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Regional characterization of ultramafic to mafic intrusions in the La Grande Rivière and Eastmain domains, Superior Province, Quebec

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Regional characterization of ultramafic to mafic intrusions in the La Grande Rivière and Eastmain domains, Superior Province, Quebec

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ABSTRACT

The Eeyou Istchee Baie-James region is dominantly underlain by Archean rocks belonging to the Superior Province, which is mainly composed of juxtaposed sequences of predominantly sedimentary, volcano-plutonic and plutonic rocks. The distribution of mafic to ultramafic intrusions and ultramafic volcanism reveals a general abundance at the regional scale, with the greatest volume in the La Grande Rivière and Eastmain domains of the La Grande Subprovince in the central-eastern part of the Superior Province flanked by the Opinaca Subprovince to the south, the Ashuanipi Subprovince to the east, and the Minto Subprovince to the north.

Preliminary geochronological results in the Eeyou Istchee Baie-James region indicate that the ultramafic-mafic magmatism extended over a period of more than 200 Ma, from ca. 2.88 Ga to 2.63 Ga. Various types of ultramafic to mafic magmatism have been documented in the La Grande Rivière and Eastmain domains and their vicinity: 1) ultramafic lavas and ultramafic intrusions of komatiitic affinity; 2) dominantly ultramafic intrusions; 3) dominantly mafic intrusions; 4) ultramafic to mafic intrusions of alkaline affinity; and 5) lesser volumes of ultramafic lamprophyres. Several of these ultramafic to mafic intrusion types also contain Cr-(PGE), Ni-Cu-(PGE), and Fe-Ti-(V) mineralization. The most important examples of these types of mineralization include the Menarik Complex (Cr-(PGE)), the Lac des Montagnes intrusions (Cr-(PGE)), the Lac Gayot intrusions (Ni-Cu-(PGE)), the Nisk intrusion (Ni-Cu-(PGE)), and the baie Chapus Pyroxenite (Fe-Ti-(V)).

As part of the Targeted Geoscience Initiative – Phase 4 (TGI-4), the Geological Survey of Canada and the Ministère de l'Énergie et des Ressources naturelles (MERN) have undertaken reconnaissance work to better characterize these types of intrusions in terms of their distribution, geochemical and mineralogical characteristics, and prospectivity for the above-mentioned mineralization types. Studies are ongoing for intrusions in the Lac Yasinski, Lac Pelletan, Lac Gayot, Lac des Montagnes, and Lac Fed areas, in addition to a more regional study underway in the area south of the La Grande 4 Reservoir (Lac Richardie). New geochronological work is also in progress, which will allow us to better understand the temporal distribution of the ultramafic to mafic magmatism in this portion of the Superior Province. A better understanding of these ultramafic and mafic intrusions will also reveal whether they demonstrate similar characteristics to ultramafic to mafic intrusions recently discovered in the McFaulds Lake area of Ontario (a.k.a. "Ring of Fire"), which contains major Cr-(PGE) and Ni-Cu-(PGE) deposits.

INTRODUCTION

Mafic and ultramafic intrusions and ultramafic volcanic rocks are widely distributed throughout the Superior Province, many of which host significant Cr-platinum-group element (PGE), Ni-Cu-(PGE) and Fe-Ti-(V) orthomagmatic mineralization (see Fig. 1 in Houlé et al., 2015). Recent discoveries of world-class chromite deposits (e.g. Black Thor, Big Daddy), Ni-Cu-(PGE) deposits (e.g. Eagle's Nest), and Fe-Ti-(V) occurrences (e.g. Thunderbird) in the McFaulds Lake greenstone belt (MLGB) in northern Ontario (see Metsaranta et al., 2015) highlight the mineral potential of this region, in addition to possible correlative areas eastward across the Superior Province, such as the La Grande Rivière and Eastmain domains within the Eeyou Istchee Baie-James region in northern Quebec (Houlé et al., 2015).

As part of the High-Mg Ultramafic to Mafic Ore Systems subproject under the Targeted Geoscience Initiative 4 (TGI-4), the Geological Survey of Canada

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and the Ministère de l'Énergie et des Ressources naturelles (MERN) undertook a reconnaissance study to better characterize some of the numerous ultramafic to mafic intrusions within the La Grande Rivière and the Eastmain domains within the La Grande Subprovince in the Eeyou Istchee Baie-James region (Fig. 1). The main goal of this contribution are to present the spatial and temporal distribution of these ultramafic to mafic intrusions including the main geological findings from local-scale studies conducted across these domains over the past couple of years in the Lac Yasinski, Lac Pelletan, Lac Richardie, and Lac Gayot areas within the La Grande Rivière domain and the Lac des Montagnes and Lac Fed areas within the Eastmain domain (Fig. 1). Some economic implications at the regional scale will be also briefly discussed.

GEOLOGICAL SETTING

The Eeyou Istchee Baie-James region is dominantly underlain by Archean rocks of the Superior Province, which are mainly composed of juxtaposed sequences of predominantly sedimentary, volcano-plutonic and plutonic rocks. The distribution of ultramafic to mafic intrusions and ultramafic volcanism reveals a general abundance at the regional scale, with the greatest volume in the La Grande Rivière and Eastmain domains (La Grande Subprovince) in the central-east part of the Superior Province, flanked by the Opinaca Subprovince to the south, the Ashuanipi Subprovince to the east, and the Minto Subprovince to the north (Fig. 2).

