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GEOLOGY OF THE NORTHEASTERN ASHUANIPI COMPLEX, WESTERN LABRADOR (PARTS OF NTS 23J/05, 06, 07 and 11)

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ABSTRACT

The Ashuanipi Complex is a granulite-facies, sedimentary–plutonic subprovince of the Archean Superior Province, part of which is preserved in western Labrador. In Labrador, the complex consists of older sequences of migmatitic paragneiss intercalated with pretectonic tonalite to diorite and gabbro and ultramafic intrusions. These rocks predate the intrusion of extensive diatexite migmatite, variably deformed granitoid intrusions and late granitic pegmatite and gabbro dykes. The eastern margin of the Ashuanipi Complex is unconformably overlain by siliciclastic sedimentary rocks of the Proterozoic New Québec Orogen (Labrador Trough). Orthopyroxene–garnet-melt assemblages indicate granulite-facies conditions were attained. Structures are dominated by a northwest-striking S_1 regional fabric and moderately plunging F_2 folds. Field relations indicate complex relationships between formation of metatexite and diatexite and intrusion of tonalite to ultramafic rocks, followed by late-stage felsic granitoid plutonism.

The region has potential to host gold, base-metal and platinum-group-element mineralization associated with sulphide-bearing gossan zones in gneissic units, granitoid plutons as well as mafic and ultramafic intrusions.

INTRODUCTION

The northeast portion of the Ashuanipi Complex of the Superior Province, western Labrador, was examined during July through August 2015. The surveyed area includes parts of NTS 1:50 000-scale map areas 23J/05, 06, 07 and 11 (Figure 1), and is a continuation of mapping efforts of parts of NTS map areas 23J/ 06, 07, 10, 11, 14 and 23O/03 (van Nostrand and Bradford, 2014). The 2015 project was the second field season of a multi-year, 1:50 000-scale bedrock mapping program to evaluate the geological evolution and mineral potential of the region.

Ground traverses were carried out at approximately one to two kilometre spacings over well-exposed areas, complemented by helicopter traverses. The area was previously surveyed at 1:125 000-scale by Percival (1987, 1993), who carried out ground traverses throughout the map area and surveyed extensively in the region surrounding Lac Desliens. The regions not examined in detail by Percival (*op. cit.*) were the focus areas during the 2015 survey.

LOCATION, ACCESS AND PHYSIOGRAPHY

The centre of the map area is located about 50 km southwest of the town of Schefferville, Québec, and 160 km north of Labrador City (Figure 1). Most regions are best accessed by helicopter or float-plane either from Schefferville or Labrador City. The western shore of Lake Menihek can be accessed by boat from the hydroelectric station at Menihek, which connects to Schefferville by a 45-km-long, rough gravel road.

Bedrock exposure is fair to good. The topography is of moderate- to high-relief, characterized by rounded to flat, barren hilltops, broad valleys and moss and coniferous tree-covered slopes.

PREVIOUS INVESTIGATIONS

The first reconnaissance surveys by Kidd (1950) and Perrault (1951) produced 1 inch to one-half-mile scale

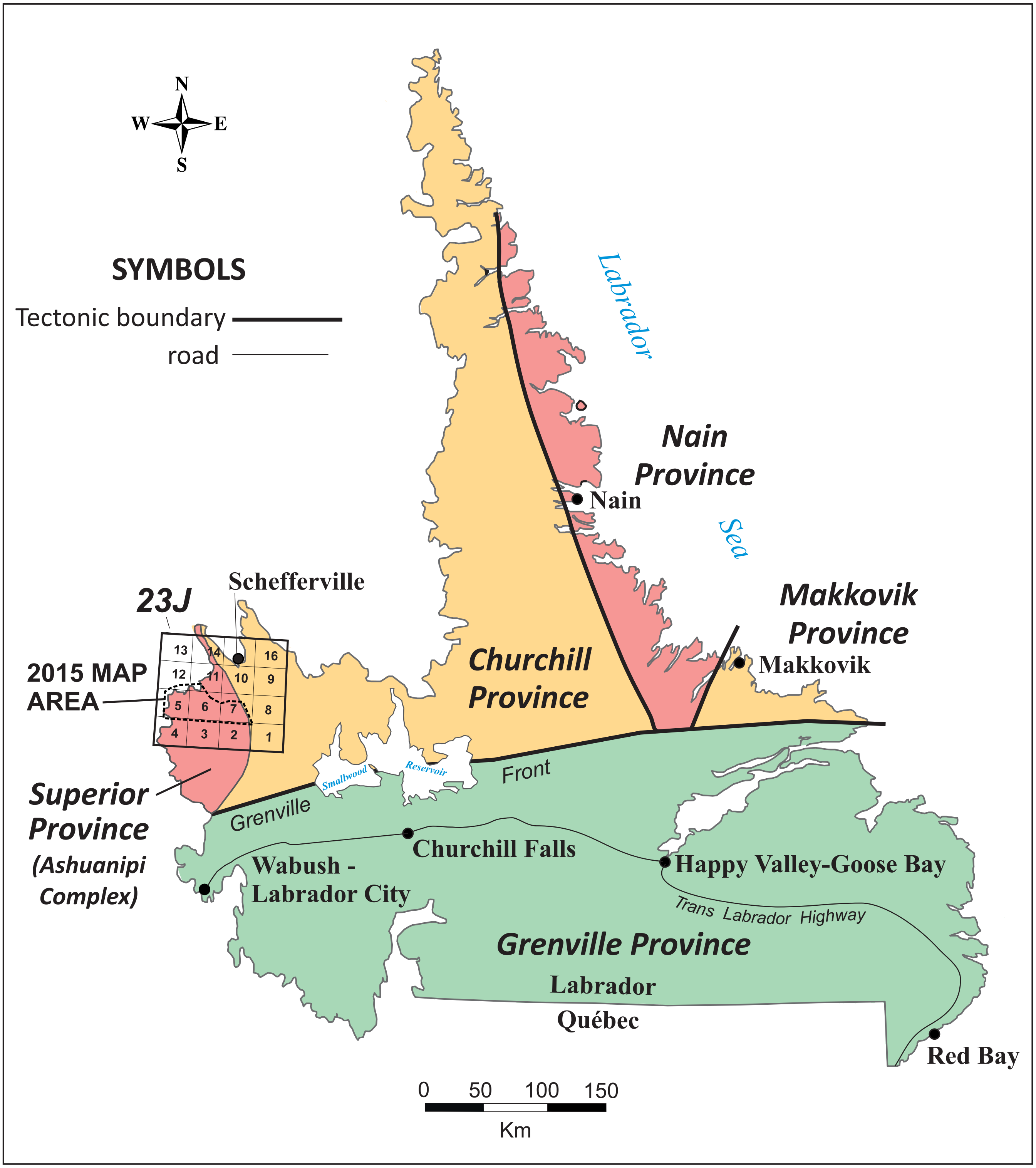

Figure 1. *Tectonic provinces of Labrador. The Superior Province in Labrador is composed entirely of the Ashuanipi Complex. The location of the 2015 map area is outlined by dashed line.*

maps, along the main waterways, immediately south of the map area, in the McPhayden River area. Parts of three, 1:253 440-scale (1 inch to 4 miles) geological maps include the present map area. Frarey (1961) and Stevenson (1963) mapped the east and west parts, respectively, of NTS map area 23J.

Wardle (1982a, b) included rocks of the Ashuanipi Complex, the unconformity and Proterozoic rocks on 1:100 000-scale bedrock map compilations of the south-central Labrador Trough. Percival (1989, 1993) produced a 1:125 000-scale map of NTS map areas 23J/3, 4, 5, 6, 11 and 12 and parts of 23J/2, 7 and 10. In addition to the mapping, Percival (1987, 1991a, b), Percival and Girard (1988) and Percival *et al.* (1992, 2003) reported on the geology, geochemistry and geochronology of the Ashuanipi Complex.

The map area is covered by regional lake-sediment geochemistry surveys of NTS map areas 23J (Geological Survey of Canada, 1982). Detailed lake-sediment, lake-water and stream-geochemical surveys were completed over all regions of the map area (Butler and McConnell, 1989; McConnell, 2009, 2012a, b). The map area is included in a report on the glacial history and till geochemistry of Labrador (Klassen and Thompson, 1990).

A 1:1 000 000-scale residual total-field aeromagnetic map (Geological Survey of Canada, 1984), has been compiled as a colour, shaded-relief map (Kilfoil, 2013), and a 1:500 000-scale Bouger gravity anomaly map (Earth Physics Branch, 1975). Map area 23J/07 is included in 1:50 000-scale airborne geophysical survey maps of the Lake Attikamagen–Schefferville region (Dumont *et al.*, 2010a). Part of the area was included in a survey of heavy mineral concentrates from esker sand and gravel collected over rocks of the Ashuanipi Complex and the Proterozoic Labrador Trough (Brushett and Amor, 2013).

Thomas and Butler (1987) carried out a bedrock-sampling survey of the Ashuanipi Complex in Labrador, to determine the potential for gold mineralization, based on anomalies detected by an earlier regional lake-sediment sampling program (Geological Survey of Canada, 1982). The survey delineated elevated gold values in several occurrences in gossan zones in gneissic and foliated granitoid rocks. Subsequent gold-exploration programs focused on bedrock and some soil, rock and stream sampling, in the vicinity of these and other gossan zones (McConnell *et al.*, 1987, 1989; Dimmell, 1989; Graves, 1992; Leonard, 1997; Simpson, 2010).

In adjacent Québec, LaPointe (1986), Chevè and Brouillette (1992), LaPointe and Chown (1993) and Ivanov (2012) reported significant gold occurrences hosted in Archean Algoma-type, metamorphosed iron formation, migmatitic gneisses and quartz veins to the north of the map area. *See* discussion of regional exploration surveys by van Nostrand and Bradford (2014).

