Note:

On November 7, 2024, GS2024-3 was updated with corrections to Figure GS2024-3-6 on page 16.

GS2024-3

Preliminary results from field investigations in the Cat Lake–Winnipeg River pegmatite field, southeastern Manitoba (parts of NTS 52L5, 6, 11, 12)

by C. Nambaje[1], T. Martins, C.R.M. McFarlane[1], M. Kaczmer[2,3], M.L. Rinne and L. Groat[4]

In Brief:

- The Cat Lake-Winnipeg River pegmatite field is highly prospective for elements considered critical
- Lithological and structural controls of rare-element mineralized pegmatites were noted regionally

Citation:

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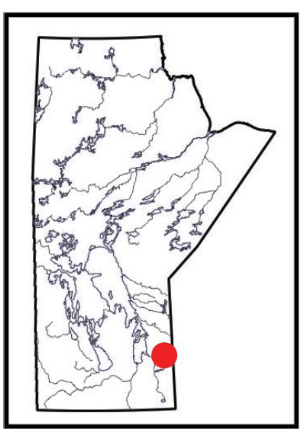

Summary

This report highlights preliminary results from detailed fieldwork that was conducted in the Cat Lake–Winnipeg River pegmatite field of southeastern Manitoba for the field season extending from May to July 2024. This work is a collaboration between the Manitoba Geological Survey (MGS), the University of New Brunswick (UNB), The University of British Columbia (UBC) and the exploration company New Age Metals. During fieldwork, numerous pegmatite groups and their hostrocks were examined and approximately 200 samples collected for further studies. Preliminary field investigations indicate that there are different generations of pegmatites. Some of them are simple and barren at their present surface (e.g., Eaglenest Lake pegmatite group, Axial pegmatite group and Birse Lake pegmatite group). Others are highly evolved and enriched in potential critical metals, including deposits of lithium, tantalum, tin, beryllium and cesium (e.g., Bernic Lake pegmatite group, Maskwa Lake pegmatite series, Eagle-Irgon pegmatite group, Lac du Bonnet pegmatite group, Shatford Lake pegmatite group, Greer Lake pegmatite group, Cat Lake pegmatite group and Rush Lake group). It has generally been noted that pegmatites emplaced in more mafic country rocks and/or intermediate country rocks are those that tend to be highly evolved and enriched in rare elements compared to those emplaced in more felsic country rocks, which are barren. The underlying cause of this observation will be addressed in future studies.

Introduction

Critical minerals have been identified as a priority for Canada. The Government of Canada updated a list of 34 minerals and metals considered critical for the sustainable economic success of the country and its allies, and to position Canada as the leading mining nation (Government of Canada, 2024). Several elements and minerals considered critical for economic success are found in rare-element pegmatites, including cesium, lithium, niobium, tantalum, tin and rare-earth elements (Linnen et al., 2012). Lithium is not only a critical element but also a key component in batteries for electric vehicles and consequently vital to Canada's commitment to climate action, environmental protection and economic growth.

The Cat Lake–Winnipeg River pegmatite field is well known for its multiple lithium-bearing pegmatites, particularly the world-class Tanco rare-metals pegmatite deposit. This pegmatite field is also known for its prospectivity for lithium and other critical elements (e.g., niobium, tantalum, cesium, tin, beryllium) hosted in granitic pegmatites (Černý et al., 1981). Most of the previous studies in this area focused on locally selected pegmatites (e.g., Camacho et al., 2012, 2014; Breasley et al., 2021, 2022, 2024; Martins et al., 2023; Roush et al., 2023; London, 2024), but the Cat Lake–Winnipeg River pegmatite field as a whole has not been studied on a regional scale or in detail since the late 1970s (Černý et al., 1981). Therefore, the present fieldwork focused on the regional geology of the entire Cat Lake–Winnipeg River pegmatite field.

Fieldwork for the 2024 season included detailed mineralogy and textural and structural observations, as well as sampling of different pegmatite types, hostrocks and pegmatite-related granite intrusions from the study area. Recent drillcores were also examined and sampled. Overall, the current project aims to infer the source of pegmatites, age, mode of emplacement, structural controls and how country-rock type influences the style of mineralization in rare-element pegmatites

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of the Cat Lake–Winnipeg River pegmatite field. This information will contribute to a better understanding of the geological context of the pegmatite field, which will lead to better exploration for critical minerals and metals in the region.

Geological setting

This project focuses on the Cat Lake–Winnipeg River pegmatite field, located within the Neoarchean Bird River greenstone belt (BRGB) of the western Superior Province in southeastern Manitoba (Figure GS2024-3-1). The BRGB is part of an east-trending supracrustal belt that extends 150 km from Lac du Bonnet in the west to Separation Lake (Ontario) in the east (Figure GS2024-3-1; Percival et al., 2006a, b; Gilbert et al., 2008). The BRGB is in fault contact with the English River basin to the north and the Winnipeg River terrane to the south (Figure GS2024-3-1). It is divided into northern and southern arms that are separated by the Maskwa Lake batholith, which contains intrusive phases ranging in age from 2.85 to 2.73 Ga (Gilbert et al., 2008).