RESULTS

Spatial and Temporal Distribution of Ultramafic and Mafic Intrusions

Various types of ultramafic to mafic magmatism have been documented in the La Grande Rivière and Eastmain domains and vicinity including (1) ultramafic lavas and ultramafic intrusions of komatiitic affinity, (2) ultramafic-dominated intrusions, (3) mafic-dominated intrusions, (4) ultramafic to mafic intrusions of alkaline affinity, and (5) ultramafic lamprophyres. To date, the komatiitic rocks have been recognized essentially within the La Grande Rivière domain but also occur sporadically within the Eastmain domain. The main occurrences of komatiitic rocks are recognized in the Guyer Group within the Lac Guyer-Keyano greenstone belt, in the Dalmas Formation within the Escale-Trieste greenstone belt, and in the Gayot Complex within the Vénus-Moyer greenstone belt but some have been also reported in the Laforge-Aquilon and Coulon greenstone belts (Figs. 1, 2). The presence of komatiitic rocks in the Eastmain domain is more restricted; they occur mostly in the Komo and Natal formations within the Basse Eastmain greenstone belt and at the base of the Haute Eastmain greenstone belts in the Lac Lépante area (Figs. 1, 2). The ultramafic-dominated and mafic-dominated intrusions are widespread across these domains and commonly coexist. However, they appear to be locally grouped and form ultramafic-dominated areas and mafic-dominated areas, which broadly alternate from north to south and trend east-west in the Eeyou Istchee Baie-James area (Fig. 2). The ultramafic to mafic alkaline intrusions are much more restricted and occur predominantly in the Lac Pelletan and Lac Richardie areas of the La Grande Rivière domain and in its vicinity within the Opinaca Subprovince near the boundary of between these two lithotectonic entities. Ultramafic lamprophyre is relatively widespread throughout the area but extremely marginal in abundance.

Preliminary geochronological results indicate that the ultramafic-mafic magmatism in the La Grande Rivière and Eastmain domains may have extended over a period of more than 200 Ma, from ca. 2.88 to 2.63 Ga. The upper age constraint is provided by a felsic volcanic rock in the Lac Gayot area within the Vénus-Moyer greenstone belt that yielded an U-Pb age of ca. 2880 Ma (David et al., 2009), which would constrained the komatiite lava flows in that greenstone belt the oldest recognized manifestation of the ultramafic magmatism in the La Grande Rivière domain. The lower age constraint is defined by a maximum age of ca. 2630 Ma (U-Pb), which was obtained in the course of this study from an alkaline gabbroic rock in the Lac Pelletan area within the Opinaca Subprovince at the margin of the La Grande Rivière domain (see below).

Local-Scale Studies – La Grande Rivière Domain

Lac Yasinski Area

Regional bedrock mapping has been conducted in the Lac Yasinski area by the ministère de l'Énergie et des Ressources naturelles (MERN) in the late 1990s, where a series of ultramafic to mafic intrusions (e.g. Menarik Complex, baie Chapus Pyroxenite) was recognized and further characterized by Cimon et al. (1997), Houlé (2000), Houlé et al. (2002), and Houlé and Goutier (unpub. data). However, during the course of this study, reassessment of the baie Chapus Pyroxenite has been undertaken by Sappin et al. (2015) and new geochronological work has been carried out on this intrusion and also on the Menarik Complex (MC) to better understand their temporal relationship.

The MC (~2 x 3 km; Fig. 1) is one of the largest layered ultramafic-mafic intrusions found in the La Grande Rivière domain. It consist of a lower Ultramafic Zone composed of peridotite, poikilitic

