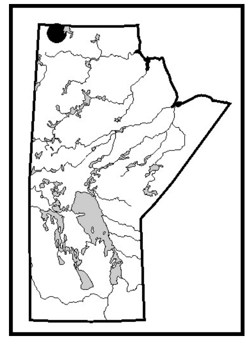
GS-13 Preliminary results from geological bedrock mapping of the Kasmere and Putahow lakes areas, northwestern Manitoba (parts of NTS 64N6, 10, 11 and 15)

by C.O. Böhm and S.D. Anderson



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Summary

As part of the Manitoba Geological Survey's initiative to update the geological knowledge base of Manitoba's far north, field investigations in 2006 were focused on the Kasmere and Putahow lakes areas. Detailed bedrock mapping and sampling were undertaken for lithogeochemical, isotope geochemical and geochronological studies to improve the currently limited understanding of the nature and evolution of this portion of Manitoba's Precambrian shield, and to support ongoing uranium and gold exploration in the area. In this report, bedrock exposures at Kasmere and Putahow lakes are described and subdivided into 1) metasedimentary rocks of the Paleoproterozoic Wollaston Domain, which include semipelite, psammite, arkosic metasandstone, quartzite, calcsilicate rocks and calcareous greywacke; and 2) younger, Paleoproterozoic granitic intrusions and pegmatite. No examples of potential Archean basement rocks were observed in the map area.

The tentative field results from this year's mapping in the Kasmere and Putahow lakes areas, when compared with the 2005 mapping results from the Nejanilini Lake area, suggest no significant differences in the nature and composition of the metasedimentary successions in the two areas. This may indicate that Paleoproterozoic metasedimentary rocks previously assigned to the Wollaston (Kasmere and Putahow lakes) and the Hurwitz (Nejanilini Lake) supergroups formed contemporaneously and in a similar or related tectonic setting in northern Manitoba.

Several occurrences of sulphide mineralization in bedrock and boulders were sampled and submitted for geochemical analysis. Uranium (pitchblende) was observed in outcrop and boulders, with the latter likely to be of local provenance, as described in the accompanying report on the surficial geology of the Kasmere–Putahow lakes area (Matile, GS-14, this volume).

Introduction

This report summarizes field observations and data collected during four weeks of 1:50 000 scale bedrock and surficial (Matile, GS-14, this volume) geological mapping at Kasmere and Putahow lakes during July and August 2006. The area was last mapped in the 1970s by the Manitoba Geological Survey; the results of this work are described by Weber et al. (1975a) and presented on the Kasmere Lake 1:250 000 scale bedrock compilation map (Manitoba Industry, Trade and Mines, 2000). Kasmere Lake is located approximately 40 km southeast of the Nunavut-Saskatchewan-Manitoba junction (Figure GS-13-1), and Putahow Lake straddles the Nunavut-Manitoba border and lies approximately 75 km east of the Saskatchewan-Manitoba border (NTS 64N). The area was accessed by float-equipped aircraft from Thompson via Treeline Lodge at Nueltin Lake. Bedrock exposure is generally poor throughout the map area and the extensive cover of glacial sediments is described in Matile (GS-14, this volume). The preliminary maps (Böhm and Anderson, 2006; Anderson and Böhm, 2006) include interpretation of the subsurface bedrock geology based on both the previous and new bedrock mapping, as well as aeromagnetic maps.

The 2006 field studies included detailed petrographic-petrological and structural mapping of the rare bedrock exposures, combined with mapping and description of the surficial geology. A large number of representative bedrock samples was collected for thin section, geochemical, isotopic and geochronological analysis. In addition, 21 till samples for kimberlite and base-metal indicator analysis were taken at an approximate spacing of 3 to 5 km within the bedrock mapping area (Matile, GS-14, this volume).

Bedrock and surficial mapping in the Kasmere and Putahow lakes areas was carried out to support mineral exploration activities in the region and to advance and update the currently limited understanding of the geology of a large part of Manitoba's far northwest. The 2006 field component forms part of an ongoing Manitoba Geological Survey (MGS) initiative to study the southeastern margin of the Archean Hearne craton in Manitoba's far north. The purpose is to further the understanding of the nature, evolution and mineral potential of the principal geological building blocks of Manitoba's far north. The MGS far north initiative commenced in 2004 with a Sm-Nd isotopic study carried out on archival samples from throughout the Nejanilini Domain (Böhm et al., 2004). This study was followed up in 2005 with targeted bedrock and surficial mapping and sampling in the Nejanilini Lake area (Anderson and Böhm, 2005; Anderson et al., 2005; Matile, 2005). From a bedrock geological perspective, these two studies provide detailed insight into the granulite-grade supracrustal and plutonic