REGIONAL GEOLOGY

The Superior Province is an Archean craton divided into several subprovinces (Figure 2A; Card and Ciesielski, 1986; Stott, 1997). The northern subprovinces are predominantly of continental affinity and contain crustal vestiges as old as 3.0 Ga (Percival *et al.*, 2003). The southern subprovinces consist of linear metavolcanic, metaplutonic and metasedimentary belts. Most of the Superior Province formed between 3.0 and 2.65 Ga, and the subprovinces demarcate amalgamated volcanic arcs, sedimentary prisms and composite terranes accreted, progressively, from north to south between 2.75 and 2.70 Ga. A sub-greenschist- to granulite-facies transition from west to east, exposing the high-grade and deeper level Minto and Ashuanipi subprovinces in the east is attributed to a widescale crustal tilting (Card and Ciesielski, 1986; Percival and Williams, 1989; Card, 1990; Percival *et. al.,* 1992).

GEOLOGY OF THE ASHUANIPI COMPLEX

The Ashuanipi Complex is a granulite-grade subprovince of the eastern Archean Superior Province, approximately 90 000 km^2 in area (Figure 2A, B). The complex is bounded by Proterozoic rocks of the New Québec Orogen (Labrador Trough) to the east, and by Archean rocks of the Le Grande, Bienville and Opinaca subprovinces to the west, north and southwest, respectively. To the southeast, the Ashuanipi Complex is bounded by the Grenville Front, but its reworked continuation extends into the Grenville Province.

The Ashuanipi Complex consists of older migmatitic paragneiss, which are intruded by pretectonic tonalite, granodiorite, quartz diorite, diorite and gabbro plutons of the Desliens igneous suite (Percival *et al.*, 2003), interpreted as a fractionated series of intrusive rocks. Granulite-facies metamorphism produced orthopyroxene-bearing assemblages and migmatitic fabrics, and resulted in the formation of predominantly sedimentary-derived, syn-, to late-metamorphic stage diatexite (Percival, 1991b; James, 1997). Mafic and ultramafic rocks occur as isolated intrusions, sills, thin layers or dykes. Leucogranite syenite and tonalite plutons are later intrusions that crosscut fabrics in other units. Pre-, to posttectonic granite, alkali-feldspar granite and alkali-feldspar quartz-syenite veins, and pegmatite also intrude most units. The eastern margin of the Ashuanipi Complex is unconformably overlain by siliciclastic sedimentary rocks of the Proterozoic Knob Lake Group of the

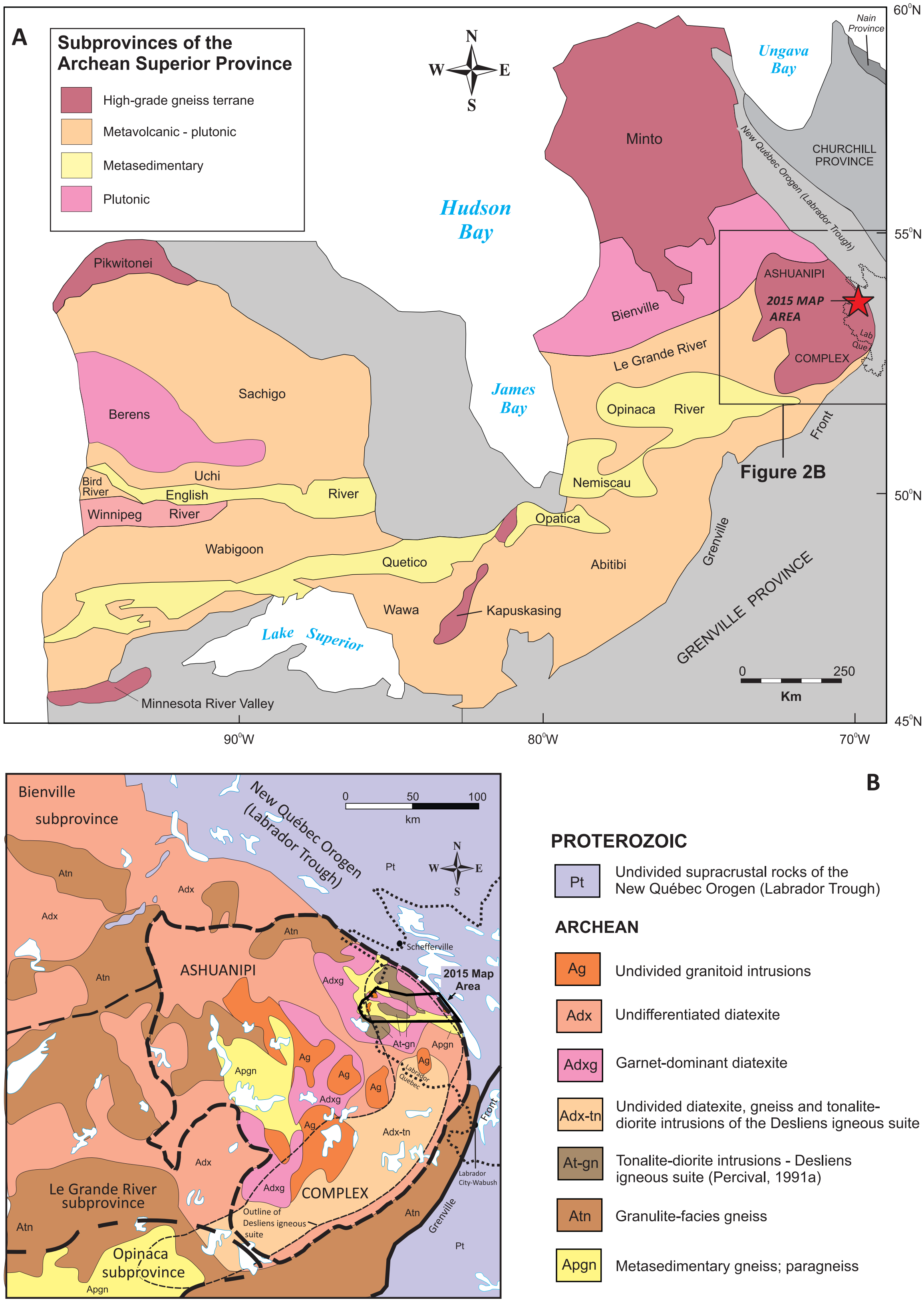

Figure 2 A) *Main subdivisions of the Archean Superior Province (modified from Card and Ciesielski, 1986, and Card, 1990). Location of the 2015 map area shown by red star.* B) *Regional geology of the Ashuanipi Complex, Superior Province (modified after Wheeler* et al.*, 1996) and the location of 2015 map area is outlined.*

Labrador Trough, of the New Québec Orogen. Percival (1987, 1991a, b) and Percival and Girard (1988) have described the regional geology of the Ashuanipi Complex in some detail, including the regional structural, metamorphic and geochronological relationships, and the reader is encouraged to consult these reports for additional information.

GEOCHRONOLOGY OF THE EASTERN ASHUANIPI COMPLEX

The only radiometric date reported for the map area is a 2723 ± 6 Ma U–Pb zircon age from a quartz diorite unit of the Desliens igneous suite (Percival *et al.*, 2003). Several other U–Pb ages from zircon and monazite are available from other units in adjacent map areas of Labrador and Québec. A summary of geochronological data are listed below:

- 3.4 to 2.7 Ga: age range of detrital zircons from metasedimentary rocks; indicates that deposition of sedimentary rocks and minor volcanic rocks completed by *ca.* 2.7 Ga (Mortensen and Percival, 1987)
- 2.7 and 2.68 Ga: intrusion of tonalite, granodiorite, diorite and mafic rocks of the Desliens igneous suite (Percival, 1991a)
- 2.68 to 2.65 Ga: high-grade metamorphism, development of S_1 migmatitic fabric or foliation and intrusion of syn- to late-metamorphic garnet ± orthopyroxene-bearing granite and granodiorite–diatexite (Mortensen and Percival, 1987)
- 2.65 to 2.63 Ga: post-peak metamorphic cooling (Percival and Gerard, 1988)
- 2.65 Ga: intrusion of posttectonic granite pegmatites and leucogranite (Percival, 1991b)
- 2.65 to 2.6 Ga: post-metamorphic thermal event resulting in new zircon crystallization in diatexite and new monazite growth in older gneisses (Chevè and Brouillette, 1992)

GEOLOGY OF THE MAP AREA

The geology of the Ashuanipi Complex in the 2015 map area is shown in Figure 3. The geology to the north of the map area (Figure 3A *in* van Nostrand and Bradford, 2014) is also included in Figure 3 for continuity. Two areas outlined by the dashed lines to the northeast of Lac Desliens and in the southeast part of NTS map area 23J/07, are compiled primarily from Percival (1993). The rocks include older migmatitic paragneiss intruded by foliated to gneissic tonalite and diorite intrusions of the Desliens igneous suite (Percival, 1991a). Pyroxene-rich ultramafic rocks occur as subordinate discontinuous sills and boudins. Granite to granodiorite–diatexite occurs as 10s of km-scale bodies, and as abundant outcrop-scale veins and concordant layers throughout. Massive to weakly foliated granite, syenite and tonalite intrusions postdate the diatexite units. Syn- to post-tectonic granite and alkali-feldspar quartz-syenite pegmatite veins intrude most units. Fine-grained, variably deformed, metre-scale, northeast-striking gabbro dykes intrude gneissic rocks and diatexite. North-northeast-striking gabbro dykes postdate the Proterozoic rocks of the Labrador Trough in the eastern map area (Figure 3).

The dominant structural fabric is a northwest-striking, S_1 migmatitic layering in gneiss, and a weak to strong foliation in granitoid rocks and mafic rocks that are folded about moderately plunging F_2 axes. Granulite-facies conditions are inferred throughout, based on widespread orthopyroxene–garnet-melt assemblages in the metatexite, but some granitoid and gabbroic rocks preserve remnants of primary pyroxene (Percival, 1991a).