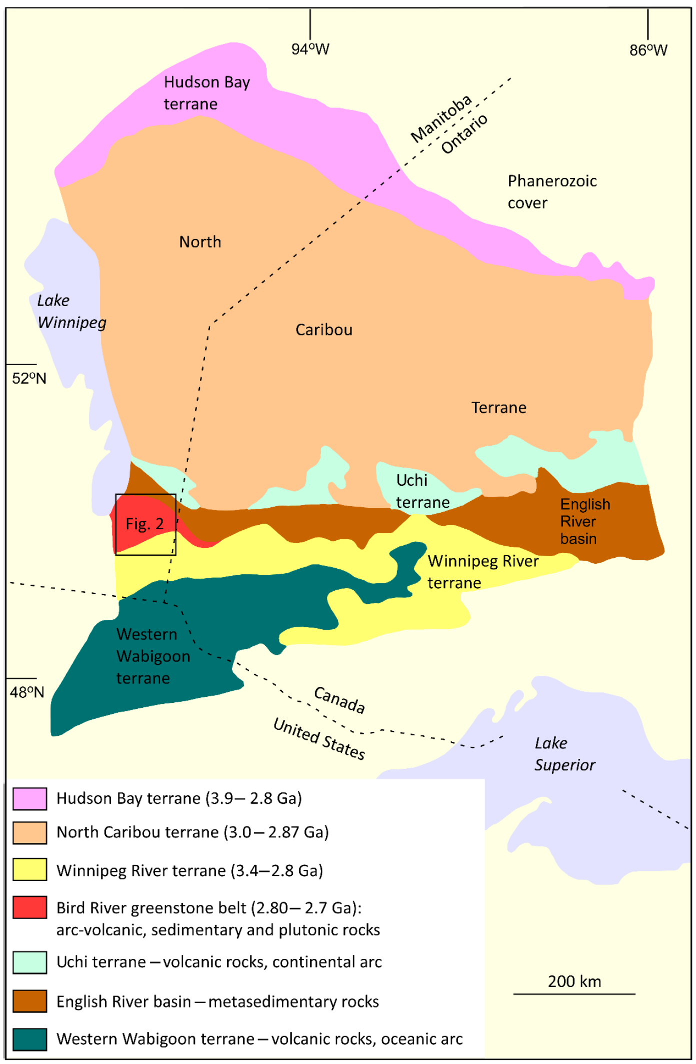

***Figure GS2024-3-1:** Simplified geology of the northwestern Superior province, showing the regional geological setting of the Bird River greenstone belt (map after Gilbert et al., 2008; Yang and Houlé, 2020). Black box shows the location of Figure GS2024-3-2.*

The southern part of the BRGB has been subdivided into two sequences (northern and southern panels) that are geochemically distinct (Gilbert et al., 2008). Both are composed of ca. 2.75–2.72 Ga juvenile arc-type metavolcanic and associated metasedimentary rocks. These two panels are separated by the Booster Lake formation (< ca. 2.71 Ga; Gilbert, 2006; Gilbert et al., 2008), a turbiditic sequence with clastic sedimentary rocks from the fluvial-alluvial deposits of the Flanders Lake formation to the east (Gilbert, 2006; Gilbert et al., 2008; Mealin, 2008; Duguet et al., 2009; Kremer, 2010; Figure GS2024-3-2).

The northern part of the BRGB includes the Cat Creek–Euclid Lake area, underlain by a suite of greenstone assemblages formed in a continental-margin setting adjacent to the Mesoarchean Maskwa Lake batholith (Yang 2012, 2013, 2014; Yang and Houlé, 2020). The greenstone assemblages consist mainly of mafic–felsic volcanic and related intrusive rocks; epiclastic and minor volcaniclastic rocks; and mafic–ultramafic layered intrusions. These were intruded by younger phases of tonalite-trondhjemite rocks from a granodiorite suite (i.e., Maskwa Lake batholith II of Yang and Houlé, 2020), late peraluminous granitoid rocks and pegmatites (e.g., Yang et al., 2019; Yang and Houlé, 2020).

In terms of mineral occurrences and resources, the BRGB is endowed with a unique combination of Li-Ta-Cs rare-metal–bearing pegmatites (e.g., Tanco pegmatite; Martins et al., 2023; Rinne, 2023), shear-hosted gold mineralization and Ni-Cu-PGE-Cr minerals associated with mafic–ultramafic intrusions that may have been formed during an extensive Neoarchean Bird River magmatic event proposed by Houlé et al. (2013, 2015).

Results and discussion

Fieldwork was conducted on different pegmatite groups of the Cat Lake–Winnipeg River pegmatite field and their hostrocks. This pegmatite field was subdivided into two pegmatite districts, the Cat Lake–Maskwa Lake district in the north and the Winnipeg River district in the south. The pegmatites were separated into groups of spatially, mineralogically and geochemically related bodies (Černý et al., 1981). The Cat Lake–Maskwa Lake district includes the Maskwa Lake series (MWL), Eagle-Irgon group (EAI), Beryl-Tourmaline group (BET), Cat Lake group (CAT) and Central Claim group (CC). The Winnipeg River district includes the Shatford Lake group (SHL), Lac du Bonnet group (LdB), Greer Lake group (GL), Eaglenest Lake group (ENL), Axial group (AX), Birse Lake group (BIS), Rush Lake group (RL) and Bernic Lake group (BL; Figure GS2024-3-2).

Maskwa Lake pegmatite series (MWL)

In the MWL, the visited pegmatite is locally known as the ‘Main dike’ (Figure GS2024-3-2, sites CNM-88 and -89)[5]. It is a

[5] All site locations refer to Figure GS2024-3-2.