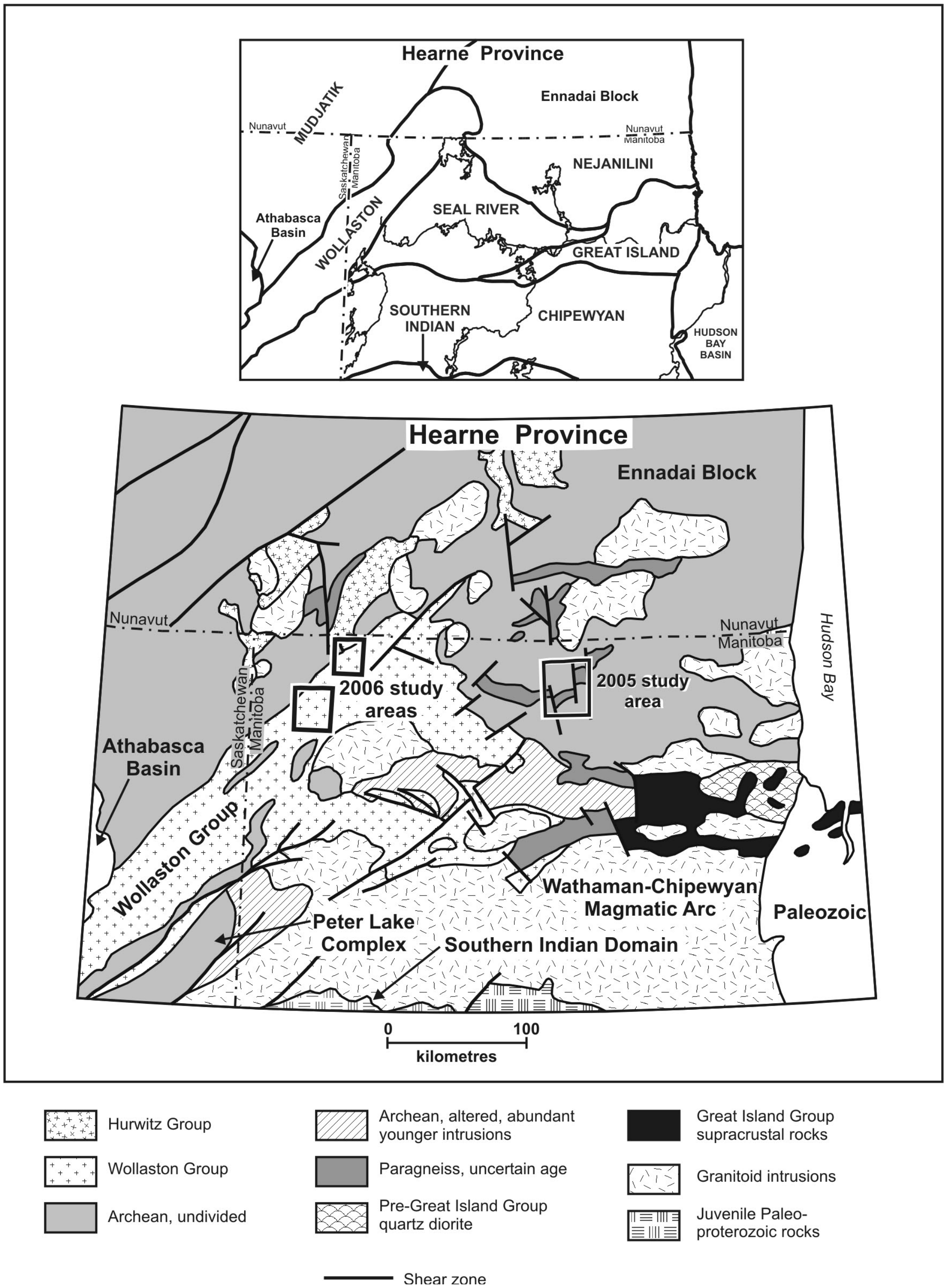

Figure GS-13-1: *Lithotectonic elements of the Trans-Hudson Orogen–Rae-Hearne craton region (*modified after *Manitoba Industry, Trade and Mines, 2000), with the 2006 mapping areas at Kasmere and Putahow lakes and the 2005 mapping area at Nejanilini Lake outlined.*

rocks of the Nejanilini Domain, including metasedimentary rocks tentatively assigned to the Hurwitz Group (Anderson et al., 2005). Accordingly, the 2006 field work was focussed west of the Nejanilini Domain, in the dominantly metasedimentary rocks that form part of the Paleoproterozoic Wollaston Domain. These rocks are best exposed in Manitoba along the Snyder–Kasmere–Tice–Putahow lakes corridor. For a regional synthesis, the results from the Kasmere and Putahow lakes project will be compared with those from the Nejanilini Lake project, as well as with extensive recent bedrock geological investigations in northeastern Saskatchewan (e.g., Harper et al., 2005a, b; Harper and Slimmon, 2005).

Geological setting

The Kasmere and Putahow lakes map areas form part of the southeastern flank of the Hearne craton in Manitoba. The Archean continental crust of the Hearne craton is overlain by Paleoproterozoic cover rocks and, together with the cover rocks, has undergone varying degrees of thermotectonism during the Paleoproterozoic Trans-Hudson orogeny (Cree Lake Ensialic Mobile Zone; Lewry et al., 1978; Lewry and Sibbald, 1980). The ensialic mobile zone has been subdivided into six domains in Saskatchewan and Manitoba: the Mudjatik, Peter Lake, Wollaston, Seal River, Great Island and Nejanilini domains (Figure GS-13-1). The domains are distinguished by their cover rocks, the proportion or absence of basement rocks, and their dominant structural trends. The Kasmere and Putahow lakes areas, investigated during the summer 2006 mapping, lies mainly within the Wollaston Domain and straddles the adjacent Mudjatik Domain to the northwest (Figure GS-13-1). The eastern boundary of the Mudjatik Domain is defined by a pronounced geophysical lineament that is traceable from the Manitoba-Saskatchewan border northeastward to the Nunavut border. A trough of low magnetic intensity, correlating with rocks of the Wollaston Domain, lies to the southeast of the more magnetic rock types in the Mudjatik Domain. This boundary is considered to be structural in origin and is likely similar in age to the Needle Falls Shear Zone (1855–1800 Ma; Stauffer and Lewry, 1993) that forms the eastern boundary of the Wollaston Domain in Saskatchewan.