Several mineral occurrences are hosted in gossan zones in migmatitic gneiss, foliated granitoid rocks and pyroxenite. These rocks have potential for hosting gold and base metals and, in the case of ultramafic rocks, platinum-group-element (PGE) mineralization.

DESCRIPTION OF ROCK UNITS

All rock types have been described previously, in some detail, by Percival (1987, 1991a, b), Percival and Girard (1988), Percival *et al.* (1992) and van Nostrand and Bradford (2014). The salient features of the rock units shown in Figure 3 are discussed below. All igneous rocks described below, except late gabbro dykes, are metamorphic and should be prefixed by meta-, but, for simplicity, igneous terminology is retained. The subdivision of migmatitic rocks in the map area is based on definitions after Sawyer (2008). The two, first-order migmatite divisions are metatexite and diatexite. A metatexite is a rock that is heterogeneous at the outcrop scale and pre-partial-melting structures are widely distributed in the paleosome. The neosome is generally segregated into leucosome and melanosome components.

A diatexite is a migmatite in which the neosome is dominant and melt is pervasively distributed throughout. Pre-partial-melt structures are absent from the neosome and are commonly replaced by syn-anatectic flow structures or isotropic neosome. The neosome is variable in appearance reflecting a large range in the degree of partial melting.

UNIT Apgn – MIGMATITIC PARAGNEISS

The oldest rock unit, based on field relationships, is

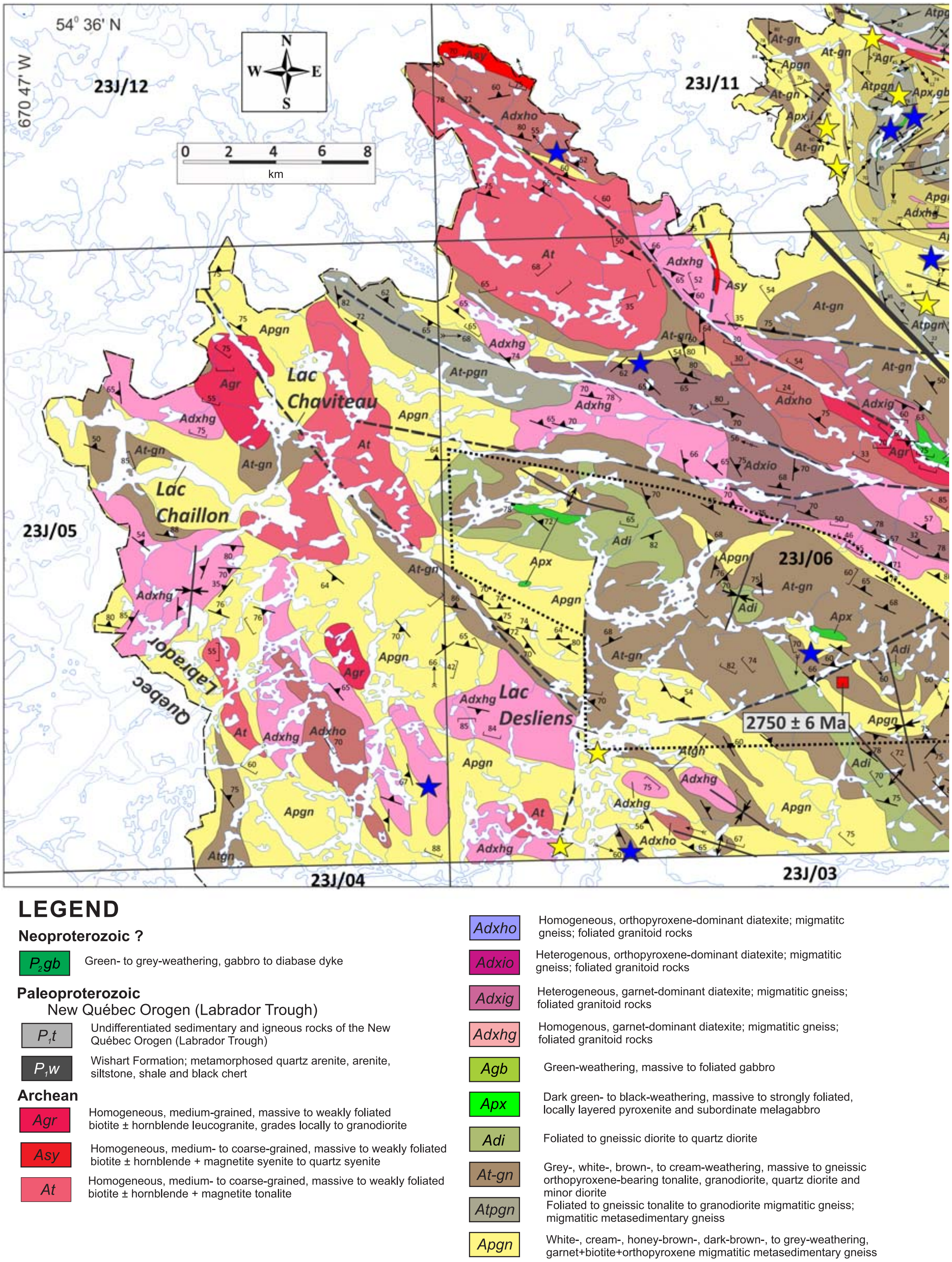

Figure 3. *Geology of the Ashuanipi Complex in the study area, compiled from field data collected during the 2015 survey and from work by van Nostrand and Bradford (2014). The 2013 and 2015 map area boundary is shown by the solid black line. The areas enclosed by the dashed line in the Lac Desliens area and the southeast corner of NTS 23J/07 were not mapped in detail as in the rest of the map area and some of the geological patterns here are compiled primarily from the 1:125 000-scale map of Percival (1993).*

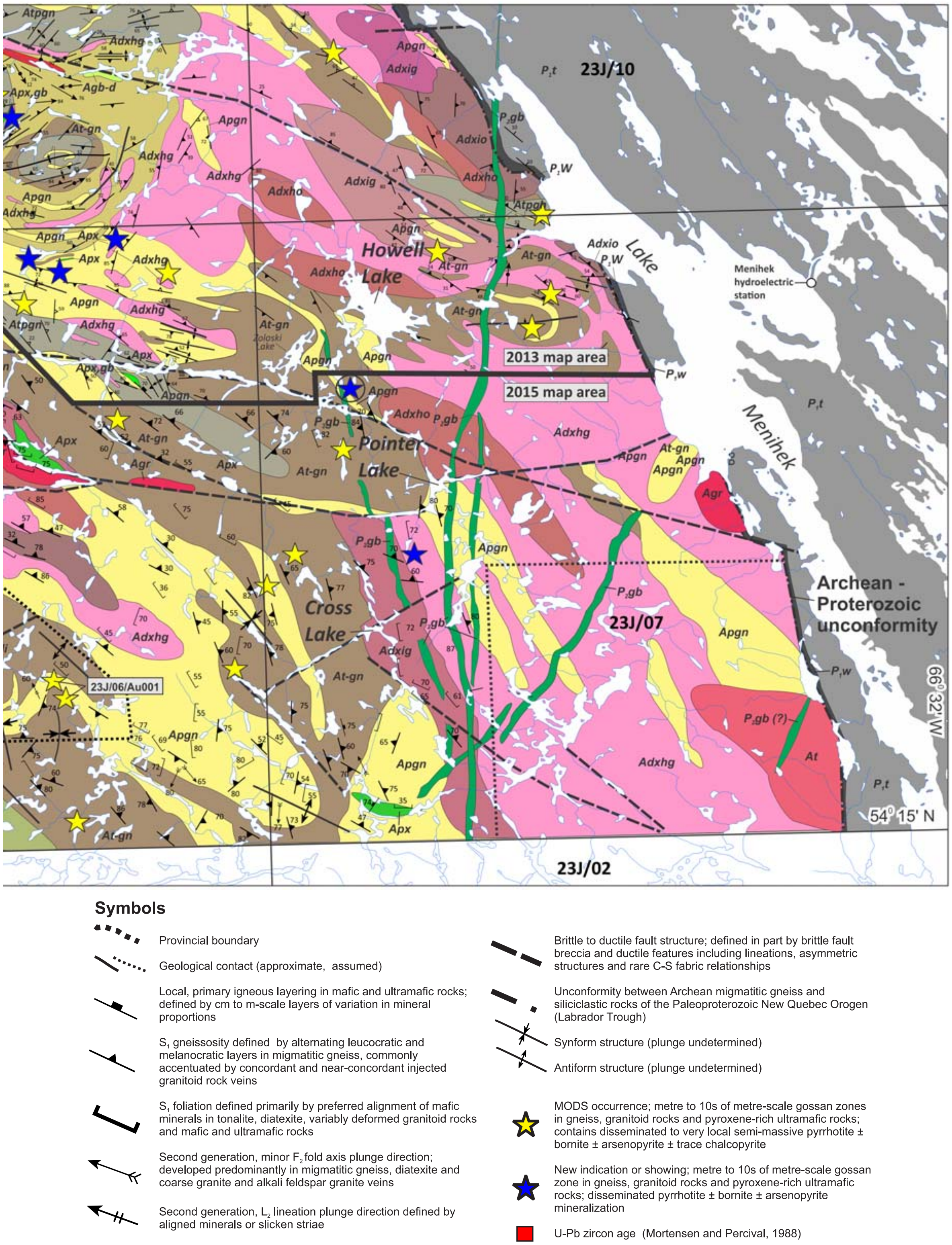

Figure 3. (*continued*) *Geology of the Ashuanipi Complex in the study area, compiled from field data collected during the 2015 survey and from work by van Nostrand and Bradford (2014). The 2013 and 2015 map area boundary is shown by the solid black line. The areas enclosed by the dashed line in the Lac Desliens area and the southeast corner of NTS 23J/07 were not mapped in detail as in the rest of the map area and some of the geological patterns here are compiled primarily from the 1:125 000-scale map of Percival (1993).*

migmatitic paragneiss. Rocks of this unit are white-, cream-, grey-, tan-, to honey-brown-weathering, fine-, to medium-grained, biotite + garnet ± orthopyroxene psammitic to semi-pelitic gneiss. The paragneiss exhibit a dominant stromatic structure, where mm-, to cm-scale, melanosome ± paleosome layers alternate with granitic leucosome. The proportion of leucosome is variable, although it generally ranges from 10–20% of the total rock, and varies from a dominant 'straightened' appearance to variably folded (Plates 1 and 2). Patch and schollen metatexites are also a widespread migmatitic paragneiss texture. Garnet porphyroblasts are near ubiquitous and vary from red, maroon, orange, brown to pink, are anhedral to euhedral, and range from 1 mm to several cm in diameter, and locally comprise up to 50% of the total rock (Plate 3). Feldspars, quartz, pyroxene, biotite and magnetite inclusions are common. Orthopyroxene occurs as dark-brown to black-weathering, anhedral to subhedral porphyroblasts, ranging from 1 to 10 mm in diameter and locally comprising up to 10 % of the total rock.