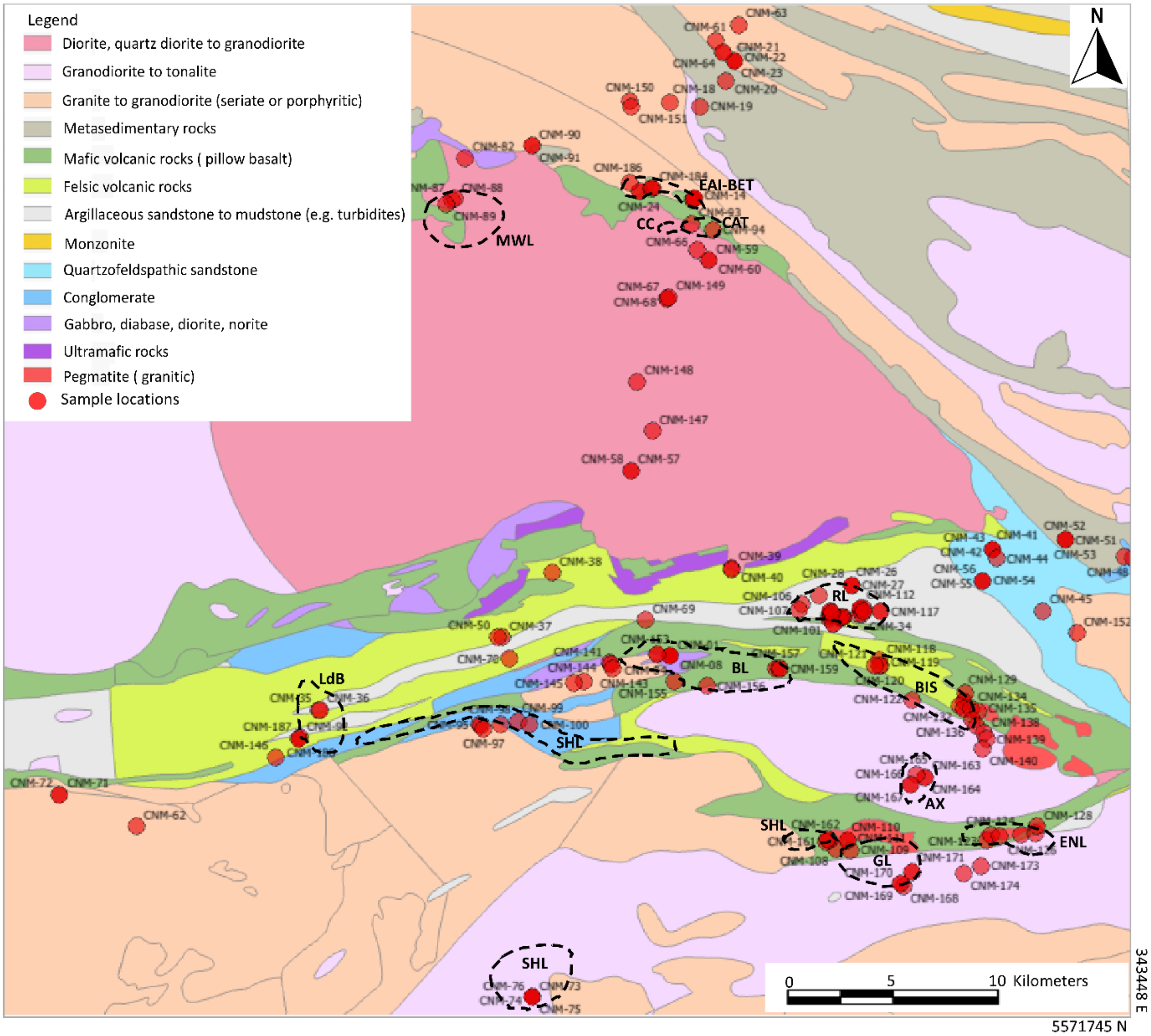

Figure GS2024-3-2: *Simplified geology of the Bird River Greenstone Belt (BRGB), modified from the 250 000 compilation map of the Manitoba Geological Survey (Černý et al., 1981, Gilbert et al., 2008; Yang, 2013), with locations investigated in this project from the Cat Lake–Winnipeg River pegmatite field and the English River basin. The dotted black outline indicates the different pegmatite groups (after Černý et al., 1981). Abbreviations: AX, Axial group; BET, Beryl-Tourmaline group; BIS, Birse Lake group; BL, Bernic Lake group; CAT, Cat Lake group; CC, Central Claim group; EAI, Eagle-Irgon group; ENL, Eaglenest Lake group; GL, Greer Lake group; LdB: Lac du Bonnet group; MWL, Maskwa Lake series; RL, Rush Lake group; SHL, Shatford Lake group.*

Li-rich spodumene-bearing pegmatite dike that is about 1.5 km long and 5 m wide, and more than 650 m deep (as per historical drilling). This pegmatite dike strikes N42°E and dips 74°NW, and is hosted by porphyritic anorthosite to metagabbro. The main foliation of the anorthosite gabbro is oriented N70°E, and the contacts of the pegmatite with the hostrock are sharp and marked by local patches of holmquistite in the metagabbro (Figure GS2024-3-3a). The observed mineralogy of this pegmatite includes plagioclase, quartz, muscovite, spodumene, K-feldspar, plagioclase and apatite. The spodumene is white, with a crystal size that can vary between 1 and 5 cm long (Figure GS2024-3-3b). This pegmatite dike is locally deformed and stretched in sinistral deflection. The main foliation strikes N46°E and the aplitic texture predominates the deformed portion.

Another pegmatite outcrop, locally named the 'Sand pegmatite', was observed northeast of the MWL (CNM-90). The Sand pegmatite is exposed for more than 15 m and is hosted in granodiorite with an irregular contact (Figure GS2024-3-3c). The mineralogy of this pegmatite includes biotite, plagioclase (±K-feldspar), quartz, garnet and accessory greenish beryl and black tourmaline (Figure GS2024-3-3d). No spodumene was observed in the outcrop and no drilling has been done on this pegmatite to check the subsurface mineralogical variations.

Eagle-Irgon pegmatite group (EAI)

In the Eagle-Irgon pegmatite group, the F.D. No. 5 pegmatite (CNM-17, 184 and 186), Eagle pegmatite (CNM-24) and Irgon