No examples of potential Archean basement rocks to the Wollaston Domain metasedimentary rocks were observed in the map areas. Hence, the geology of the map areas is interpreted to consist predominantly of Paleoproterozoic (ca. 2.1–1.9 Ga; Kays, 1972; Weber et al., 1975b; Ray and Wanless, 1980; Ansdell et al., 2000; Yeo et al., 2000; Tran, 2001; Tran et al., 2003; Harper et al., 2005a, b) metasedimentary rocks of the Wollaston Supergroup, with subordinate granitic intrusive rocks probably related to magmatism during the Trans-Hudson orogeny. The Wollaston Supergroup supracrustal rocks appear to occupy elongate dome-and-basin structures, whereas the granitic intrusions tend to abruptly truncate the sedimentary rocks and locally contain large xenolithic rafts of the adjacent country rock. The Wollaston Supergroup is partially time-equivalent to Hurwitz Group metasedimentary rocks (ca. 2.4–1.9 Ga; Patterson and Heaman, 1991; Heaman and LeCheminant, 1993; Davis et al., 2000), the nearest exposures of which are in the Nejanilini Lake area in northern Manitoba (Anderson et al., 2005), in the Misaw Lake area in northwesternmost Saskatchewan (e.g., Harper et al., 2003; Harper and Slimmon, 2005), and in various parts of the Hearne craton in southern Nunavut and the Northwest Territories.

The Wollaston Supergroup in Saskatchewan has been subdivided into three major sequences (Harper et al., 2005a, b; Yeo and Delaney, in press). Exposures of the Wollaston Supergroup in the Kasmere and Putahow lakes areas are comparatively scarce but tentatively interpreted to be most similar to the Middle Sequence, equivalent to the Daly Lake Group of Yeo and Delaney (in press) in Saskatchewan. The Middle Sequence in the Wollaston Lake area of Saskatchewan represents a foreland basin sequence that comprises, from base to top, psammite, pelite and graphitic pelite, along with various calcareous metasedimentary rocks (including marble), overlain by pelite and psammite, and topped by arkose and quartzite (Harper et al., 2005a, b). Detrital zircon populations in a number of Wollaston Supergroup metasedimentary rocks analyzed from the Wollaston Lake area indicate an Archean provenance (Annesley et al., 1992). Rubidium-strontium ages for semipelitic and pelitic rocks of the Wollaston Domain, which range from 1815 to 1835 Ma (Weber et al., 1975b; Cummings and Scott, 1976), are evidence for Paleoproterozoic metamorphism. The high initial $^{87}Sr/^{86}Sr$ ratios for these rocks suggest that a component of their sedimentary provenance was Archean; however, the ratio does not support an Archean age of sedimentation.

Biotite psammite gneiss of the Wollaston Supergroup in northeastern Saskatchewan and psammite and semipelite in the Kasmere Lake area are considered to be stratigraphic equivalents, based on their lithological similarity and apparent lateral gradation (Weber et al., 1975a). These formations can, in turn, likely be correlated with the Ameto Formation of the Hurwitz Group in Nunavut. Zircon and baddeleyite from gabbro sills in the lower to middle Ameto Formation, in the area of North Henik Lake, Nunavut, were dated by the U-Pb method at 2094 +26/–17 Ma (Patterson and Heaman, 1991). This establishes a minimum depositional age of ca. 2.10 Ga for the lower to middle Ameto Formation of the Hurwitz Group.

A similar minimum age of ca. 2.10 Ga has been established for the Wollaston Group in Saskatchewan. A date of 2076 ±3 Ma, interpreted to be an igneous crystallization age, was obtained from samples of mylonitic quartzofeldspathic gneiss in the rocks of the Courtenay Lake Formation of the Wollaston Group (Annesley et al., 1992). Courtenay Lake Formation conglomerate, arkose and quartzite are interlayered with mafic volcanic rocks characterized by within-plate lithogeochemistry, thus favouring emplacement in a continental rift setting (Fossenier et al., 1995; MacNeil et al., 1997). The timing of continental rifting recorded in the Courtenay Lake Formation in Saskatchewan, at ca. 2100 Ma, is consistent with the observations in Nunavut and Manitoba.

Rocks of the Wollaston Supergroup were intruded by granitic and leucogranitic bodies, along with pegmatite. Granitic and granitic pegmatite rocks in the Wollaston Domain in Saskatchewan yield ages ranging from 1.80

to 1.84 Ga (Annesley et al., 1992, 1997), which corresponds to the main period of Hudson granite emplacement throughout the western Churchill Province (Peterson et al., 2000, 2002). The granitic rocks within the Wollaston Supergroup metasedimentary rocks in the Kasmere and Putahow lakes areas are generally nonmagnetic and thus produce no anomalies within the areas of generally low magnetic intensity that correspond to the metasedimentary bedrock (Anderson and Böhm, 2006; Böhm and Anderson, 2006). A distinctive northwest-trending magnetic lineament, which is most prominent southeast of Kasmere Lake (Figure GS-13-2; Böhm and Anderson, 2006), is interpreted to represent an unexposed, ca. 1.27 Ga, Mackenzie diabase dike (LeCheminant and Heaman, 1989).