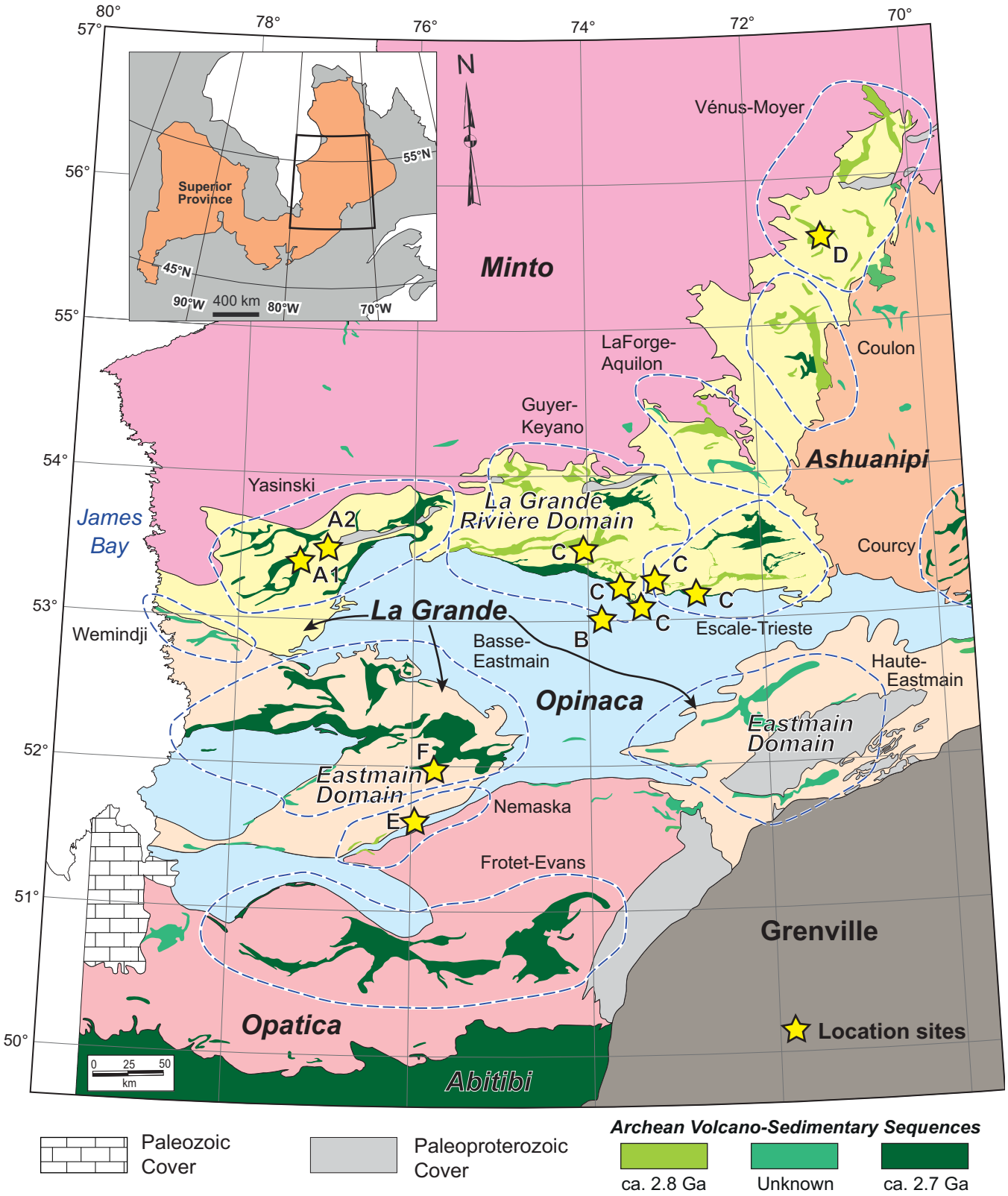

Figure 1. Simplified geological map of the eastern part of the Superior Province showing the distribution of the main Archean volcano-sedimentary sequences within the La Grande Rivière and Eastmain domains of the La Grande Subprovince (modified from Thériault and Beauséjour, 2012). Yellow stars indicate the location sites: A = Lac Yasinski (A1 = Menarik Complex, A2 = baie Chapus Pyroxenite); B = Lac Pelletan; C = Lac Richardie; D = Lac Gayot; E = Lac des Montagnes; and F = Lac Fed. Dashed blue outlines highlight the greenstone belts.

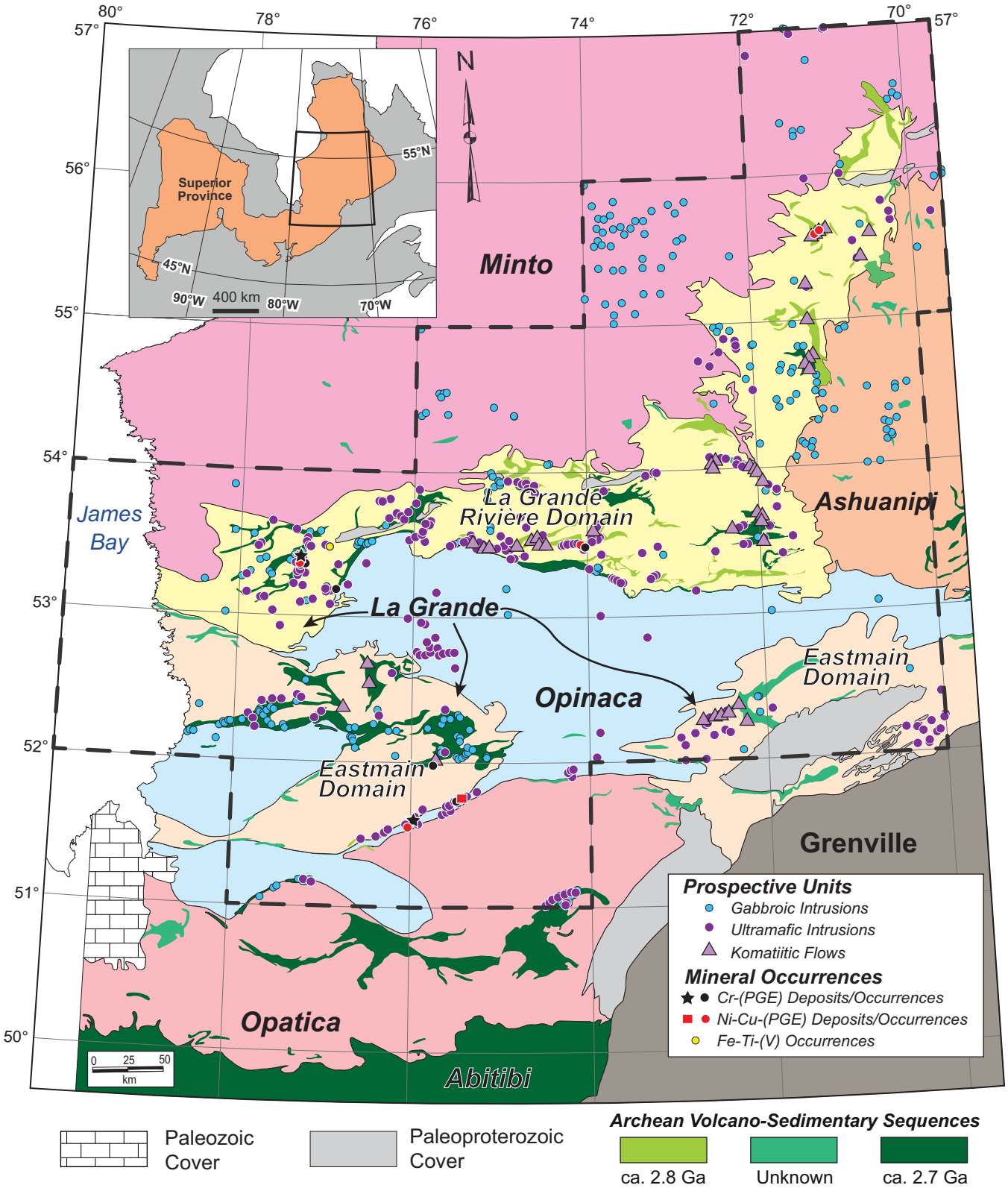

Figure 2. Simplified geological map of the eastern part of the Superior Province showing the distribution of the prospective units (ultramafic and mafic intrusions and komatiitic flows) and the main Cr-(PGE), Ni-Cu-(PGE), and Fe-Ti-(V) deposits and occurrences within the La Grande Rivière and Eastmain domains of the La Grande Subprovince (modified from Thériault and Beauséjour, 2012). Dashed black outline referred to the area where prospective units have been extracted from the SIGEOM.