Plate 1. *Well-banded, stromatic-textured, migmatitic metasedimentary gneiss containing orthopyroxene–garnet-melt assemblages. Marker is 12 cm in length.*

Plate 2. *F_2 folding of the S_1 migmatitic layering in a metasedimentary gneiss enclave enclosed within garnet-dominant diatexite. Pencil is 14 cm in length.*

Plate 3. *Garnet-rich layer in migmatitic metasedimentary gneiss. The S_1 migmatitic fabric visible as a thin layering at top left is partially obscured by overgrowths of metamorphic garnet. The coarse-grained leucocratic patches are quartz-rich segregations, which in a few areas, cut the large garnet aggregates and the segments preserve an oblique angle to the main fabric, an example of this is shown just above the scale card.*

DESLIENS IGNEOUS SUITE: TONALITE–DIORITE (–GABBRO–PYROXENITE)

The Desliens igneous suite is a 500-km-long belt of pre-tectonic tonalitic to mafic intrusions in the eastern Superior Province (Figure 2B; Percival, 1991a; Percival *et al.*, 2003). These rocks, and their sedimentary host rocks, were variably deformed and metamorphosed at granulite facies. Field relationships indicate that the tonalite, diorite and ultramafic rocks are the oldest plutonic units in the map area. Percival (1991a) proposed that these units are a fractionated igneous series of ultramafic through tonalitic compositions. van Nostrand (2015) reported lithogeochemical analyses of tonalite, gabbro and ultramafic intrusions in the 2013 map to determine whether a genetic relationship exists between these rock types. Although a definitive lithogeochemical link is not evident, the analyses indicate that these rocks all have a mantle signature based on similar Th/Yb ratios. Mantle metasomatic enrichment may have had an effect on the source of the mafic–ultramafic rocks and the tonalitic–dioritic rocks of the suite. Different amounts of slab melting, source enrichment and crustal contamination may have resulted in formation of these rocks from a similar mantle source.

UNIT At-gn – FOLIATED TO GNEISSIC TONALITE

The pretectonic tonalitic rocks of the Desliens igneous suite occur as km-scale northwest-striking belts and layers and enclaves on a scale of metres or tens of metres within metatexite and diatexite. The rocks of this unit are predominantly tonalite but include diorite, quartz diorite and subordinate granodiorite. They vary from white-, green-, brown-, to grey-weathering, fine- to coarse-grained and massive to gneissic. The dominant mineral assemblage is biotite + orthopyroxene ± clinopyroxene ± garnet ± amphibole. A characteristic feature of the foliated tonalite is the presence of brown-, grey-, to black-weathering, anhedral to subhedral, inclusion-filled, orthopyroxene crystals up to 3 cm in diameter (Plate 4). Percival (1991a) interpreted these sieve-textured orthopyroxenes as a relict igneous phase overprinted by granulite-facies metamorphic assemblages and the migmatitic S_1 fabric.

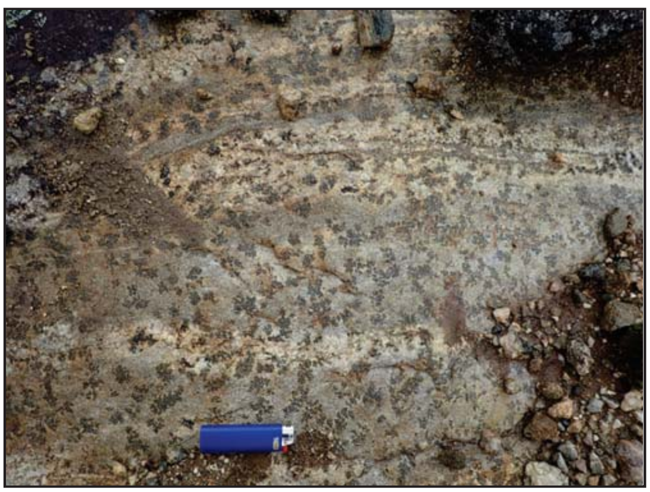

Plate 4. *Foliated orthopyroxene-bearing tonalite of the Desliens igneous suite with characteristic sieve-textured orthopyroxene poikioblasts. Lighter is 7 cm in length.*

The gneissic equivalent of this unit exhibits diffuse-, to well-layered cm-scale alternations of leucosome and paleosome components (Plate 5).

UNIT Adi – FOLIATED TO GNEISSIC DIORITE

Rocks of this unit have similar textures and mineral assemblages as Unit At-gn. These rocks can be differentiated from the tonalitic rocks of the Desliens igneous suite

Plate 5. *Pre-D_1 tonalite of the Desliens igneous suite with inhomogeneous texture. The texture ranges from a migmatitic S_1 layering with 'S' folds of some leucosome layers (right centre) to a weakly foliated texture that preserves inclusion-rich anhedral orthopyroxene oikocrysts (dark grey-weathering patches).*

based on a higher proportion of pyroxene and biotite, low quartz content and they correspond to strong regional aeromagnetic highs (Plate 6 and *see* section on Aeromagnetic Signatures – Bedrock Geology Correlations). Map-scale bodies of dioritic rocks of this suite have been delineated in the central part of the map area where they occur as kilometre-scale intrusions within the larger tonalite bodies.

Plate 6. *Foliated to gneissic orthopyroxene-bearing quartz diorite to diorite (Unit Adi) of the Desliens igneous suite. Diffuse leucocratic leucosome alternate with orthopyroxene-biotite-rich melanosome. This texture is typical of the dioritic rocks north and northeast of Lac Desliens in the southern part of the map area.*

UNIT Atpgn – UNDIFFERENTIATED METATEXITE

In the northwestern map area (Figure 3), paragneiss and tonalite intrusions are intercalated on scales of 10s and 100s of metres and are not subdivided at the present scale of mapping.

ULTRAMAFIC ROCKS

Ultramafic rocks are a subordinate unit within the map area and occur as boudinaged, map-scale bodies up to 250 m wide and as metre and 10s of metre-scale lenses of massive to layered pyroxenite and subordinate melagabbro, intercalated with paragneiss and foliated to gneissic granitoid rocks.

UNIT Apx – PYROXENE-RICH ULTRAMAFIC ROCKS

The protolith of these locally layered ultramafic rocks is equivocal, but their elongate and approximate tabular shape, concordant and sharp contacts with the enclosing rocks, suggest they are deformed sills.

The rocks exhibit a variety of textures ranging from massive, coarse grained and homogeneous and containing very coarse-grained pyroxene crystals to strongly foliated and locally gneissic (Plates 7 and 8).

Plate 7. *Coarse-grained, massive and homogenous pyroxenite (Unit Apx) showing large anhedral orthopyroxene crystals and thin segmented granite veins. These crystals are interpreted as relict oikocrysts that have been overprinted by granulite-facies metamorphism.*

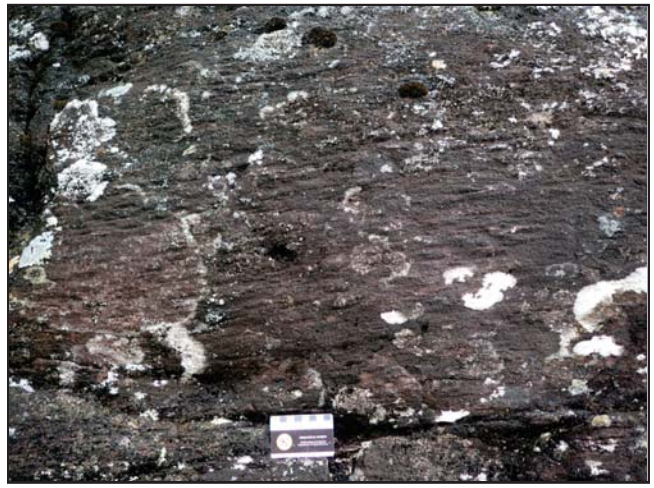

Plate 8. *Medium-grained, homogenous, strongly foliated pyroxenite. This texture is typical of the ultramafic rocks in the map area.*

Igneous layering is observed within the ultramafic rocks in a few areas, defined by variations in the proportions and grain size of constituent minerals (Plate 9). van Nostrand and Bradford (2014) discussed the relationships of the ultramafic rocks in the 2013 map area (Figure 3).

Plate 9. *Cumulate igneous layer developed within a boudinaged ultramafic sill. The top layer consists of coarse-grained pyroxenite to metagabbro that shows a sharp contact with medium-grained pyroxenite.*

DIATEXITE ROCKS

Diatexite is a predominant rock type, occurring as map-scale bodies containing older gneiss and foliated granitoid rock enclaves, and as metre- to 10s m-scale veins and bodies. Percival (1987, 1991b, 1993), James (1997) and van Nostrand and Bradford (2014) classified the diatexites of the northeastern Ashuanipi Complex into two compositional types and two textural types. These are, i) homogeneous and heterogeneous garnet–diatexite and ii) homogeneous and heterogeneous orthopyroxene–diatexite, where homogeneous and heterogeneous were used to characterize diatexite having, respectively, less and more than 25% enclaves or inclusions of older rocks.