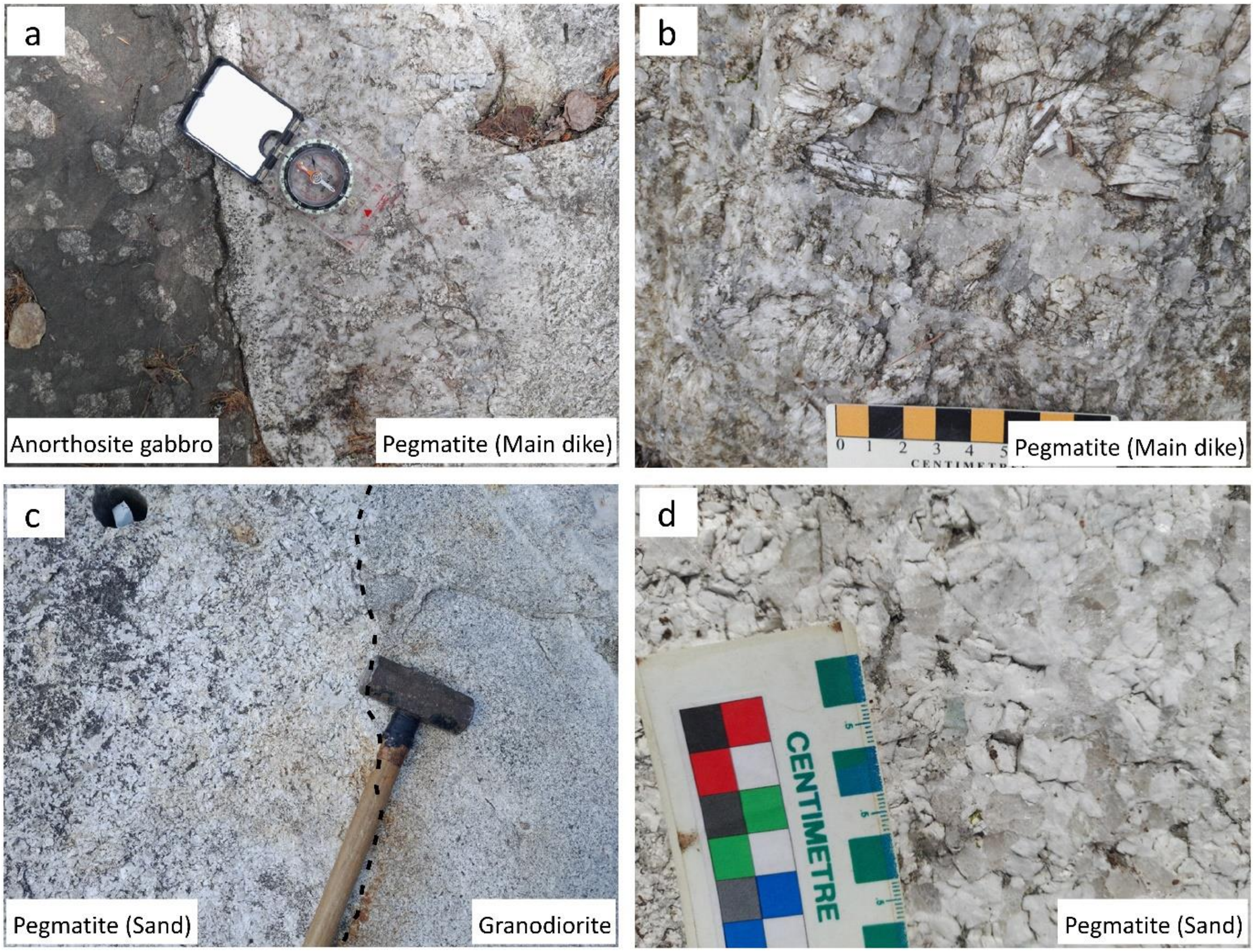

Figure GS2024-3-3: *Field photos of pegmatite in the Maskwa Lake Series (MWL):* ***a)*** *Li-rich spodumene-bearing pegmatite hosted by the porphyritic anorthosite metagabbro;* ***b)*** *pegmatite with white spodumene crystals that vary between 1 and 5 cm in length;* ***c–d)*** *pegmatite hosted in granodiorite with irregular contact and greenish beryl.*

pegmatite (CNM-14, 83, 85) were investigated in this study. The F.D. No .5 pegmatite is composed of green spodumene, K-feldspar, plagioclase, quartz, biotite, muscovite, black tourmaline, beryl and apatite. It is hosted in granodiorite, but part of the pegmatite narrows between the granodiorite and amphibolite (Figure GS2024-3-4a). The core zone of this pegmatite is enriched in hematized plagioclase and green spodumene (Figure GS2024-3-4b), while the wall-contact zone is enriched in K-feldspar, hematized plagioclase, quartz and beryl (Figure GS2024-3-4c). See Roush et al. (2023) for a more detailed mineralogical description of the F.D. No. 5 pegmatite.

The Eagle pegmatite is a Li-mineralized pegmatite hosted in a granodiorite, with holmquistite formation in the contact zone. The main Eagle pegmatite has an exposed thickness varying between 3 and 4 m, and strikes east and dips 80°S. The main minerals in this pegmatite are hematized plagioclase (±K-feldspar), quartz, muscovite and green spodumene. In the studied outcrops, the pegmatite has been subjected to sinistral shearing that is most evident in a narrow pegmatite vein from the same area (Figure GS2024-3-4d). Sinistral-sense movement/deformation is also related to north-northeast–trending fractures reflected in the main pegmatite dike (Figure GS2024-3-4e). Two generations of Li mineralization are observed in the field: the first occurs as disseminated spodumene within the easterly oriented pegmatite (Figure GS2024-3-4e and f), while the second occurs as north-northeast-trending fracture-filling spodumene (Figure GS2024-3-4f). See Roush et al. (2023) for a more detailed mineralogical description of the Eagle pegmatite.

Two different pegmatite dikes were observed at Irgon: the highly deformed Irgon pegmatite (Figure GS2024-3-5a–c) and the undeformed Irgon pegmatite (Figure GS2024-3-5d–g). The undeformed pegmatite (CNM-14 and 85) is found to the northeast, 60 m from the deformed pegmatite (CNM-83). Both dikes are Li mineralized and beryl occurs in the undeformed pegmatite as