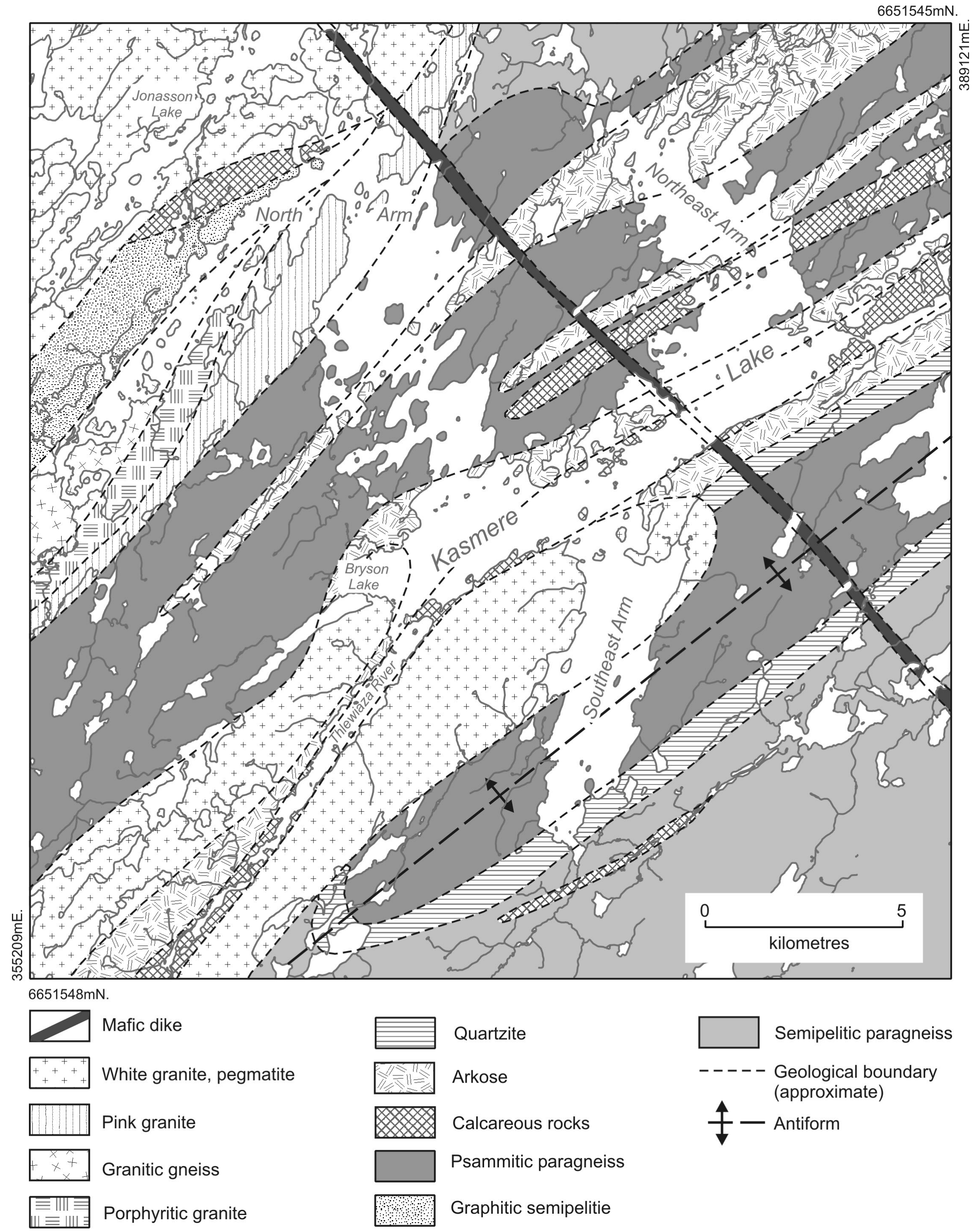

Figure GS-13-2: *Simplified, interpretative bedrock geology of the Kasmere Lake area, based on scarce bedrock exposures and detailed magnetic data.*

Bedrock geology of the Kasmere and Putahow lakes areas

The interpretive bedrock geology of the Kasmere and Putahow lakes map areas is summarized in Figures GS-13-2 and -3, respectively, and integrated in the regional geology on the 1:50 000 scale preliminary geological maps PMAP2006-4 (Böhm and Anderson, 2006) and PMAP2006-5 (Anderson and Böhm, 2006), respectively. Due to extensive glacial drift cover (Matile, GS-14, this volume), bedrock exposures at Kasmere and Putahow lakes are limited. The northeast-trending Quaternary landforms are subparallel to the dominantly northeast trends of the bedrock geology at Kasmere and Putahow lakes (Figures GS-13-2 and -3), which makes identification of potential bedrock exposures on airphotos difficult. The scarce, largely lichen-covered bedrock exposures occur mainly along lake shorelines and are typically frost heaved. Block and boulder fields (felsenmeer) proved useful in many areas to constrain the possible bedrock geology.