Diatexites have been described in some detail elsewhere (Percival, 1987, 1991b; Guernina, 2007; van Nostrand and Bradford, 2014) and only the pertinent features of these units will be discussed below.

Unit Adxhg – HOMOGENEOUS GARNET–DIATEXITE

The predominant type in this unit is a homogeneous, enclave-poor, garnet-dominant diatexite (Plate 10). This unit is white-, grey-, and pink-weathering, medium to coarse grained, and massive to moderately foliated. The garnets are pink-, red-, and orange-weathering, subhedral to anhedral, commonly fractured and inclusion-filled and range from 1 mm to 5 cm in diameter. The diatexite also contains up to 10% orthopyroxene, ranging up to 5 mm in diameter.

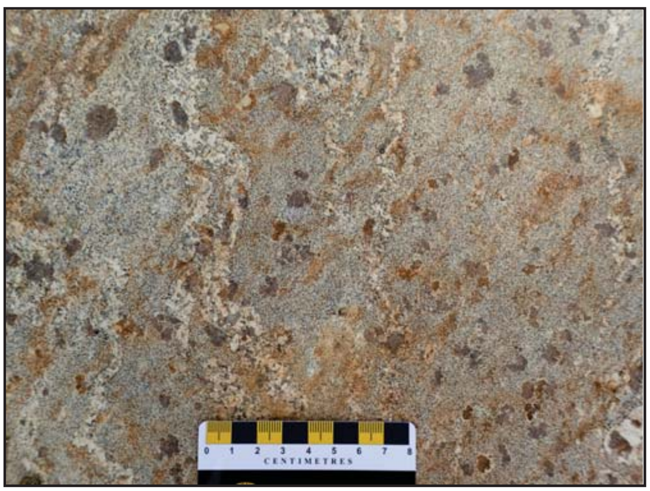

Plate 10. *Garnet-dominant diatexite texture that is typical of Unit Adxhg. Note the deformed leucocratic alkali-feldspar granite veins that are near ubiquitous in these rocks.*

UNIT Adxig – HETEROGENEOUS GARNET–DIATEXITE

This unit, having a predominant granodiorite composition, is a variant of Unit Adxhg. The mafic mineral contents appear to be proportional to the percentage of enclaves present (Plate 11).

Plate 11. *Well-banded metasedimentary gneiss enclave in garnet-dominant diatexite. The slight warping of the S_1 migmatitic fabric around the large inclusion-rich garnet at top right suggests the diatexite (and garnet growth) formed pre- to syn- D_2 deformation.*

UNIT Adxho – HOMOGENEOUS ORTHOPYROXENE–DIATEXITE

Orthopyroxene–diatexite, in which the proportion of enclaves ranges approximately 5 to 15% of the total outcrop, is coarse-grained, massive, predominantly granite in composition, and contains 5 to 10% subhedral orthopyroxene, 5 to 10% biotite and subordinate garnet (Plate 12).

Plate 12. *Homogeneous, medium-, to coarse-grained orthopyroxene-dominant diatexite (Unit Adxho).*

UNIT Adxio – HETEROGENEOUS ORTHOPYROXENE–DIATEXITE

This diatexite unit is characterized by containing 25% or more enclaves of foliated to gneissic tonalite and paragneiss. The orthopyroxene occurs as subhedral to locally euhedral dark-brown-, and black-weathering oikocrysts having sharp grain boundaries and comprising 2 to 15% of the rock. Biotite and garnet are minor phases, ranging up to 5% of the total rock (Plate 13).

Plate 13. *Orthopyroxene-dominant diatexite (Unit Adxio) containing abundant enclaves of tonalitic gneiss. Pencil is 12 cm in length.*

LATE- to POSTTECTONIC IGNEOUS ROCKS

Massive to weakly foliated granite, syenite and tonalite occur as 10s of kilometre-scale bodies in the western and eastern map areas and as smaller intrusions within fault zones in the north-central part (Figure 3). These plutons have a massive to weak fabric and unaltered mineralogy and are interpreted to postdate most rock types with the exception of some late coarse-grained granite and pegmatite intrusions and gabbro dykes. The rocks are very poorly exposed and contacts with the surrounding units were not observed, however, veins of granite and syenite occur locally in adjacent older rocks. The intrusions are coincident with moderate to strong, regional aeromagnetic highs and most of the contacts of the larger bodies in Figure 3 were delineated on the basis of these signatures (*see* section on Aeromagnetic Signatures – Bedrock Geology Correlations).

UNIT Agr – MASSIVE TO WEAKLY FOLIATED GRANITE TO GRANODIORITE

This unit occurs as several elliptical-shaped, km-scale intrusions. Granite is the dominant composition, although is gradational to granodiorite in some of the larger bodies. In the central part of the map area, two elongate plutons, which may be part of the same intrusion, occur along a west-northwest-striking fault zone. Rocks of this unit also occur along fault zones in the 2013 map area (van Nostrand and Bradford, 2014). The occurrence of these leucocratic, relatively hydrous granitoid rocks suggests that they may have been more ductile during deformation therefore accommodated more strain during the later tectonism. The rock varies from white- to pink-weathering, fine- to medium-grained, massive to very weakly foliated, biotite leucogranite to locally pyroxene-bearing granodiorite. The mineralogy of the fine-grained granite consists of 5-10% biotite and 5% magnetite (Plate 14), whereas the granodiorite component of some of these intrusions also contains up to 10% clinopyroxene and minor hornblende.

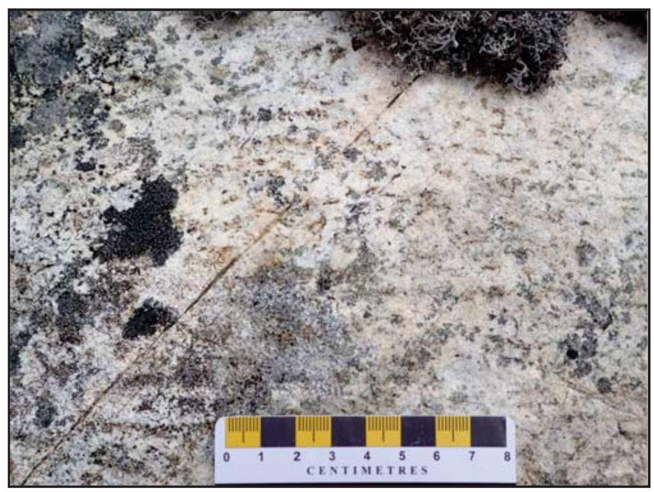

Plate 14. *Fine-grained, massive and homogeneous texture of biotite leucogranite that is typical of the late- to posttectonic granite intrusions (Unit Agr).*

UNIT At – MASSIVE TO WEAKLY FOLIATED TONALITE

Rocks of Unit At occur as irregular- to elliptical-shaped, poorly exposed intrusions in the western and eastern parts of the map area (Figure 3). They are white- to grey-weathering, massive to weakly foliated, medium to coarse grained and contain 10–15% hornblende, 5% biotite and 2–10% magnetite (Plate 15).

Plate 15. *Medium-grained, homogenous massive to weakly foliated late- to posttectonic tonalite (Unit At) containing hornblende, minor biotite and magnetite.*

UNIT Asy – MASSIVE TO WEAKLY FOLIATED SYENITE

Syenite occurs as two intrusions in the northwestern part of the map area (Figure 3). A portion of one intrusion intrudes diatexite near the provincial border and Percival (1993) mapped the extension into adjacent Québec and a 150-m-wide body of syenite intrudes along a north-striking fault zone. The syenite is white- to pink-weathering, massive, medium to coarse grained and contains 5–10% hornblende and minor biotite and magnetite (Plate 16). The syenite is intruded by local alkali-feldspar granite pegmatite and fine-grained granite aplite veins.

Plate 16. *Representative photograph of massive and homogeneous, medium-grained syn- to posttectonic syenite (Unit Asy) containing hornblende, minor biotite and magnetite.*

GRANITE AND ALKALI-FELDSPAR GRANITE PEGMATITE VEINS

Coarse-grained to pegmatitic granite, alkali-feldspar granite and alkali-feldspar-quartz syenite are widely distributed rock types and thus are not depicted on Figure 3. They occur as several generations of pre- to posttectonic, cm-, to 10s-m-scale veins and minor intrusions (Plate 17).

Plate 17. *Dark-weathering dioritic gneiss of the Desliens igneous suite in which the banding is defined by concordant granite veins and crosscut by a later alkali-feldspar granite pegmatite vein. Scale card is 8 cm in length.*

FINE-GRAINED GABBRO DYKES

Concordant to slightly discordant, northeast-striking gabbro dykes intrude gneissic and foliated rocks in several localities. The dykes are fine grained, massive to foliated, homogeneous, appear fresh, and contain plagioclase, clinopyroxene as well as minor olivine and amphibole. The dykes range from one to five metres in width, are variably deformed and have local, well-developed chilled margins (Plates 18 and 19). Preliminary lithogeochemical analyses of one of these dykes, immediately north of the map area suggest they have a tholeiitic affinity (T. van Nostrand, unpublished geochemical data, 2014).

PROTEROZOIC ROCKS

UNIT P_1w – WISHART FORMATION

Siliciclastic sedimentary rocks of the Wishart Formation of the Labrador Trough supracrustal sequence, (Wardle, 1982b) unconformably overlie granitoid rocks and metasedimentary rocks along the western shoreline of Lake Menihek (Figure 3). Only a few exposures of this unit were

Plate 18. *Fine-grained, massive, undeformed northeast-striking gabbro dyke showing well-developed chilled margin against the enclosing metasedimentary gneiss. Scale card is 8 cm in length.*

Plate 19. *Fine-grained, homogeneous gabbro dyke that is openly folded about moderately southeast-plunging F_2 axis. A very weak foliation is observed along the margins of this dyke. Dyke contacts are outlined by white line. Hammer is 80 cm in length.*

examined in the map area. These rocks are well-bedded, grey-weathering, quartz arenite and have thin dark-weathering shale layers.