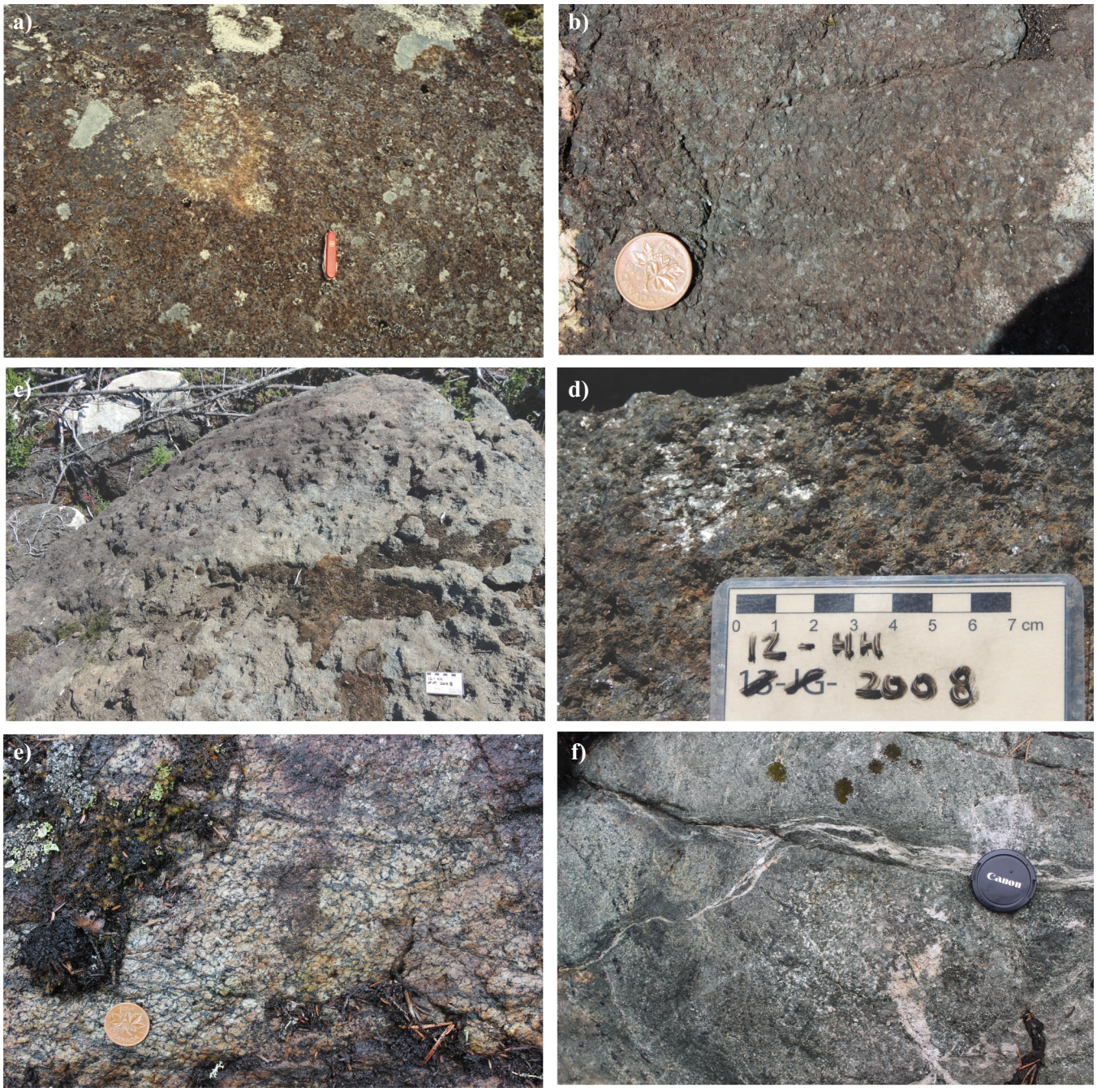

Figure 3. Typical lithologies associated with the ultramafic-dominated intrusion within the La Grande Rivière and Eastmain domains. **a)** Typical poikilitic peridotite from the Menarik Complex. **b)** Typical pyroxenite from the baie Chapus Pyroxenite. **c)** Phlogopite pyroxenite from an alkaline intrusion in the La Grande Rivière domain. **d)** Close-up of the phlogopite pyroxenite showing in (c) with a pyroxene porphyroblast of 4 cm in diameter. **e)** Chromite-bearing peridotite from the Lac des Montagnes intrusions. **f)** Varitextured gabbro from the Lac des Montagnes intrusions.

peridotite (Fig. 3a) with lesser pyroxenite and chromite-rich horizons and an overlying Mafic Zone composed of gabbroic rocks. The intrusive rocks mostly have high Cr_2O_3 contents and flat rare earth elements (REE) profiles but their mineral compositions are unknown as almost all primary mineralogy has been replaced except for chromite. The composition of the chromite cores plot in a limited range of Cr# (100*Cr/(Cr+Al)), from 69 to 58, but exhibit a much wider range of Mg# ($100*Mg^{2+}/(Mg^{2+}+Fe^{2+})$), from 61 to 2, that are interpreted to reflect the primary composition of the parental magma and the subsolidus reequilibration with the silicates, respectively (Fig. 4a). A pegmatitic gabbroic rock has been sampled and yields a crystallization age of ca. 2750 Ma.

The baie Chapus Pyroxenite (~1 x 3 km; Fig. 1) is a broadly layered intrusion, composed mainly of pyroxenite (Fig. 3b), plagioclase pyroxenite, and olivine

pyroxenite, in addition to mesocratic gabbro and lesser peridotite and dunite. Significant accumulations of magnetite were found near the summit of the intrusion. The intrusive rocks have locally high-FeO_t content and are enriched in light REE compared with heavy REE and contain preserved clinopyroxene with relatively primitive composition ($Mg\#_{92–73}$). Near the top of the intrusion, a pegmatitic phase composed of chlorite, hornblende, plagioclase with lesser ilmenite and apatite, yielded an age of ca. 2802 Ma, which is significantly older than the age obtained from the MC. However, this age is interpreted to represent an inherited zircon age based on the presence of numerous tonalitic enclaves and trace element signature that appeared to be the result of mixing between the uncontaminated pyroxenite of the intrusion and the adjacent tonalitic rocks or underlying Mesoarchean basement.

