Lake; Kremer et al., 2009a; Martins and Kremer, 2013) is restricted to the altered contact zone with the basalt hostrocks and occurs as a band (5–10 cm thick) of semi-massive to massive pyrite and chalcopyrite within the pegmatite. The semi-massive sulphide contains abundant white to pale green beryl crystals (1–3 cm). Samples from this zone returned high values of Be, Au, Ag, Bi, Zn, Nb and Ta (Kremer et al., 2009b, c; Martins, 2014). Moreover, this association is analogous to the Fort Knox deposit in Alaska, which is also associated with granitoid plutons and pegmatite (Quandt et al., 2008).

The margins of Archean cratons can be important regional vectors for diamond exploration. In east-central Saskatchewan, two diamond occurrences are located in areas thought to be underlain at depth by the mostly buried Archean crust of the Sask craton (Fort à la Corne kimberlite field and the Pikoo kimberlite). Determining the potential extent of Archean crust in the Southern Indian Lake area (i.e., by isotopic studies) may help to inform diamond exploration in the region.

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