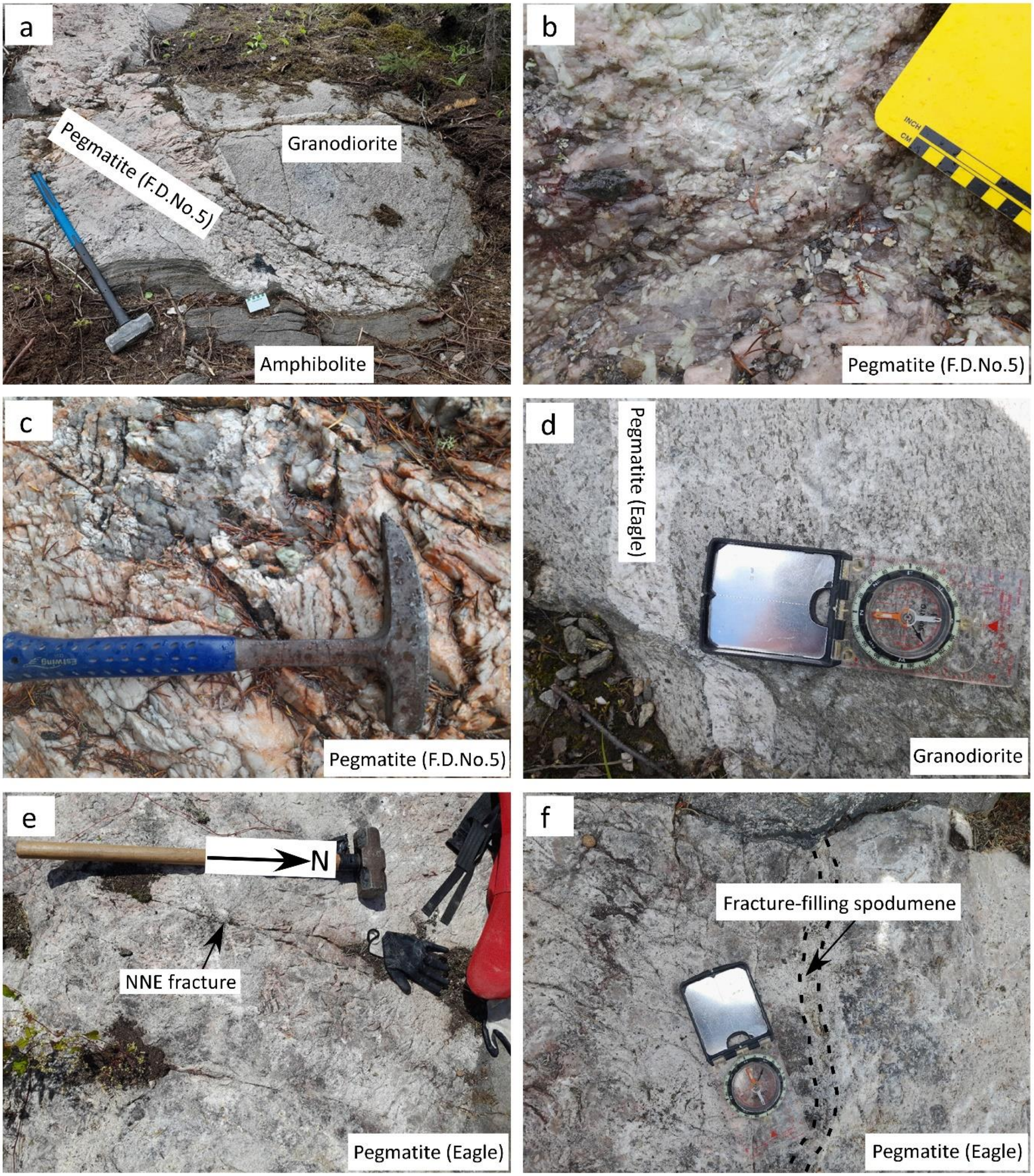

Figure GS2024-3-4: *Field photos of F.D. No. 5 and Eagle pegmatites:* ***a)*** *spodumene-bearing F.D. No. 5 pegmatite emplaced between granodiorite and amphibolite;* ***b)*** *F.D. No. 5 pegmatite core zone rich in hematized plagioclase and green spodumene;* ***c)*** *wall-contact zone rich in K-feldspar–hematized plagioclase, quartz and beryl;* ***d)*** *Eagle pegmatite subjected to sinistral sense of shear;* ***e)*** *related NNE fractures reflected in the wide pegmatite with primary spodumene;* ***f)*** *secondary Li-mineralization in the form of NNE-trending fracture-filling spodumene.*

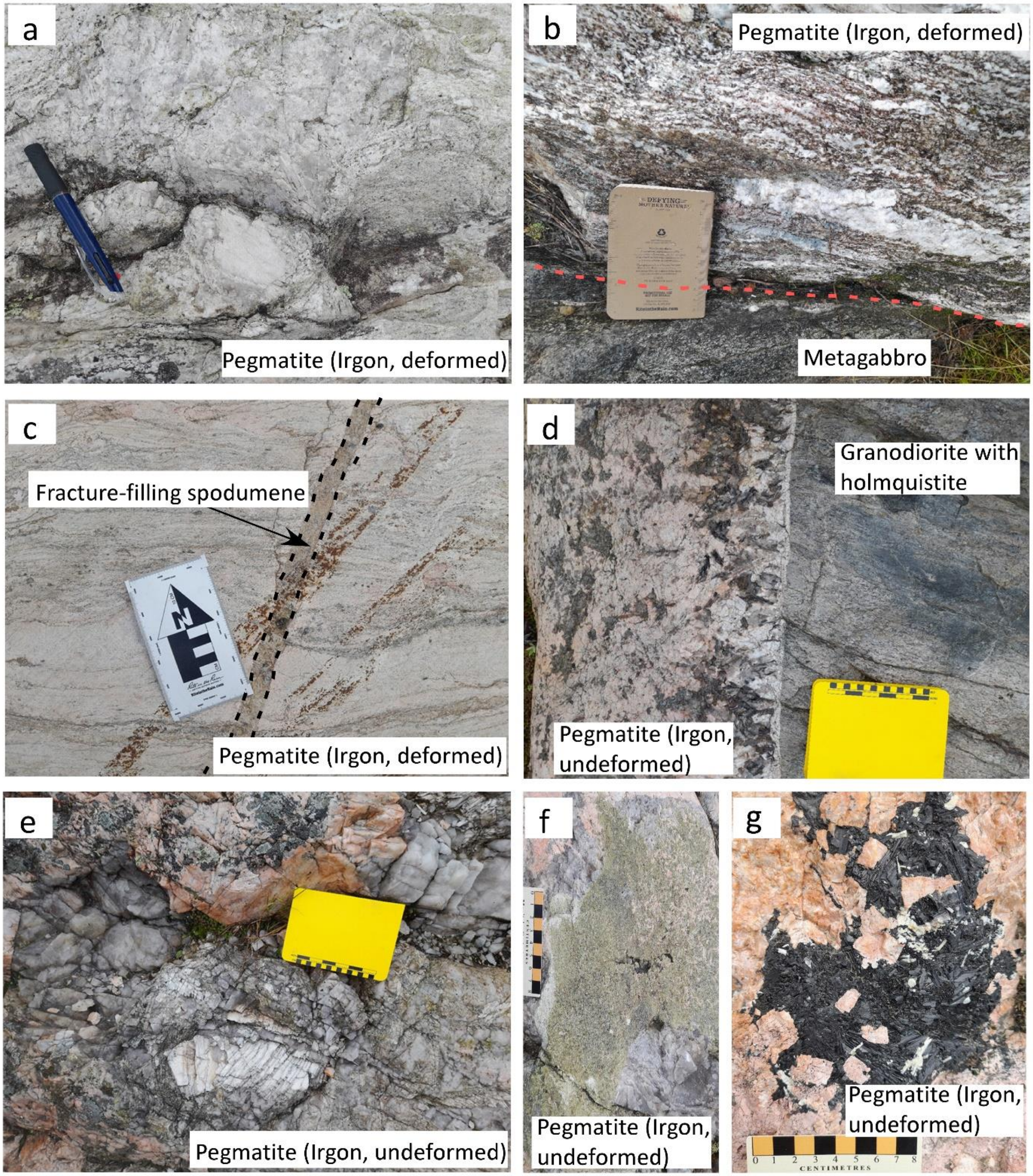

Figure GS2024-3-5: *Field photos of deformed and undeformed Irgon pegmatite:* ***a, b)*** *highly deformed pegmatite composed of spodumene (whitish, primary), plagioclase, greenish to whitish muscovite, garnet, bluish apatite and quartz;* ***c)*** *secondary Li mineralization appearing as fracture-filling spodumene that trends NNE (N40°E);* ***d)*** *undeformed pegmatite emplaced across the deformation fabric of the granodiorite;* ***e)*** *undeformed pegmatite with coarse spodumene (whitish) and hematized plagioclase (pinkish gradational colour); and* ***f)*** *undeformed pegmatite with greisen (agglomeration of greenish mica); and* ***g)*** *black tourmaline and beryl associated with pink K-feldspar.*

well. The highly deformed pegmatite is composed of spodumene (whitish, primary), plagioclase, K-feldspar, greenish to whitish muscovite, garnet, bluish apatite and quartz (Figure GS2024-3-5a and b). It is a very highly deformed pegmatite, highly foliated and sheared, with the foliation planes striking east to N50°W (Figure GS2024-3-5a–c). The pegmatite is emplaced parallel to the deformation fabric of the host metagabbro that contains holmquistite towards the contact. The thickness of this deformed pegmatite is 10–15 m; it is cut by a quartz vein striking N42°E and dipping 70°E. Late Li mineralization is present as a fracture-filling spodumene vein that trends N40°E (Figure GS2024-3-5c). This indicates that there are at least two stages of Li mineralization in this area, consistent with what was observed at the Eagle pegmatite. There are also minor north-trending fractures in the same deformed pegmatite that cut across the NNE-trending fractures.