Lac Pelletan Area

Regional bedrock mapping conducted by the MERN in the Lac Pelletan area during the summer 2012 led to the discovery of an ultramafic intrusion (Fig. 1) characterized by an uncommon metamorphic mineralogical assemblage (e.g. anthophyllite, hornblende) and texture (Chartier-Montreuil, 2013) in the Eeyou Istchee Baie-James region.

This ultramafic-mafic intrusion (~90 x 240 m) has been metamorphosed to upper amphibolite facies but is relatively undeformed. It consists primarily of an olivine pyroxenite unit that contains typically large orthopyroxene porphyroblasts (from mm to 5 cm-scale, but locally up to 10 cm in diameter) and a minor gabbroic unit. The presence of phlogopite and generally high K_2O contents of these intrusive rocks suggest an alkalic affinity for this intrusion. These rocks are also enriched in light REE compared with heavy REE and the ultramafic unit contains relicts of olivine of intermediate composition ($Mg\#_{79–73}$). U-Pb geochronology on the gabbroic unit of this intrusion yielded an age of ≤2630 Ma.

Lac Richardie Area

Several ultramafic intrusions were inventoried during a mapping program conducted in the summer 2013 by the MERN in the Lac Richardie area (Fig. 1) within the La Grande Rivière domain and Opinaca subprovince and were further characterized by Grzela et al. (2014).

These ultramafic intrusions (<10 km length) were subdivided into two main types, based on field observations, petrographic work, and geochemical analysis. Type I intrusions are composed mainly of peridotite with minor layers of chromite. The intrusions are generally enriched in Cr_2O_3 and PGE and exhibit flat REE profiles. Type II intrusions are composed mainly of olivine pyroxenite and pyroxenite with localized peridotite and they exhibit light REE enrichment profiles. Several subtypes have been defined for the type II intrusions: (1) a subtype characterized by the presence of phlogopite and enrichment in K_2O suggesting an alkalic affinity (Fig. 3c,d), (2) a subtype characterized by the lack of phlogopite and a depletion in K_2O, and (3) a subtype characterized by an enrichment in FeO. The mineral composition and ages of these ultramafic intrusions have not been studied.

Lac Gayot Area

A komatiitic succession, including lava flows and intrusions, has been discovered within the Vénus-Moyer greenstone belt (Fig. 1) during bedrock regional mapping by the MERN and prospecting by Virginia Mines in 1998. This area has not been revisited by the authors but new petrographic work and geochemical analysis has been conducted during the course of this study (Huot et al., 2015).

The komatiitic succession is subdivided into a lower and upper komatiitic unit. The lower unit consists of peridotite, with local harrisite, pyroxenite, and gabbro, which are interpreted to be intrusive in origin based on the lack of volcanic features and local discordant relationships with the country rocks exhibiting metamorphism and metasomatism contacts. The upper unit is composed of very fine-grained ultramafic rocks that are likely extrusive, as suggested by poorly developed pillowed flows and volcanic breccias (Huot et al., 2015).

Local-Scale Studies – Eastmain Domain

Lac des Montagnes

The Lac des Montagnes ultramafic-dominated intrusion (LMI) is part of a series of east-northeast-trending ultramafic intrusions found in the Nemaska volcano-sedimentary belt (Fig. 1) and referred as the Lac des Montagnes intrusive suite (Fig. 2). A reconnaissance study was conducted by Bédard et al. (2014, 2015) to better characterize this intrusion.

This ultramafic-dominated intrusion (~185 x 1100 m) is mainly composed of peridotite (Fig. 3e), olivine pyroxenite and pyroxenite with lesser chromite-rich layers and is overlain by a mafic sequence composed of mesocratic to melanocratic gabbroic rocks (Fig. 3f). Geochemical analysis of this intrusion is in progress. The core compositions of the chromite have a wider range of Cr# than other intrusions, from 98 to 62, but some of these extreme values might be related to a loss of aluminum during the alteration. However, the range exhibit a of Mg#, which range from 49 to 9, are similar to the other intrusions in the area (Fig. 4b). The intrusion is interpreted to possess komatiitic affinities, based on the occurrence of randomly-oriented olivine