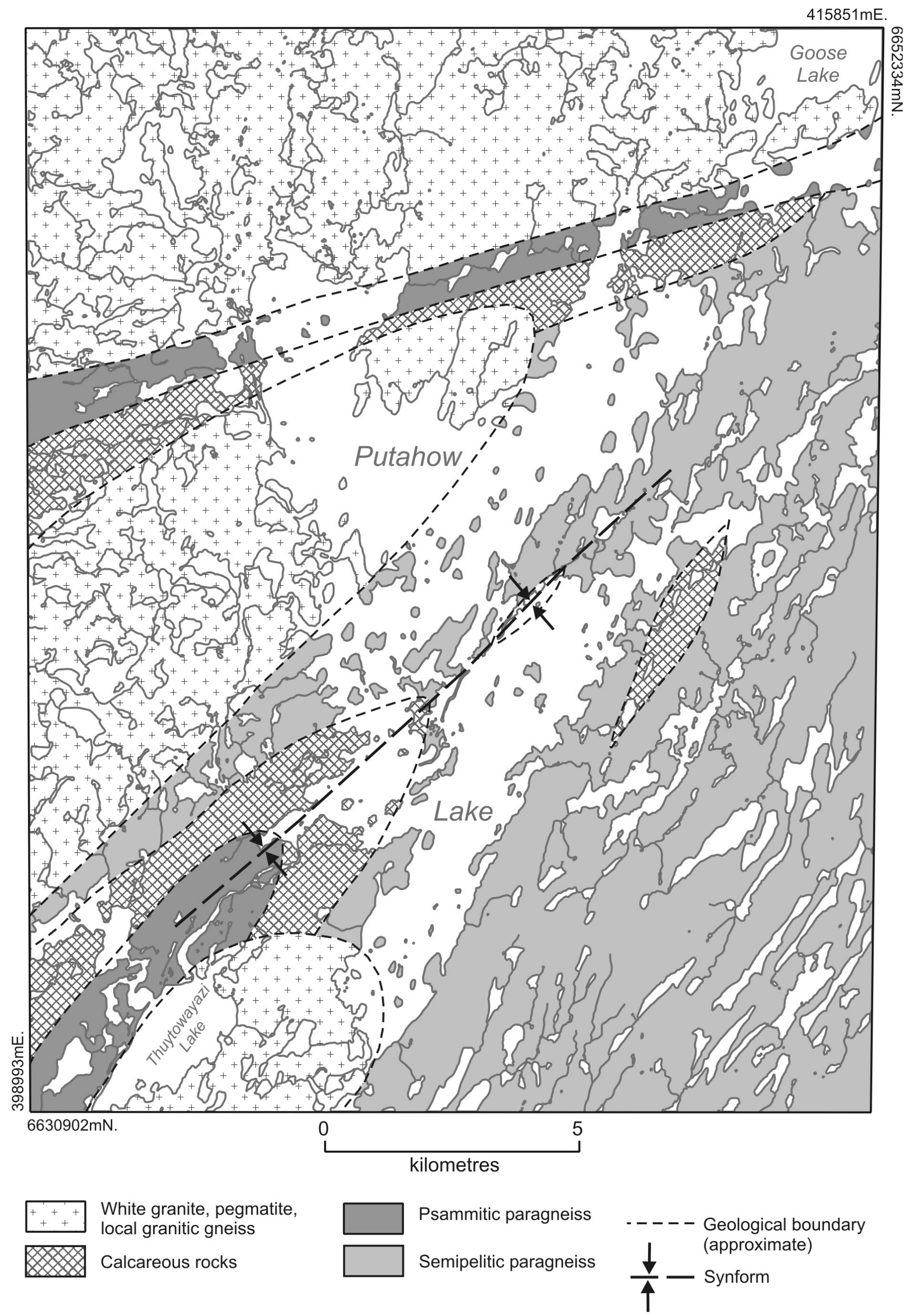

Figure GS-13-3: *Simplified, interpretive bedrock geology of the Putahow Lake area, based on scarce bedrock exposures and magnetic data.*

As described below and illustrated in Figures GS-13-2 to -4, bedrock exposures at Kasmere and Putahow lakes can be grouped into two main mappable units: 1) presumably Paleoproterozoic metasedimentary rocks of the Wollaston Supergroup; and 2) younger, presumably Trans-Hudson–related Paleoproterozoic granitic intrusions and pegmatite. No rocks potentially older than the Wollaston Supergroup metasedimentary rocks were observed in the Kasmere and Putahow lakes map areas. High-grade metamorphism, concurrent with deformation, is indicated by synkinematic garnet-cordierite-sillimanite porphyroblasts and leucosome veins in the metasedimentary rocks of the Wollaston Supergroup (e.g., Figure GS-13-4a). They indicate relatively low-pressure, high-temperature regional metamorphism, corresponding to middle to upper amphibolite facies conditions. Structurally, these rocks show evidence for polyphase deformation, with at least two generations of foliation and folds. The main phase of felsic intrusions appears to be syn- to postdeformational, based on both crosscutting and layer-parallel granitic injection and generally weak foliation in the felsic intrusive rocks (e.g., Figure GS-13-4b).

Metasedimentary rocks of the Wollaston Domain

The Wollaston Domain in the study area has a dominant northeasterly trend and is approximately 35 km wide at the south end of Kasmere Lake. Northeast of Kasmere Lake, the domain is less well defined and narrows to approximately 20 km at Putahow Lake. In the study area, the Wollaston Domain appears to form elongate structural domes, resulting from doubly plunging antiformal and synformal folds. At the Southeast Arm of Kasmere Lake, parasitic folds in paragneiss and regional aeromagnetic trends indicate an antiformal dome structure cored by psammitic and semipelitic gneiss and rimmed by quartzite and locally by arkose (Figure GS-13-2). In the paragneiss, a moderately southwest-plunging synform is traceable for several kilometres across central Putahow Lake, and contains pegmatite intrusions along its hinge line (Figure GS-13-3).

The basal unit of the Wollaston Group in Saskatchewan is a psammitic to semipelitic garnet-biotite±cordierite gneiss. In the Kasmere and Putahow lakes areas, garnet-biotite semipelitic gneiss appears to contain, and/or be overlain by, a compositionally variable sequence of calcsilicate rocks that may represent calcareous sedimentary rocks deposited in a platform setting (Weber et al., 1975a). The calcsilicate rocks appear to be overlain by regionally discontinuous psammitic gneiss and locally by quartzite and arkosic rocks. This metasedimentary succession may signify a tectonic change from a platform setting to possible uplift. Alternatively, the quartzite and arkosic rocks may define an antiformal culmination, and would thus be overlain by the calcsilicate rocks, which occur outside the quartzite at southeastern Kasmere Lake. The latter structural and resultant stratigraphic interpretation is more consistent with a classic basin subsidence.

Quartzite, semipelite and psammite samples from the Kasmere Lake and Putahow–Goose lakes areas have been submitted for U-Pb zircon age dating and Nd isotope analysis. Results from these analyses will permit a more scientifically rigorous comparison of the metasedimentary rocks at Kasmere and Putahow lakes with those of the Wollaston Supergroup rocks in Saskatchewan, and possibly related metasedimentary rocks previously assigned to the Hurwitz Group at Nejanilini Lake.