The undeformed Irgon pegmatite is composed of spodumene (whitish), hematized plagioclase (pinkish gradational colour) with or without K-feldspar, muscovite (often greenish), quartz, greisen, black tourmaline and beryl (GS2024-3-5d–g). Its thickness ranges from 3 to 5 m and its strike is between N30°E and N40°E, with dip 70°E. It is hosted in a granodiorite and crosscuts the general fabric of the hostrock (GS2024-3-5d). The granodiorite is enriched in holmquistite towards the contact with the pegmatite. This granodiorite is foliated N50°W, the same as in the nearby deformed Irgon pegmatite and its hostrock. The highly deformed pegmatite is endowed with later fractures that are oriented NNE (mainly N40°E), consistent with the trend of the undeformed pegmatite and later fracture-filling spodumene vein.

Cat Lake pegmatite group (CAT)

Two different pegmatite outcrops were studied this summer (CNM-93 and CNM-94), one near Cat Lake and another near Euclid Lake. Both are hosted in a fine- to medium-grained metamorphosed basalt (Figure GS2024-3-6a).

The pegmatite near Cat Lake is composed of plagioclase (hematized), greenish muscovite, quartz, K-feldspar, garnet (in the aplitic zone) and a few grains of spodumene (Figure GS2024-3-6b). This pegmatite is oriented N80°W to E-W, measures 20 m in width and is slightly deformed, with an E-W foliation defined by muscovite flakes GS2024-3-6a). The pegmatite outcrop near

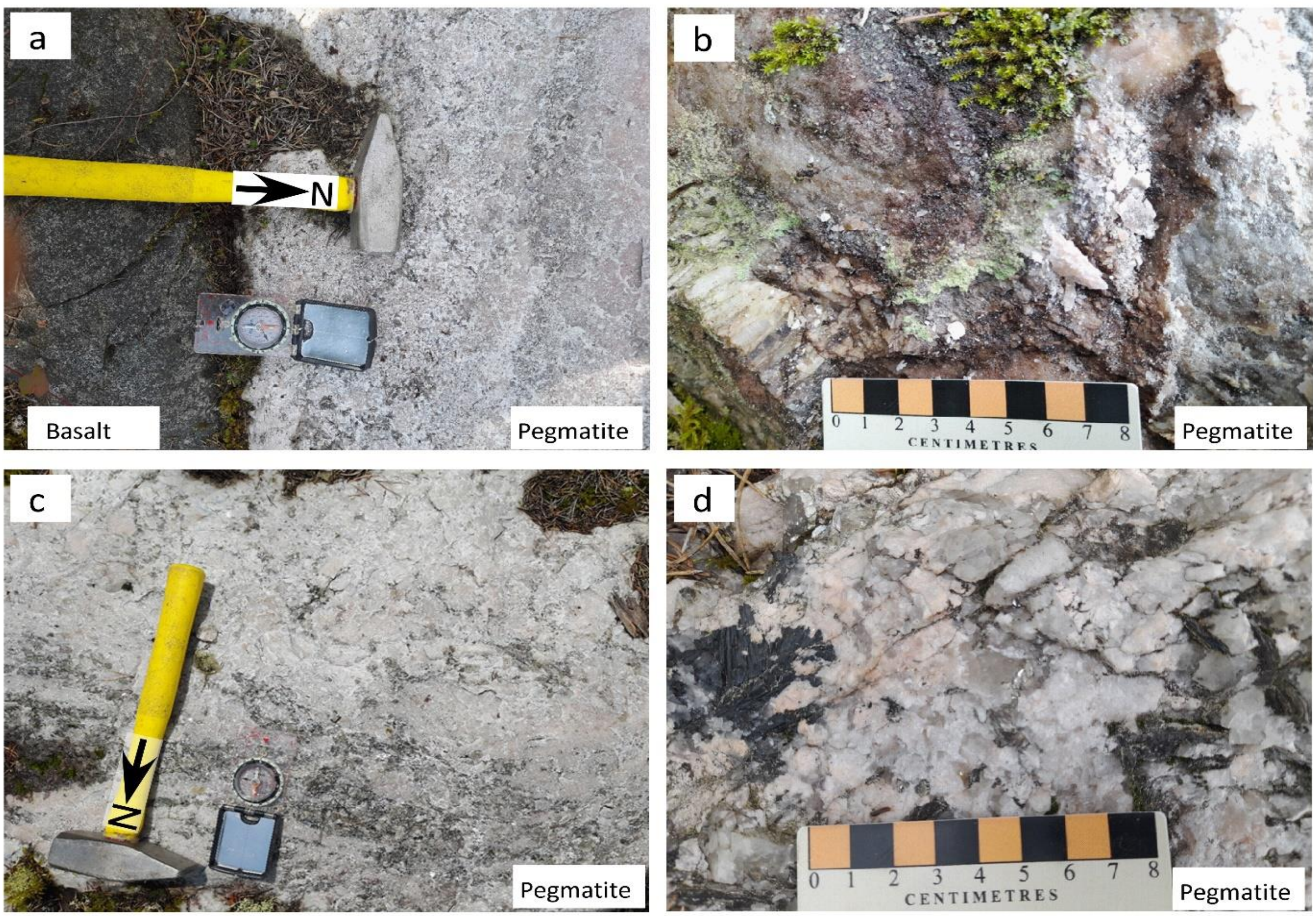

Figure GS2024-3-6: *Field photos of Cat Lake pegmatite group (CAT):* ***a)*** *E-W deformed pegmatite hosted in metabasalt near Cat Lake;* ***b)*** *pegmatite composed of plagioclase (hematized), greenish muscovite, quartz, K-feldspar, garnet (in the aplitic zone) and a few grains of spodumene, near Cat Lake;* ***c)*** *slightly deformed with an E-W foliation, near Euclid Lake;* ***d)*** *pegmatite composed of plagioclase, blocky K-feldspar or/and hematized plagioclase, quartz, greenish muscovite, garnet (in the aplitic zone), apatite and black tourmaline, near Euclid Lake.*

Euclid Lake 150 m long and up to 5 m wide. This dike strikes N60°E to E-W, with a dip of 70°NNW. It exhibits an E-W deformation pattern indicated by the alignment of muscovite flakes (Figure GS2024-3-6c). It is composed of plagioclase, blocky K-feldspar and/or hematized plagioclase, quartz, greenish muscovite, garnet (in the aplitic zone), apatite and black tourmaline (Figure GS2024-3-6c–d).