UNIT P_2gb – GABBRO DYKES

North-northeast and north-striking-dykes crosscut the Archean–Proterozoic unconformity and rocks of the Labrador Trough at the eastern margin of the map area (Figure 3). Wardle (1982a, b) referred to these undated dykes as 'Mary Jo diabase'. The dykes are poorly exposed, but their extent can be delineated by rare outcrops and strong, positive, linear aeromagnetic signatures. The intrusions vary from 100 to 200 m wide based on the documented exposures, topography and aeromagnetic signatures. The gabbro dykes are grey- to brown-weathering, fine to medium grained, massive and homogeneous and have subophitic texture (Plate 20). The minerals present are variable proportions of plagioclase, orthopyroxene and magnetite, with and without clinopyroxene and amphibole. In Figure 3, the extent of some dykes (solid contact lines) are based on *in situ* exposures and confirmed by their coincidence with aeromagnetic signatures. Other dykes that are not exposed, are presumed, based only on aeromagnetic signatures and weak aerial photograph lineaments, shown with dashed contact lines in Figure 3 (*see* Aeromagnetic Signatures – Bedrock Geology Correlations).

Plate 20. *Medium-grained, homogeneous, undeformed, subophitic-textured gabbro dyke (Unit P_2gb). This texture is typical of the large, north-northeast-striking dykes that postdate the Archean–Proterozoic unconformity in the eastern part of the map area.*

STRUCTURE

Primary structures in the map area are limited to local igneous layering developed in some ultramafic rocks and igneous flow features in some granitoid rocks.

The dominant structural feature is a west-northwest-striking regional fabric. It is defined by, i) a syn-metamorphic S_1 migmatitic layering and/or schleiren-texture in gneissic rocks, ii) a weak to strong alignment of primarily biotite in gneiss and foliated granitoid rocks (including diatexite), and iii) aligned pyroxene (± plagioclase) grains in gabbroic and ultramafic rocks.

The D_1 fold structures were not recorded in the map area; however, macroscopic D_2 structures are developed in most rock types and define the overall map pattern of units in Figure 3. These D_2 structures are tight to isoclinal, predominantly southwest-plunging folds of earlier S_1 fabrics (Plate 21). The S_1 fabric within individual outcrops commonly has a highly variable strike and dip as a result of the superposed younger D_2 folding. Structural patterns are complex, particularly near bodies of older granitoid bodies that may have remained more rigid during deformation, and focussed much of the regional strain in the adjacent rocks. This is supported by the observation that the interiors of many of these tonalite to diorite intrusions are weakly foliated, whereas the marginal zones are typically gneissic (Percival, 1991a; van Nostrand and Bradford, 2014).

Plate 21. *Well-banded metasedimentary gneiss enclave within orthopyroxene-dominant diatexite. The S_1 gneissic fabric in the enclave is tightly folded about a moderately plunging F_2 axis. The orthopyroxene-dominant diatexite does not have a tectonic fabric in this example, and appears to postdate the D_2 deformation.*

Most diatexite bodies postdate gneissic fabrics (S_1) but are commonly open to tightly folded about moderately plunging F_2 axes (Plate 22). This indicates that most diatexite units postdate D_1 deformation and the S_1 fabric and were emplaced prior to D_2 deformation. However, in some areas, diatexite appears to be late- to post-D_2 deformation (*see* Discussion).

Local shear zones and outcrop-scale faults are common in most rock types and occur as narrow discontinuities that offset small veins and intrusions on cm to 10s of cm-scale. In a few areas, one to five-metre-wide submylonitic zones occur adjacent to rock contacts (Plate 23). These zones of offset and shearing have a widely variable orientation, however most are concordant to the regional northwest-striking fabric and exhibit both sinistral and dextral shear sense.

Plate 22. *Garnet-dominant granite diatexite vein intruding well-banded migmatitic tonalite gneiss. Both the diatexite and the gneiss are folded about moderately plunging F_2 axes, indicating that the garnet-dominant diatexite was formed pre-D_2 deformation, which is in contrast with the relationship of the orthopyroxene-dominant diatexite observed in Plate 21.*

Plate 23. *Strongly deformed zone in mafic-rich dioritic gneiss adjacent to contact with metasedimentary gneiss. Leucocratic granitic veins are strongly attenuated and some boudins are locally rotated, although a definitive shear sense is not evident.*

Several northwest- and northeast-striking, late-stage faults transect the map area (Figure 3). Fault breccia, chlorite, epidote and hematite alteration occur within these structures (Plate 24). Map unit offsets were not documented across these faults, with one exception; the Proterozoic–Archean unconformity is offset approximately 1.75 km in a sinistral sense along a west-northwest-striking fault on the western shore of Lake Menihek, immediately southeast of a granite intrusion (Wardle, 1982a; *this study*). Similar offsets

Plate 24. *Hematized and silicified diatexite unit within a late northwest-striking fault zone. Late chlorite and epidote alteration is also present in these brittle faults.*

of the unconformity were documented farther to the north (Wardle, 1982a, b; van Nostrand and Bradford, 2014). Rare, weak, subhorizontal lineations in a few of these faults suggest a predominant strike-slip movement.

METAMORPHISM

The presence of widespread orthopyroxene–leucosome melt-bearing assemblages is indicative of granulite-facies conditions. Percival (1991b) and James (1997) reported minimum metamorphic and igneous diatexite emplacement conditions of 700 to 800°C and 5 to 6.5 kbar, using several geothermometers and geobarometers.

Percival (1991b) proposed that some orthopyroxenes in tonalitic, granodioritic and mafic-ultramafic rocks of the Desliens igneous suite are relict oikocrysts that have been overprinted by regional granulite-facies, pyroxene-bearing assemblages and the regional S_1 fabric. Percival (1991b) and James (1997) discussed the presence of anhedral, inclusion-rich orthopyroxene in granitoid rocks, particularly tonalite units, and suggested that the pyroxene is a relict igneous phase derived from an anhydrous mantle melt source.

In contrast, subhedral, orthopyroxene crystals containing sparse to absent inclusions, show sharp grain contacts with other constituents, including the leucosome melt component, and commonly having mafic-depleted haloes of feldspar and quartz, are interpreted as a peak metamorphic mineral phase.

Localized alteration of biotite, garnet and pyroxenes to chlorite and epidote, particularly associated with late fault zones, indicates some retrogression of the granulite-facies assemblages.

AEROMAGNETIC SIGNATURES – BEDROCK GEOLOGY CORRELATIONS

A colour-shaded compilation of two aeromagnetic surveys covering the map area is shown in Figure 4 (Geological Survey of Canada, 1984; Dumont *et al.*, 2010a, b; Kilfoil, 2013).

Some direct correlations of the bedrock geology and aeromagnetic signatures are evident and highlighted below.

In the western and central map area, several 10s of kilometre scale, northwest-striking regional aeromagnetic highs are coincident with mafic-rich, pretectonic quartz diorite to diorite intrusions (Unit Adi) of the Desliens igneous suite, whereas moderate strength aeromagnetic signatures are coincident with tonalitic rocks of this suite (Unit At-gn). These patterns correspond to higher mafic content of the quartz-poor granitoids of this suite of rocks. Strong aeromagnetic highs are also coincident with later, massive to weakly foliated granite (Unit Agr), syenite (Unit Asy) and tonalite (Unit At) intrusions. The large elliptical-shaped tonalite intrusion (Unit At) in the northwestern part of the map area is coincident with a ringed-shaped aeromagnetic signature with an outer magnetic high and an inner low. The pattern corresponds to a higher mafic content in the outer part of the intrusion.

The 1:50 000-scale aeromagnetic compilation in the eastern part of the map area (NTS 23J/07 and 10) shows several detailed patterns that are not evident in the regional-scale map. In the Cross Lake area and in the southeast corner of NTS map area 23J/07, two regional aeromagnetic highs, which straddle the regional and detailed compilations, are shown to consist of several, northwest-striking high and low signatures on the detailed scale compilation, compared to the 'undifferentiated' regional magnetic highs. These detailed aeromagnetic patterns reflect the complex geology of some of the larger bodies, although these have not been differentiated on Figure 3.

A small circular aeromagnetic high, located southwest of Howell Lake is coincident with a graphitic-rich, pyrrhotite–bornite-bearing gossan zone within metasedimentary gneiss. The association indicates that some detailed aeromagnetic signatures may be possible vectors for locating new gossans and expanding the extent of known mineralized zones.

The late, north-, northeast- and southeast-striking gabbro dykes in the eastern map area are coincident with moderate to strong, linear aeromagnetic signatures. The pattern and relative strength of these signatures and slightly different composition and texture of the rare dyke exposures suggest more than one pulse of gabbro dyke intrusion may be present. Crosscutting relationships between the dykes have not been documented in the field; however, southeast of Cross Lake, a strong northeast-striking aeromagnetic lineament appears to predate a strong north-striking signature. *In situ* gabbro outcrop is documented within both of these lineaments and based on the aeromagnetic patterns in Figure 4, suggest a relative age difference between these two gabbro dykes. To the west of these two dykes, a north-northwest-striking dyke is coincident with a moderate to weak aeromagnetic signature. The pattern associated with this dyke may indicate either a separate, smaller phase of dyke intrusion or possibly one with a lower mafic content, than the other dykes that are coincident with strong aeromagnetic signatures.

An obvious aeromagnetic correlation, evident from Figure 4, is the strong magnetic gradient associated with the Archean–Proterozoic unconformity where the magnetic high signatures are related to iron formation of the Labrador Trough.