Semipelitic paragneiss

Semipelitic paragneiss, interpreted as metagreywacke, generally shows a well-developed metamorphic layering defined by alternating grey to dark grey, biotite-rich layers (1–100 cm thick), and white to beige, medium- to coarse-grained felsic lits (e.g., Figure GS-13-4c). At northwestern Kasmere Lake, strongly graphitic biotite-rich semipelite is beige to rusty brown to grey, commonly coarse grained, well foliated to cataclastic, and schistose to gneissic (Figure GS-13-2; Figure GS-13-4d).

Semipelitic paragneiss is characteristically biotite rich and graphitic, and contains quartz-plagioclase ±garnet ±cordierite ±sillimanite (faserkiesel; e.g., Figure GS-13-4e), as well as white tonalitic leucosome or partial melt veins (e.g., Figure GS-13-4a) and granitic pegmatite dikes. Semipelitic gneiss is commonly interlayered with calcareous psammite or semipelite and/or centimetre- to metre-thick layers of psammitic gneiss (Figure GS-13-4e). Areas underlain by these rocks generally coincide with areas of low magnetic intensity (2000–2200 gammas), such as large parts of the southeastern Kasmere and Putahow lakes areas (Böhm and Anderson, 2006; Anderson and Böhm, 2006).

Psammitic paragneiss

Psammitic paragneiss, interpreted to be derived from quartz-rich greywacke, is generally more quartz±feldspar rich compared to the above semipelitic paragneiss, with which it is closely associated and locally interlayered. Together they form the predominant rock types in the Kasmere and Putahow lakes map areas (Figures GS-13-2 and -3). The psammite is dark grey to light grey, fine to coarse grained, well foliated and layered, schistose to gneissic, and locally contains pebbly layers defined by larger quartz and/or feldspar aggregates. Psammitic rocks commonly contain K-feldspar, quartz, plagioclase, biotite ±sillimanite/cordierite (faserkiesel) ±garnet ±hornblende, as well as abundant white to pink leucosome with some coarse-grained blue cordierite and rare garnet. The best exposures of psammitic rocks are at southwestern Bryson