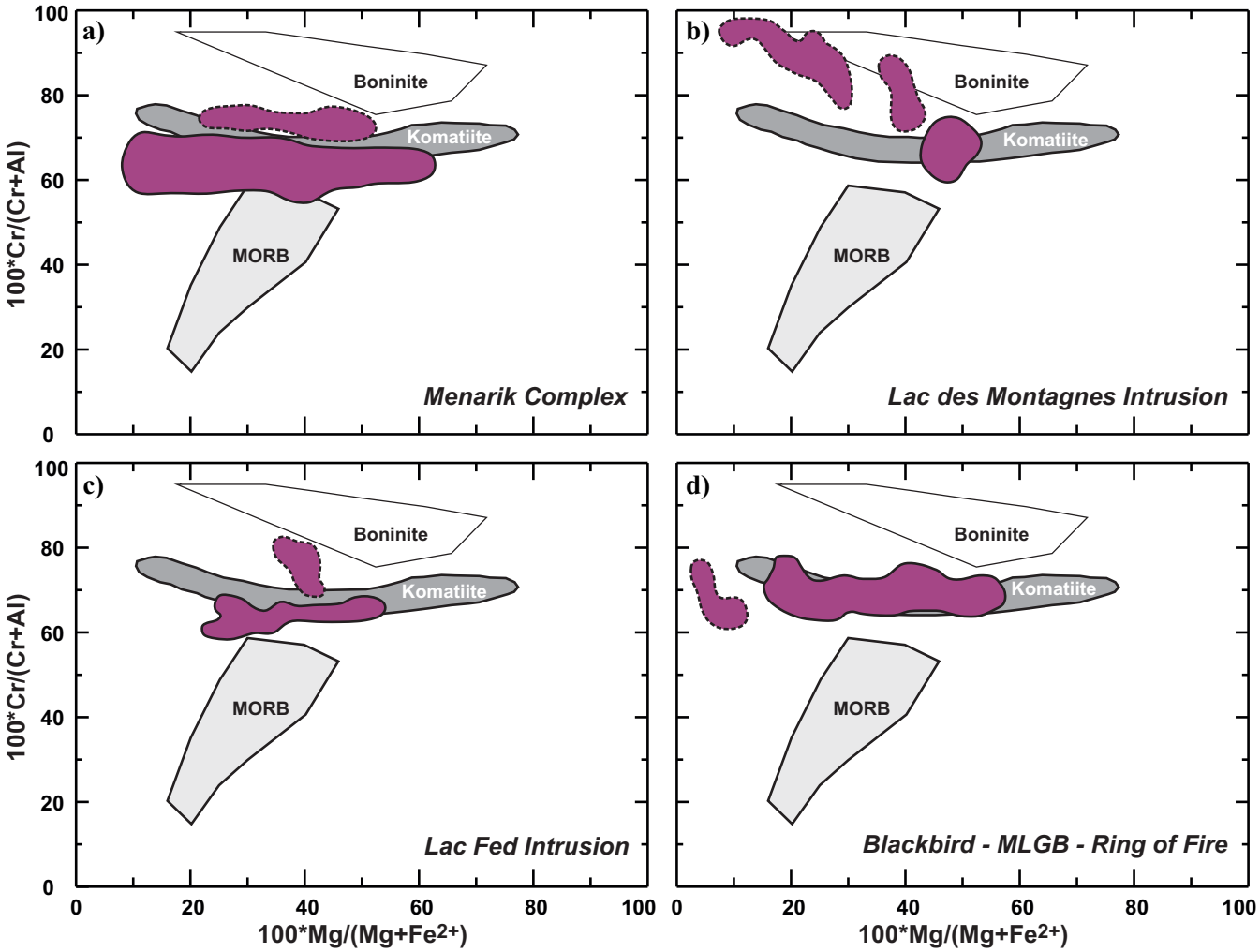

Figure 4. Typical compositions of chromite cores obtained by electron microprobe analysis (in purple) associated with some of the ultramafic-dominated intrusions in the La Grande Rivière and Eastmain domains. **a, b, c, d)** Cr# (100*Cr/(Cr+Al)) versus Mg# (100*Mg 2+/(Mg 2+ + Fe 2+)), for the Menarik Complex (a), the Lac des Montagnes intrusions (b), the Lac Fed intrusion (c), and the Blackbird deposit (d) in the McFaulds Lake greenstone belt (MLGB) (data from Azar, 2010). Fields for MORB and the boninites are from Bédard and Hébert (1996) and field for the komatiites is from Liipo et al. (1995). Dashed outlines on a, b, c, and d represent chromite core compositions that might have been modified by subsequent alteration.

spinifex texture near the base of the intrusion, chromite composition that is similar to typical chromite composition of komatiites, and the presence of olivine with high Mg number ($Mg\#_{91–89}$). A pegmatitic gabbroic rock was sampled for geochronological work and yielded an age of ca. 2802 Ma, which is interpreted as the crystallization age.

Lac Fed Area

The Lac Fed intrusion (Fig. 1) has been recognized by Labbé and Grant (1998) during a bedrock geological mapping conducted by the MERN. This site was not visited during the course of this study; however, a suite of samples for geochemical analysis was provided by Azimut Exploration Inc. and characterized by Fecteau (2013).

This ultramafic intrusion (~1 x 3 km) is composed mainly of peridotite and chromite-bearing peridotite that includes chromitite layers. Komatiite lava flows containing spinifex textures have also been recognized in the vicinity of the intrusion by Labbé and Grant (1998) and are interpreted to be located in its stratigraphic hanging wall. The intrusive rocks have high Cr_2O_3 contents. The core compositions of the chromite have a limited range of Cr#, from 80 to 64, but exhibit a much wider range of Mg#, from 53 to 35 (Fig. 4c). However, despite all composition reported are from the cores of the chromite grains, not all appear to represent a primary composition and may reflect some subsolidus re-equilibration with the silicates and post-magmatic alteration, as suggested for chromite from the LMI. The chromite composition, similar to the composition of chromite from komatiites, coupled with the presence of komatiite nearby suggests a komatiitic affinity for this ultramafic intrusion. The REE contents and age of the Lac Fed intrusion are unknown.

Mineralization Styles

The La Grande Rivière and Eastmain domains host a diversity of mineralization styles (e.g. lode gold, iron ore, Li-Ta bearing pegmatite), including several ultramafic to mafic intrusions that contain Cr-(PGE), Ni-Cu-(PGE) or Fe-Ti-(V) orthomagmatic mineralization (Fig. 2).

Cr-(PGE) Mineralization

Numerous Cr-(PGE) deposits and occurrences have been identified within the La Grande Rivière and Eastmain domains but the MC and LMI within the Yasinski and the Nemaska greenstone belts, respectively, are the most important (Fig. 2).

The MC contains more 30 silicate-chromitite and chromitite seams distributed throughout the Ultramafic Zone. These chromite-rich horizons were divided into 3 types: (1) chromitite and silicate chromitite (Fig. 5a) are present in massive layers ranging from 30 cm to 1 m thick (>50% chromite), (2) homogeneous chromite-rich peridotite layers range from 5 to 30 cm (<50% chromite), and (3) olivine-rich peridotite interlayered with chromitite seams or chromite-rich peridotites that reach 2 m thick (Houlé, 2000). Two styles of PGE mineralization are also present in the MC with early PGE mineralization associated with chromitite seams and later PGE mineralization associated with Fe-Ni-Cu sulphide veins (Houlé et al., 2002).