MINERALIZATION

GOLD AND BASE-METAL POTENTIAL OF THE ASHUANIPI COMPLEX

The discovery of gold and base-metal mineralization hosted in Algoma-type Archean iron formation, gneisses and quartz veins of the northeastern Ashuanipi Complex, northwest of Schefferville, Québec (LaPointe, 1986), has led to numerous mineral potential studies in the region (Thomas and Butler, 1987; Dimmell, 1989; Graves, 1992; Chevè and Brouillette, 1992; Lapointe and Chown, 1993; Simpson, 2010; Ivanov, 2012). The recognition of such mineralization significantly elevated the regional gold and base-metal potential of the Ashuanipi Complex.

In light of this previous work and the overall lack of detailed exploration surveys, particularly in the western map area, the potential for mineralized host rocks in the region remains favourable.

PLATINUM-GROUP-ELEMENT POTENTIAL

The platinum-group-element (PGE) potential may lie with the larger pyroxenite intrusions in the map area. The PGE assay values have not been reported from the map area. Graves (1992) reported slightly elevated values of 13 ppb Pd and 17 ppb Pt from an ultramafic sill immediately north of the map area, and Leonard (1997) reported assays of 6 ppb Pd and 7 ppb Pt from an mafic–ultramafic sill to the south of the map area (MODS Occurrence 23J/02/Au001). Percival and Girard (1988) reported a 70 ppb Pt assay from a sample collected from the base of an 80-m-thick ultramafic sill in adjacent Québec associated with disseminated pyrrhotite and arsenopyrite (*see* van Nostrand and Bradford, 2014). Considering the elevated values noted above and that most analyses of ultramafic and mafic rocks within the region did not include assays for PGE content, more comprehensive analyses, including PGE assays of these rocks is required to determine their PGE potential.

MODS MINERAL OCCURRENCES

Several mineral occurrences in the Newfoundland and Labrador Geological Survey's database, the Mineral Occurrence Database System (MODS), were examined in the map area (Figure 3). Most of these consist of metre-, to 10s of metre-scale, limonitic-altered gossan zones hosted in the gneissic rocks but also within ultramafic rocks, diatexite and pegmatite. Mineralization includes pyrrhotite ± bornite ± arsenopyrite ± chalcopyrite as disseminations, fine-grained coatings on fracture surfaces, thin stringers and irregular layers and lenses. Pyrite is usually present, and graphite, ranging from 1 to 15%, is found in some gossan zones.

A gold showing is located in the south-central part of the map area (Figure 3, MODS occurrence 23J/06/Au001). The locality was discovered by Thomas and Butler (1987) as part of their regional sampling survey. The occurrence includes a northern and southern part and is located in the hinge zone of a kilometre-scale, north-northwest-plunging synclinal structure and occurs within a moderate strength, northwest-striking regional magnetic high (Figures 3 and 4).

The showing consists of several, metre- to 10s of metre-scale, strongly limonite-altered zones within well-banded, orthopyroxene + garnet metasedimentary gneiss. The mineralization includes local 5–15% disseminated pyrrhotite, thin stringers of pyrite and trace arsenopyrite and chalcopyrite (Plate 25). These gossan zones are concordant to the migmatitic banding and are associated with local shear zones and fractures. Thomas and Butler (1987, Locality 71) reported assay values up to 356 ppb Au, 8280 ppm As and 373 ppm Ni from four samples collected from a strongly altered zone of this occurrence. Dimmell (1989) reported assay values ranging up to 1.8 g/t Au, greater than 10 000 ppm As and up to 1865 ppm Co from ten samples from this occurrence.

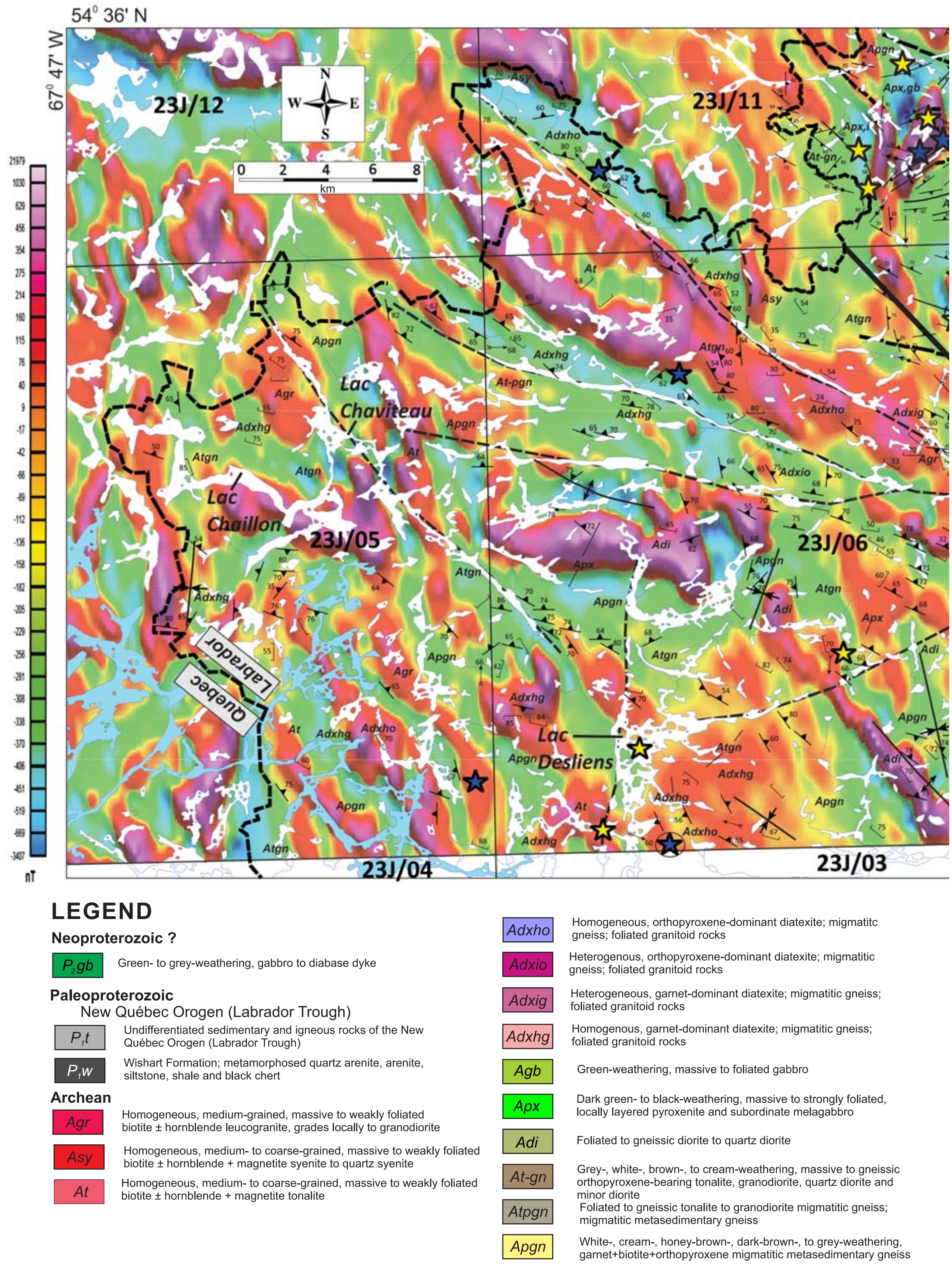

Figure 4. *Regional and detailed aeromagnetic compilation covering the map area and surrounding region (same scale as Figure 3). A 1:50 000-scale aeromagnetic survey covers NTS 23J/07 and 23J/10 (Dumont* et al.*, 2010a, b) and a regional compilation covers NTS 23J/05, 06, and 11 (Geological Survey of Canada, 1984; Kilfoil, 2013). Structural features, Unit designators and mineral occurrences are also shown.*