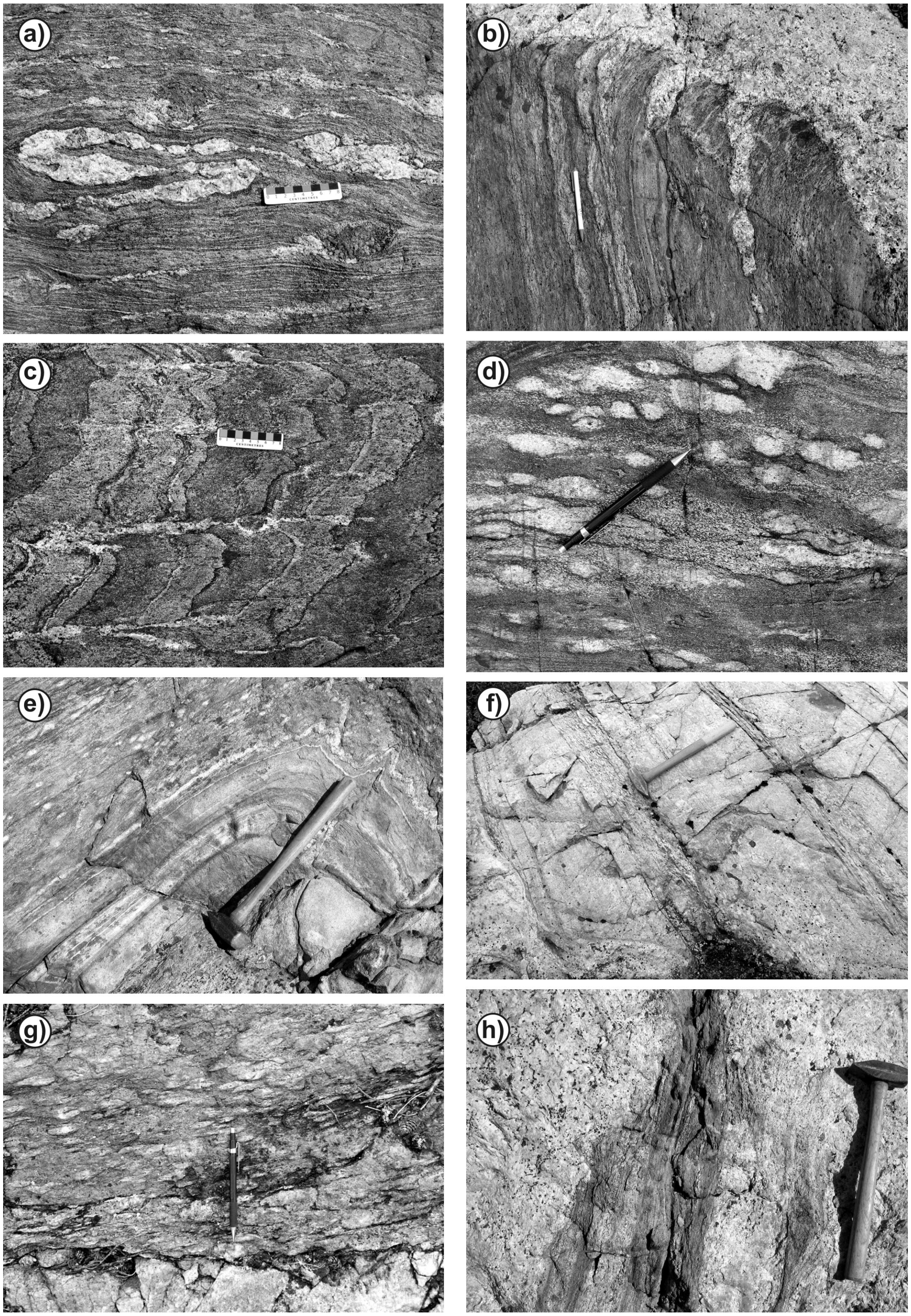

Figure GS-13-4: *Characteristic bedrock exposures at Kasmere and Putahow lakes:* ***a)*** *Folded and sheared garnet-quartz-rich melt vein in semipelite south of the Southeast Arm of Kasmere Lake.* ***b)*** *Strongly foliated and layered quartz-porphyroblastic (faserkiesel) garnet-biotite semipelitic paragneiss cut by leucogranite, south shore of Goose Lake, north-east of Putahow Lake (note layer-parallel and crosscutting aspect of the intrusion).* ***c)*** *Folded garnet-biotite-rich semipelite with minor psammitic and calcareous interlayers south of the Southeast Arm of Kasmere Lake.* ***d)*** *Psammitic to semipelitic gneiss with quartzofeldspathic nodules and feldspar porphyroblasts from Bryson Lake, southwest of Kasmere Lake.* ***e)*** *Strongly foliated and folded, layered semipelitic paragneiss, Southwest Arm of Kasmere Lake (Thlewiaza River).* ***f)*** *Bedded quartzite with sillimanite-porphyroblastic semipelitic interlayers from southeast Kasmere Lake.* ***g)*** *Arkose containing up to 40% fibrous quartz-sillimanite (faserkiesel) nodules from southeast Kasmere Lake.* ***h)*** *Semipelitic paragneiss screen in leucocratic granitic pegmatite, southwest of Kasmere Lake (Thlewiaza River).*

Lake, at west-central Kasmere Lake (Figure GS-13-2) and in the northern Putahow Lake to southern Goose Lake area (Figure GS-13-3).

Calcareous rocks

Calcareous rocks range in composition from pure carbonate (marble) to calcsilicate to calcareous psammite and semipelite. These rocks are characteristically white to pale green to pale grey-green, well foliated and layered or laminated, and vary, depending on composition and grade of deformation, from fine to coarse grained and schistose to gneissic. Recessive weathering and erosion of calcareous layers within mixed silicate-calcsilicate rocks accentuates the gneissic layering in these rocks, which is typically highly contorted due to intense multiphase folding. Marble locally includes interlayers of pelitic and psammitic gneiss. The mineral assemblage typically consists of plagioclase, quartz and biotite, with variable amounts of carbonate, diopside, K-feldspar and hornblende. Marble comprises calcite, dolomite ±diopside ±biotite, whereas calcareous arkose contains alternating pink K-feldspar– and green calcsilicate–rich layers (diopside ±biotite ±actinolite). Calcic psammitic and pelitic wacke contain quartz, feldspar, biotite ±diopside ±amphibole ±carbonate.

Good exposures of marble and calcsilicate rocks occur at the base of Kasmere Falls and downstream along the Thlewiaza River, whereas intensely layered, folded and/or lineated calcsilicate gneiss occur at the east end of Kasmere Lake in large block fields. Calcareous units are relatively less competent to weathering and thus are rarely exposed unless interlayered with other metasedimentary rocks.

Quartzite and arkose

Exposures of quartzite were mapped at southeastern Kasmere Lake and are interpreted, mainly based on magnetic data, to form the steep flanks of an antiformal dome structure (Figure GS-13-2). In this area, the quartzite exposures closely correspond to linear magnetic highs (Böhm and Anderson, 2006).

Quartzite is white, beige, light grey to greenish pink, generally well layered/bedded and foliated, and fine to coarse grained. It contains quartz, K-feldspar, plagioclase, biotite ±garnet ±hornblende ±pyrite ±magnetite, and locally contains sillimanite (faserkiesel) in semipelitic interlayers up to 20 cm thick (Figure GS-13-4f). At southeastern Kasmere Lake, quartzite is in contact and locally interlayered with pink and light grey arkose, which is weakly to well layered and contains up to 40% light grey faserkiesel nodules (Figure GS-13-4g).

Felsic intrusive rocks

Interpreted Paleoproterozoic intrusive rocks at Kasmere and Putahow lakes include foliated to porphyritic granite, abundant leucocratic, weakly deformed potassic granitic rocks, and possibly related potassic granitic pegmatite. Larger granite bodies extend for several kilometres, whereas many smaller irregular bodies and pegmatite dikes are too small to be represented on the maps. These felsic intrusive rocks presumably belong to the Hudson and/or Nueltin suites of granite (ca. 1.86–1.75 Ga; e.g., Peterson et al., 2000). Except for larger granite bodies in the northwestern Kasmere Lake area, the felsic intrusions are not notably magnetic and therefore don't produce a magnetic contrast within the metasedimentary rocks. White potassic granite and pegmatite are the dominant felsic intrusive rocks at southwestern Kasmere Lake, whereas granitic intrusions at northwestern Kasmere Lake can be subdivided into relatively weakly deformed pink and white granites, well-foliated porphyritic granite and granite gneiss (Figure GS-13-2). West and north of Putahow Lake (Figure GS-13-3), felsic intrusive bodies are dominantly a white to beige granite and granodiorite that is commonly garnet and tourmaline bearing near the contact with paragneiss. Uranium-lead dating and Nd isotope analysis on the dominant leucogranite phase at Kasmere and Putahow lakes are planned.