Shatford Lake pegmatite group (SHL)

The pegmatites investigated in this project area are the Crocodile pegmatite (CNM-99) Success pegmatite (CNM-100; northern side of the Lac du Bonnet batholith), Silverleaf pegmatite (CNM-108), Huron pegmatite (CNM-109), Annie pegmatite (CNM-110), two pegmatites (CNM-161, 162) located west of the Annie pegmatite (east side of the Lac du Bonnet batholith) and pegmatites at Point du Bois (CNM-74, 76; southeast side of the Lac du Bonnet batholith; *see* Figure GS2024-3-2).

The pegmatites on the north side of the Lac du Bonnet batholith intruded and cut the east-west deformation fabric of the host intermediate volcanic rock (andesite; Figure GS2024-3-7a). The Success pegmatite is 1 m thick, oriented N42°E and dips at 40°S. It is composed of plagioclase, muscovite, K-feldspar, quartz and garnet (which is predominant in the aplite portion of the pegmatite; Figure GS2024-3-7a). The Crocodile pegmatite is 1.5 m thick, oriented between N42°W and N60°W, and dips at 70°SSW. It is composed of coarse grains of plagioclase, smoky quartz, muscovite and an aplitic zone (often hematized) containing garnet, blue-green apatite, and accessory grains of cassiterite and tantalite (Figure GS2024-3-7b).

The Silverleaf pegmatite is a lithium-bearing pegmatite with a surface exposure of approximately 80 m by 45 m and is partially excavated. Previous studies indicate that the Silverleaf pegmatite was emplaced in metabasalt as a subvertical dike with a voluminous outer zone of garnetiferous aplite, and a complex stack of pegmatitic zones in the interior (Bannatyne, 1985; Camacho et al., 2012). It is composed of spodumene, quartz, feldspar, muscovite, lepidolite, garnet and apatite. The pegmatitic zone contains large spodumene (Figure GS2024-3-7c). Late lepidolite masses were observed filling a fracture within the outer zone of garnetiferous aplite (Figure GS2024-3-7d).

The Huron pegmatite is a niobium-yttrium-fluorine (NYF) pegmatite located amidst the dominant lithium-cesium-tantalum (LCT)–family pegmatites of the field (Černý, 1991). The Huron pegmatite is hosted in amphibolite and much of the outcrop has been mined out, hindering detailed field investigations. Previous studies indicate that the Huron pegmatite formed a subhorizontal, slightly saddle-shaped body at least 100 m by 30 m by 4 m in size (Camacho et al., 2014; Figure GS2024-3-7e). It consists of five concentric zones that are affected by three late assemblages of metasomatic veining: 1) aplitic border zone; 2) graphic pegmatite zone that is thin and intermittent, with quartz, oligoclase, K-feldspar, biotite and rare garnet; 3) medium- to coarse-grained (1–8 cm) albitic wall zone containing subordinate quartz, biotite and muscovite; 4) blocky intermediate to core-margin zone of K-feldspar with locally abundant quartz; and 5) quartz core, apparently segmented into several isolated pods. This concentric zonal pattern is only insignificantly disturbed by a fine- to medium-grained albitic replacement unit, which is locally developed in the blocky zone and cut by late anastomosing albite veinlets (Camacho et al., 2014).

A late hydrothermal assemblage of Ca>Mg, Fe-bearing minerals (such as epidote, chlorite, bavenite, titanite and probably fersmite) fills miarolitic cavities and fissures, or replaces primary minerals (such as albite and beryl; Camacho et al., 2014). The albitic wall zone (zone 3) is by far the main carrier of the rare-element mineral assemblage of beryl, zircon, thorite, uraninite, niobian rutile, columbite-group minerals, gadolinite-(Y), microlite, and monazite-(Ce; Camacho et al., 2014). Stringers of columbite-(Fe)-tantalite, uraninite, and monazite-(Ce) commonly follow fractures, occasionally accompanied by quartz veinlets, and they locally branch from the fractures into the feldspar matrix (Figure GS2024-3-7f). However, all of these minerals are members of a single, paragenetically coherent suite generated within the pegmatite body. No evidence is available for either different relative ages of individual minerals or of their associations, or their introduction from outside the pegmatite body as genetically unrelated material. Additional information on the Huron pegmatite is available in Paul (1984) and Camacho et al. (2014).

The Annie pegmatite and two pegmatites located to the west of it (east side of the Lac du Bonnet batholith) are exposed as coarse-grained pegmatite, often with a voluminous zone of garnetiferous aplite, hosted in a green mica–rich granite (Figure GS2024-3-7g). The contact between pegmatite and granite appears to be gradual and not obvious from field observation. However, recent geophysical data (New Age Metals, unpublished data) indicate that these pegmatites occur along the demagnetized E-W corridor in a granite, where this corridor is characterised by a strong K-Th-U radiometric anomaly. This granite is composed of plagioclase, K-feldspar, green muscovite, quartz and garnet. It is similar to Neoarchean S-type granites characterized by very low magnetic susceptibility values and emplaced along or proximal to tectonic boundary zones in the region (Yang et al., 2019). The pegmatites are composed of K-feldspar, muscovite, plagioclase and quartz, and garnet in the aplite zone. The garnet-bearing aplitic bands trend E-W within the pegmatite and are consistent with E-W deformation fabrics observed in the region (Figure GS2024-3-7g).

The pegmatite at Point du Bois (southeast side of the Lac du Bonnet batholith) appears as pink pegmatite that intrudes granodiorite (Figure GS2024-3-7h). The pegmatite dike varies in strike between N-S and N30°E, and dips at 70°W. Its thickness ranges between 1 and 2 m in the outcrop and appears not to have any zoning. It is composed of K-feldspar, biotite, muscovite and quartz.