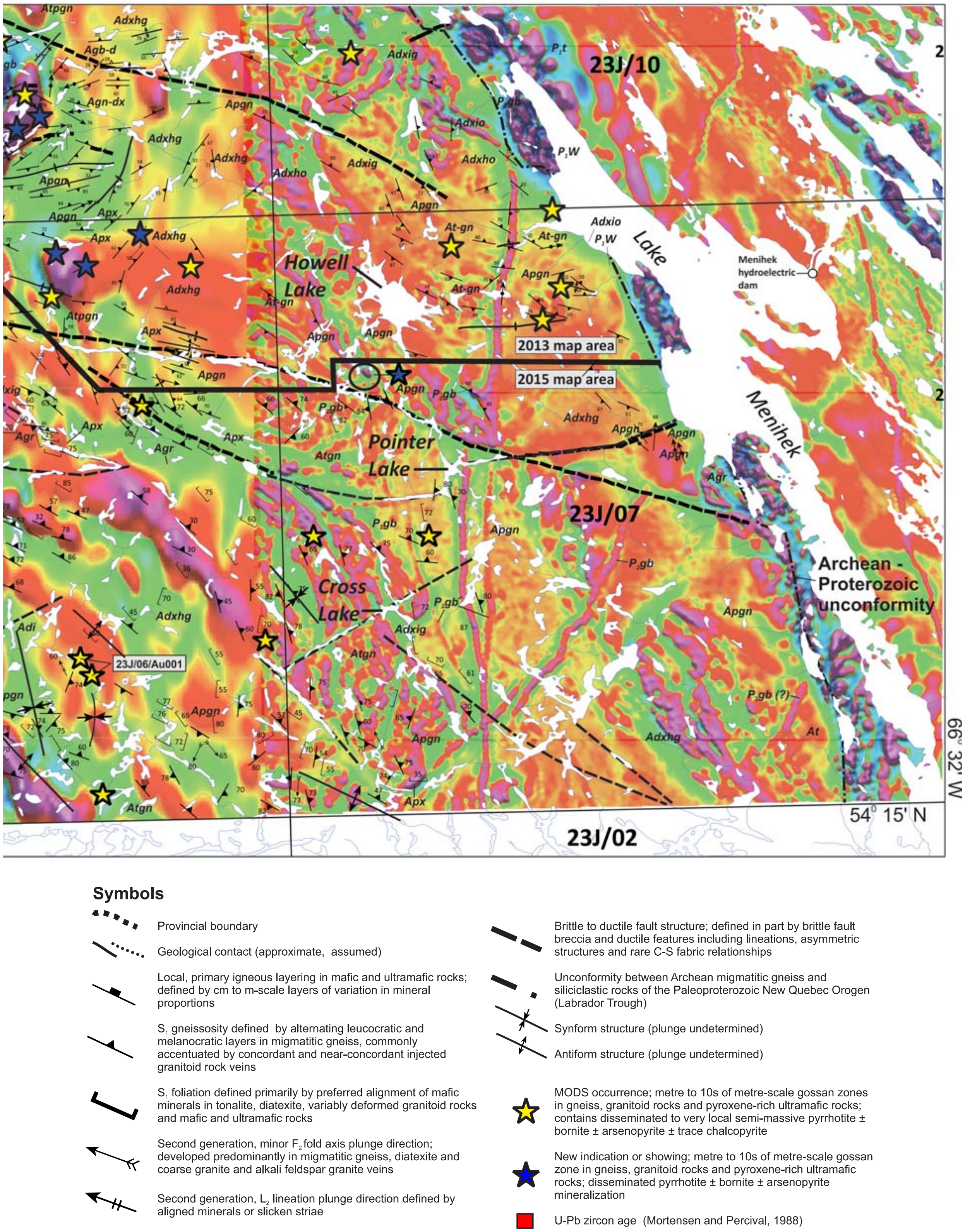

Figure 4. *Regional and detailed aeromagnetic compilation covering the map area and surrounding region (same scale as Figure 3). A 1:50 000-scale aeromagnetic survey covers NTS 23J/07 and 23J/10 (Dumont* et al.*, 2010a, b) and a regional compilation covers NTS 23J/05, 06, and 11 (Geological Survey of Canada, 1984; Kilfoil, 2013). Structural features, Unit designators and mineral occurrences are also shown.*

Plate 25. *MODS occurrence 23J/06/Au001. The occurrence consists of strongly limonitic-altered gossan zones in metasedimentary gneiss. The mineralization consists of disseminated to 20% pyrrhotite and trace arsenopyrite and chalcopyrite. Scale card is 8 cm in length.*

Plate 26. *Gossan zone in strongly deformed dioritic gneiss, southeast of Lac Desliens. Mineralization consists of disseminated to very local semi-massive pyrrhotite with trace arsenopyrite and chalcopyrite. Scale card is 8 cm in length.*

NEW MINERAL OCCURRENCES

Newly discovered mineral occurrences within the map area, include numerous, metre- to 10s of m-scale, limonitic-altered gossan zones hosting disseminated pyrrhotite ± bornite ± arsenopyrite ± trace chalcopyrite. These zones occur predominantly in metasedimentary gneiss but also within tonalite to diorite gneiss, diatexite and locally in ultramafic rocks. Two noteworthy occurrences include one immediately east of Lac Desliens, on the southern boundary of the map area, and one to the southwest of Howell Lake. The Lac Desliens occurrence consists of several, closely spaced gossan zones in strongly sheared, mafic-rich tonalite to diorite gneiss intercalated with thin metasedimentary gneiss layers that are extensively intruded by granite veins and pegmatite. The gossan zones contain disseminated to very local lenses of semi-massive pyrrhotite and bornite with trace arsenopyrite (Plate 26). The second significant occurrence, near Howell Lake in the northeastern part of the map area is coincident with a small, circular aeromagnetic high signature indicated by the circled area in Figures 3 and 4. The occurrence consists of a strongly altered gossan within metasedimentary gneiss containing disseminated pyrrhotite and bornite with up to 15% graphite (Plate 27).

INDICATIONS OF RADIOACTIVITY

Most outcrops visited during the 2015 survey were examined with a portable Radiation Solutions hand-held scintillometer (either a RS-120 or RS-230 BGO model). Readings were collected as total counts per second (tcps) radiation.

Plate 27. *Graphite-rich gossan zone hosted in well-banded metasedimentary gneiss. The mineralization consists of disseminated (5–15%) pyrrhotite and bornite with trace arsenopyrite. This occurrence is coincident with a small, circular aeromagnetic high to the southwest of Howell Lake (Figure 4).*

Most of the rock units show little or no evidence of elevated radioactivity. Average background readings span a spectrum from 70 tcps in ultramafic rocks up to 300 tcps in some coarse-grained diatexites. Anomalous readings were obtained from some syn- to late-tectonic coarse-grained to pegmatitic granite, alkali-feldspar granite, and alkali-feldspar-quartz syenite veins. Radioactive signatures recorded at several outcrops of these rocks range from 200 tcps up to a maximum of 1600 tcps.

DISCUSSION

The 2015 map area consists predominantly of migmatitic rocks derived from sedimentary and igneous protoliths, subordinate intrusions of ultramafic composition and massive to weakly foliated tonalite, granite and syenite plutons.

Percival (1991a) discussed in some detail the relationships of paragneiss, pretectonic granitoid rocks of the Desliens igneous suite and diatexite units of the northeastern Ashuanipi Complex. He reported that the paragneiss (3.4–2.7 Ga detrital zircon ages) and the pretectonic granitoid rocks (2.7–2.68 Ga zircon crystallization ages) occur as enclaves within, and are cut by, sheets and plutons of 'igneous-textured' orthopyroxene ± garnet diatexite with a range of 2.682–2.662 Ga zircon ages. He showed that the geochemical signatures of garnet-dominant diatexites and paragneiss are virtually identical indicating these diatexites formed through complete partial melting of the paragneiss and that the orthopyroxene diatexites were likely formed through a similar anatectic process, with lower degrees of partial melting. Based on field relationships and the above noted geochronology data, Percival (1991a) proposed that most diatexites postdate the development of the regional S_1 migmatitic fabric and were formed pre- to syn-D_2 deformation. He argued that the most plausible process to explain the observed structural, textural and metamorphic features in these rocks involved igneous emplacement of the diatexite units that were derived from partial melting of paragneiss at deeper levels. He further proposed that the lack of metatexite–diatexite transitions in the region would suggest that anatexis occurred at a lower crustal level than the present erosion surface, and did not entail *in situ* melting of surrounding country rock. In general, the field relationships observed in the current study support the hypothesis of Percival (1991a). However, van Nostrand and Bradford (2014) observed local metatexite–diatexite transitions in the 2013 map area, and Guernina (2007) discussed the evolution of metatexite–diatexite transitions in the Ashuanipi Complex of northern Québec. The observations noted by these authors would suggest that localized outcrop-scale, *in situ*, differential partial melting in a closed system has occurred in these rocks. Guernina (2007) concluded that metatexite–diatexite transitions are a consequence of locally higher fractions of melt and suggested that transitions can arise through factors such as; i) injection of melt magma to increase melt content, ii) a simple increase in the fraction of melt as temperature increases and iii) by the local redistribution of anatectic melt. He proposed that in the Ashuanipi Complex, the loss of continuity of pre-anatectic structures appears to be a result of the injection of anatectic melt through dyking and veining of the metatexite in and around structural sites where melt has collected. The presence of local crosscutting contacts between anatectic melt veins and dykes and the host metatexite migmatite indicates that these transitions are abrupt and can occur over a few metres distance. The contrasting interpretations of *non-in situ* versus *in situ* partial melting for metatexite–diatexite evolution may indicate that variable anatectic processes were involved in formation of the diatexite units.

Similarly, the relationship between the compositional diatexite types suggests a complex metamorphic history. Most diatexites within the map area appear to have a post-D_1 and pre- to syn-D_2 timing of formation. However, local field relationships, suggest that some diatexites are late- to slightly post-D_2 deformation. Percival (1991a) reported U–Pb zircon crystallization ages of 2662 ± 3 Ma for a garnet-bearing diatexite and 2668 ± 3 and 2682 ± 3 Ma for two orthopyroxene-bearing diatexites from the Lac Clairambault region approximately 100 km to the west of the study area. The geochronological data suggest an approximately 20 Ma age range for formation of the diatexites and indicates, at least locally, that the orthopyroxene-dominant diatexite is on the order of 10 Ma older than the garnet-dominant diatexite. The formation of the diatexites was followed by the intrusion of pre- to posttectonic granite and pegmatite and, late- to posttectonic tonalite, syenite and granite plutons. Late, gabbro dykes of presumed Proterozoic age postdate the Archean–Proterozoic unconformity.

The mineral potential of the region, although regionally assessed previously through several geochemical and exploration surveys, remains largely untested.

The gossan zones in the map area, a few with elevated gold values (*e.g.*, MODS occurrence 23J/06/Au001), and the numerous zones described by van Nostrand and Bradford (2014) farther to the north that have assayed above background gold content, implies an auriferous environment (Thomas and Butler, 1987; McConnell *et al.*, 1987; Dimmell, 1989). Further investigation of these zones in the map area is warranted. Most of the mineralized zones examined by the authors within the map area do not coincide specifically with regional aeromagnetic signatures, however, the graphitic-rich gossan zone southwest of Howell Lake (Figure 3) is coincident with a small circular magnetic high on the 1:50 000-scale aeromagnetic compilation (Figure 4) and suggests additional mineralized zones may be delineated through detailed geophysical surveys. This approach would be best applied within the strong, northwest-striking magnetic signatures underlying areas of metasedimentary gneiss in the central and extreme southwestern parts of the map area (Figures 3 and 4). Similarly, the large magnetic highs in the western and central map areas, which are coincident with mafic-rich, pretectonic and later intrusions, would also be potential prospective areas for discovery of new indications of sulphide mineralization.

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