Granitic gneiss

Based on their strong fabric development, the medium- to coarse-grained to porphyritic, locally augen-textured, moderately to strongly foliated granitic gneiss in the west part of the Northwest Arm of Kasmere Lake may be the oldest exposed phase of granitic rocks in the map areas (Figure GS-13-2). The granitic gneiss is white to light grey, moderately layered and/or veined by granitic pegmatite, and contains xenoliths of paragneiss. Main minerals of the granitic gneiss are quartz, K-feldspar, plagioclase, biotite ±muscovite ±magnetite.

Porphyritic granite seems to form a distinct intrusive body within less foliated granite at northwestern Kasmere Lake (Figure GS-13-2). The large granitic intrusion at west-central Putahow Lake (Figure GS-13-3) is composed of fine- to medium-grained, moderately foliated granodiorite to granite and contains patches and schlieren of the white leucogranite described below.

Granitic rocks including leucogranite, syenogranite

White leucocratic granite forms the main intrusive rocks in the map area. Good examples are the granite bodies, several kilometres in size, at southwestern and northwestern Kasmere Lake. In detail, these intrusions are dominantly subconcordant sheets or sills in the paragneiss. The granite is commonly medium to coarse grained to locally pegmatitic, weakly foliated and layered, and locally xenolithic and/or gneissic (e.g., Figure GS-13-4h). Main mineral constituents are K-feldspar, quartz, plagioclase, biotite ±muscovite. A pink variety of potassic granite is exposed at northwestern Kasmere Lake and may be related to the white granite (Figure GS-13-2). The white granite intrusion at the southwest end of Putahow Lake (Figure GS-13-3) is potassic and locally contains up to several percent tourmaline and/or garnet.

Granitic pegmatite

Veins, dikes and irregular pegmatite bodies commonly form diffuse patches and dikes in granitic rocks and are rarely of mappable size. Pegmatite is white to pinkish beige, massive to moderately layered and weakly foliated. Main minerals are K-feldspar, quartz, plagioclase ±biotite ±muscovite ±garnet ±tourmaline, where the accessory mineral assemblage of the pegmatite appears to be governed by the composition of the rocks they intrude. In many cases, pegmatite seems to be closely associated with the above granitic rocks. Some larger pegmatite intrusions appear to be axial planar to a main fold structure or occur along the transposed to sheared fold limbs.

Economic considerations

The northeastern extension of the Wollaston Domain into the Kasmere Lake study area was the focus of considerable exploration in the 1960s and 1970s by a number of companies, as well as comprehensive geophysical and geochemical surveys completed by government agencies. The Uranium Reconnaissance Program (URP) was a nation-wide survey carried out by the Geological Survey of Canada, with Manitoba participating in 1975 and 1976. The survey was flown on a line spacing of 5 km, using a high-sensitivity gamma-ray spectrometer. Lake-centre sediment sampling, with an approximate density of one sample per 13 km^2, was carried out as part of a concurrent geochemical survey. The URP was intended to define broad regions containing higher than average U contents. Broad zones of U enrichment were delineated in northern Manitoba, mainly in the Kasmere Lake map area.

The potential for uranium deposits in this area was originally indicated from limited prospecting, followed by more extensive exploration, by Denison Mines Ltd., Dynamic Petroleum Ltd. and Yukon Antimony Corp. Ltd. (Weber et al., 1975a). Between Snyder Lake and Kasmere Lake, the survey revealed a chain of lake sediment anomalies, trains of radiometric anomalies and relatively higher ratios of U to Th. The URP survey also indicated a complex U-Ni-Co lake sediment geochemical anomaly restricted to the region extending from Snyder Lake to Fort Hall and Thanout lakes. The anomalies can be related to calcsilicate rocks that contain a larger than average component of amphibolite and uniquely contain Co- and Ni-bearing minerals and trace amounts of Au. Subsequent to the release of the URP survey, extensive ground follow-up was carried out by mining companies, such as United Siscoe Mines Ltd. in 1976-1980 (Assessment File 93481, Manitoba Science, Technology, Energy and Mines, Winnipeg) and Zelon Enterprises Ltd. in 1982 (A.F. 93489), as well as by the Manitoba Geological Survey and the Geological Survey of Canada. This activity is summarized in Schledewitz (1986) and Soonawala (1980).

Active exploration for U and Au in northwestern Manitoba is being conducted by CanAlaska Ventures Ltd. (2006) in the Snyder–Kasmere lakes area and by Santoy Resources Ltd. (2006) in the Kasmere Lake area, where U, Mo, Co, Ni, Cu and Au mineralization have been located mainly in boulders and some outcrops. The source of the high-grade boulders, however, has not been sufficiently located by the historical exploration activity and is partly the focus of the current surficial geological studies (Matile, GS-14, this volume). On a regional scale, U mineralization occurs as unconformity-type, basement-hosted U in both calcsilicate rocks and garnet-biotite semipelitic paragneiss of the Wollaston Group. In addition, U occurs in the leucocratic granitic rocks and pegmatite in the metasedimentary rocks.

The metasedimentary rocks at Kasmere and Putahow lakes are tentatively interpreted to represent a platform cover sequence, which was likely deposited on top of the Archean Hearne craton along the passive, southeastern craton margin. Platform cover sequences typically form in response to continental extension, which may include the development of rift basins. In many cover sequences, high heat flow and magmatism associated with rifting have produced significant hydrothermal and magmatic ore deposits. Similar potential may exist in the Wollaston Supergroup metasedimentary rocks in the Kasmere and Putahow lakes areas. Known base-metal occurrences occur mainly in the calcsilicate rocks. A sedimentary origin is the preferred interpretation for the base-metal occurrences (Weber et al., 1975a). The rocks of the Courtenay Lake–Cairns Lake fold belt, which lie along the eastern edge of the Wollaston Group in Saskatchewan, also contain a number of base-metal occurrences interpreted to fit a sedimentary exhalitive origin (Delaney et al., 1997).

Acknowledgments

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