The LMI occur has three main chromite-rich zones that are hosted within the ultramafic sequence (Williams, 1965; Bédard et al., 2014). The lower and upper chromitite zones are several cm-thick layers with up to 30% net-textured chromite, alternating with serpentinized peridotite with a cumulative thickness averaging ~10s m. The 10 m thick middle chromitite zone is the most important and consists of several massive to semi-massive chromitite (75–85% chromite) layers ranging from about 10 cm to 3 m thick alternating with serpentinized peridotite with well-preserved cumulate textures (Fig. 5b).

Other significant occurrences of Cr-(PGE) mineralization occur in the Lac Long intrusion (Fig. 5c) and in the Lac Fed intrusion (Fig. 5d) within the Guyer-Keyano and the Basse Eastmain greenstone belts, respectively (Fig. 1).

Ni-Cu-(PGE) Mineralization

Numerous Ni-Cu-(PGE) occurrences are present within the La Grande Rivière and Eastmain domains, the most of which are located within the komatiitic sequences in the Vénus-Moyer greenstone belt and within the Nisk intrusion in the Nemaska greenstone belt (Figs. 1, 2).

Several of these were found in the Mesoarchean subvolcanic to volcanic komatiitic sequences in the Lac Gayot area (Huot et al., 2015). Ni-Cu-(PGE) mineralization occurs as disseminated, blebby (Fig. 5g), net-textured, and massive sulphides hosted within komatiitic units and locally within the country rocks. Despite the presence of intrusive and extrusive komatiitic rocks in this area, the mineralization has only been recognized in only the intrusive component, which is interpreted as a magmatic feeder and subconcordant sills (Huot et al., 2015).

Several Ni-Cu-(PGE) mineral occurrences have been recognized in the Nemaska area and the Nisk-1 deposit is the most significant one. It occurs within a composite peridotitic sill at the contact between the lower and upper peridotite zones and is interpreted to have a komatiitic affinity (Vallée, 2012). The sulphide mineralization exhibits several sulphide facies (e.g. Fig. 5e). The most common are massive (Fig. 5f), net-textured, and disseminated sulphides, typical of what it is observed in komatiite-associated Ni-Cu-(PGE) deposits.

Fe-Ti-(V) Mineralization

Fe-Ti-(V) mineralization is relatively uncommon in the La Grande Rivière and the Eastmain domains. The only known example is found within the baie Chapus Pyroxenite where the mineralization is several metres wide and composed of a massive to semi-massive magnetite (55–90 % magnetite) layer that and extends more than 70 m (Fig. 5h). This layer of titaniferous and vanadiferous magnetitite layer, grades up to 66% Fe_2O_{3t}, 9.2% TiO_2 and 0.7 % V_2O_5 and is composed of magnetite enriched in Ti (340–49 860 ppm) and V (1310–7440 ppm), and low in Cr (<300 ppm), Al (<140 ppm) and Ni (<620 ppm) (Fig. 6; Sappin et al., 2015).

DISCUSSION

The spatial and temporal distribution of the ultramafic to mafic intrusions is still poorly constrained across the Eeyou Istchee Baie-James region despite our new TGI-4 investigations at several localities within the La Grande Rivière and Eastmain domains.

The ultramafic-mafic magmatism that occurred broadly between ca. 2.88 Ga and 2.63 Ga (this study) generated various types of ultramafic to mafic intrusions/lavas including komatiitic ultramafic units, ultramafic-dominated intrusions, mafic-dominated intrusions, alkaline ultramafic to mafic intrusions, and ultramafic lamprophyre. These intrusions/lavas have different levels of prospectivity to host Cr-(PGE), Ni-Cu-(PGE), and Fe-Ti-(V) orthomagmatic mineralization. Preliminary results suggest that the most prospective units are associated with ultramafic bodies that are enriched in olivine and exhibit a komatiitic affinity.

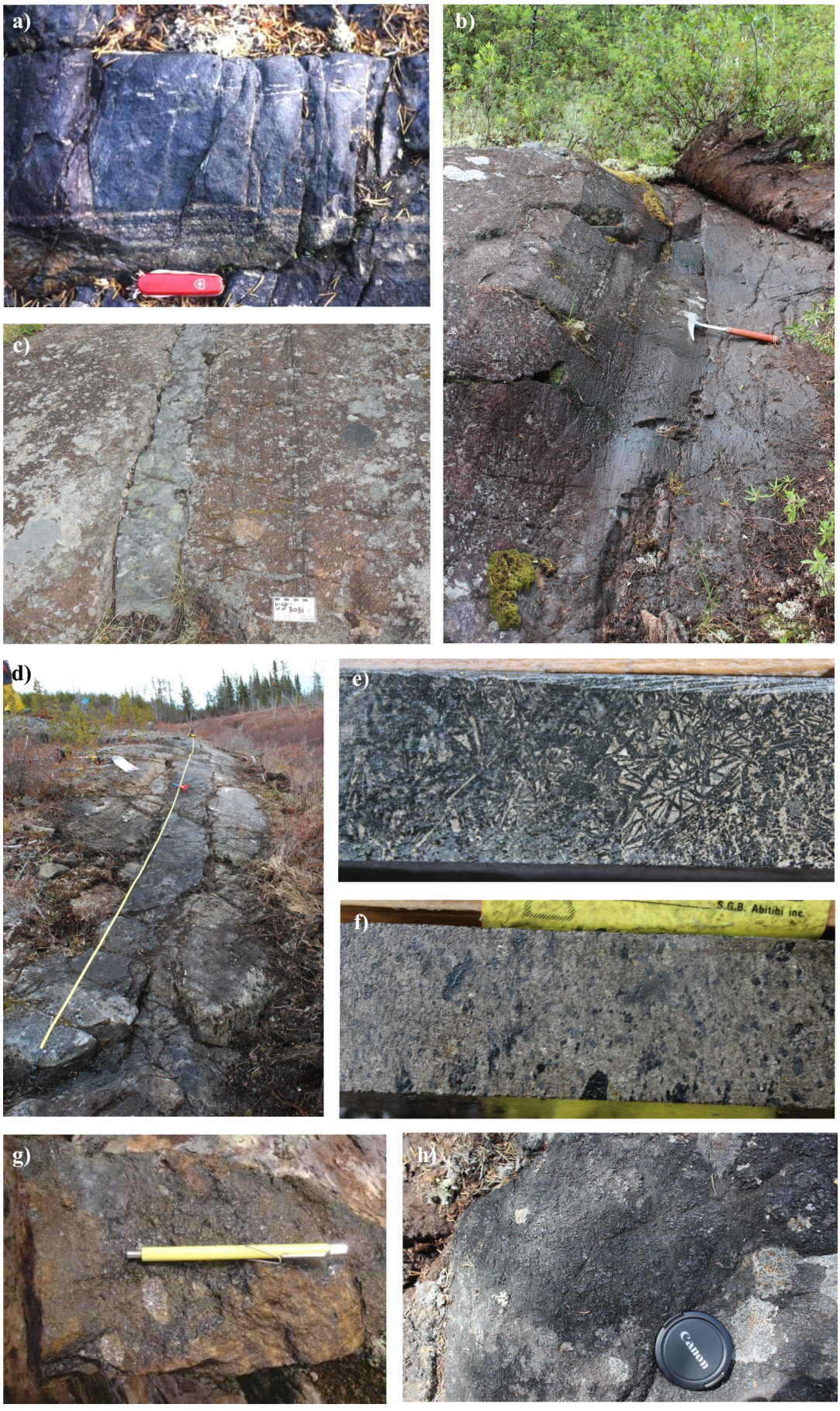

Figure 5. Typical examples of Cr-(PGE), Ni-Cu-(PGE), and Fe-Ti-(V) orthomagmatic mineralization observed in the La Grande Rivière and Eastmain domains. **a)** Chromitite and silicate chromitite seam from the Menarik Complex. Knife is 9 cm long. **b)** Massive and semi-massive chromitite seams from the Lac des Montagnes intrusions. Hammer is 30 cm. **c)** Thin massive chromite seam from the Lac Long intrusion. **d)** Massive chromite seam from the Lac Fed intrusion. Chisel is 24 cm long. **e)** Jack-straw-textured ore from the Nisk-1 deposit. Core is 4.5 cm in diameter. **f)** Massive to semi-massive sulphides from the Nisk-1 deposit. Core is 4.5 cm in diameter. **g)** Peridotite with disseminated sulphides containing cm-scale blebs of massive sulphides from the L occurrence in the Gayot area (courtesy of Mines Virginia). Magnetic pen is 12.5 cm long. **h)** Massive magnetitite from the Baie Chapus Pyroxenite. Lens cap is 4 cm.

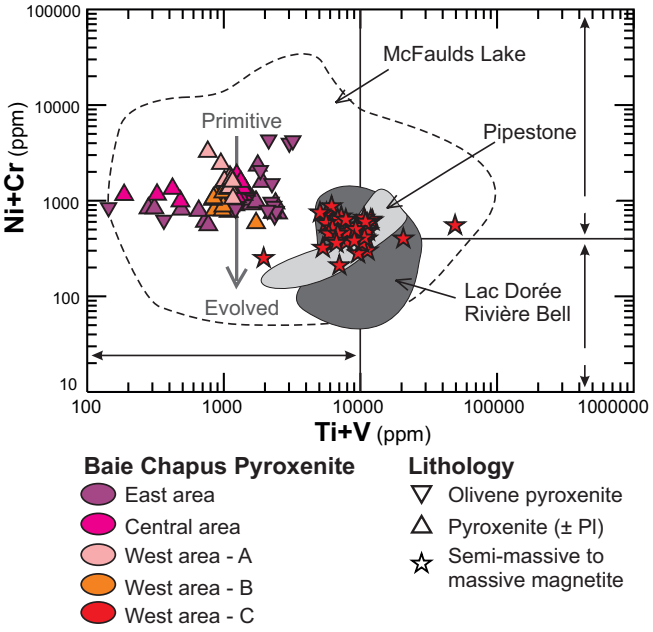

Figure 6. Ni+Cr versus Ti+V discriminant diagram from Méric (2011) for magnetite from Fe-Ti-V-P deposits and hydrothermal deposits. The data represent individual magnetite analyses from the baie Chapus Pyroxenite. The main geographic subdivisions of the baie Chapus Pyroxenite are shown on Fig. 2b in Sappin et al. (2015). The compositional field of magnetite are from TGI-4 study.

IMPLICATIONS FOR EXPLORATION

Numerous ultramafic to mafic intrusions and ultramafic volcanic rocks occur in the La Grande Rivière and Eastmain domains of the La Grande Subprovince, however, none are known to host world-class or very large Cr-(PGE), Ni-Cu-(PGE), and Fe-Ti-(V) concentrations of orthomagmatic mineralization. Although, preliminary observations suggest the Cr-(PGE), Ni-Cu-(PGE), and Fe-Ti-(V) mineralization is relatively modest, the composition of the analyzed chromite (MC, LMI, Lac Fed) (Fig. 4) and magnetite (baie Chapus) (Fig. 6) are similar to those from the McFaulds Lake area (Ring of Fire: Ontario). In light of these results, we suggest that the entire area, but more specifically the area where the ultramafic intrusions are the most abundant (Fig. 2), has potential for these styles of mineralization, which should be taken into account when planning exploration programs related to mafic and ultramafic intrusions in the Eeyou Istchee Baie-James region.

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