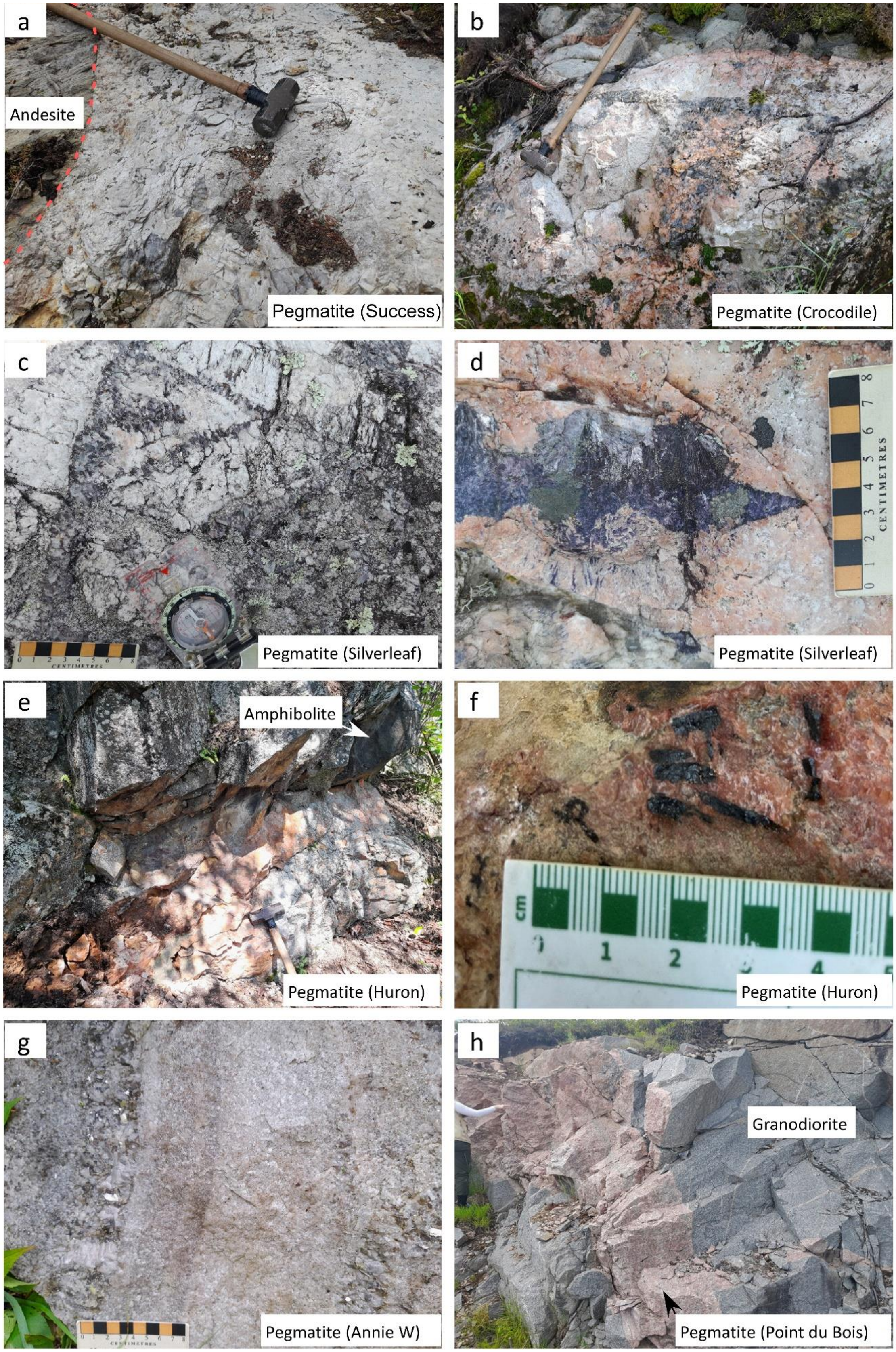

Figure GS2024-3-7: *Field photos of Shatford Lake pegmatite group (SHL):* ***a)*** *pegmatite intruding and cutting the deformation fabric of the hostrock andesite;* ***b)*** *pegmatite with coarse grains of plagioclase, smoky quartz, muscovite and an aplitic zone that is often hematized;* ***c)*** *pegmatite with large spodumene (white in colour);* ***d)*** *late lepidolite aggregate as fracture filling in the pegmatite;* ***e, f)*** *tantalite-mineralized, K-feldspar–rich pegmatite hosted in amphibolite;* ***g)*** *coarse-grained pegmatite (hosted in a green mica–rich granite) with E-W garnet-bearing aplitic bands within the pegmatite;* ***h)*** *pink (K-feldspar–rich) pegmatite intrusion in the granodiorite.*

Lac du Bonnet pegmatite group (LdB)

The Lac du Bonnet pegmatite group belongs to the widespread class of well-differentiated, blocky lithium pegmatites with primary zonal spodumene (Černý et al., 1981). This pegmatite group includes the Tappy and Matty Li-rich spodumene-bearing pegmatites that were studied in this project (CNM-92, -187, -188; Figure GS2024-3-2). The Tappy pegmatite, studied in detail by Roush et al. (2023), consists of feldspar, muscovite, quartz, spodumene and tantalite. It is exposed for more than 50 m with a N-S orientation and its width ranges between 1.5 and 4 m (Bannatyne, 1985; Roush et al., 2023). It is hosted in a metamorphosed pillow basalt and has a main foliation striking N63°E. See Roush et al. (2023) for a more detailed description of the Tappy pegmatite. The Matty pegmatite is hosted in a silicified meta-andesite and its emplacement cuts across the main fabric of the hostrock (Figure GS2024-3-8a). It strikes between N-S and N10°E, and dips 70°W based on surface measurements, but it appears that the body actually dips eastward, based on drilling intercepts (New Age Metals, unpublished drilling data), while the main foliation of the hostrock strikes N60°E. The Matty pegmatite consists of plagioclase, muscovite (greenish), quartz, spodumene (slightly greenish), hematized plagioclase (or K-feldspar) and tiny black minerals with metallic lustre that could be tantalite (Figure GS2024-3-8b).

Greer Lake pegmatite group (GL)

The Greer Lake pegmatites are dominantly concordant bodies that pinch and swell within the foliation of the host tonalitic gneiss/granodiorite, both along strike and downdip (Černý et al., 1981). The Jewel pegmatite (CNM-169) and Grace One pegmatite (CNM-171) were visited (Figure GS2024-3-2). The major outcrop of the Jewel pegmatite has been mined out (for beryl), thus limiting detailed field investigations; however, its emplacement is parallel to the foliation of the hostrock (granodiorite; Figure GS2024-3-9a). The jewel pegmatite contains coarse grains of K-feldspar, biotite, quartz, beryl and garnet (Figure GS2024-3-9b-c). The Grace One pegmatite, which was also historically mined for beryl, is oriented N44°E, parallel to the foliation of the hostrock. It is approximately 10 m wide and appears to have emplaced along a contact between granodiorite and granite. This pegmatite is composed of very coarse grains of muscovite, quartz, plagioclase and occasional beryl and K-feldspar (Figure GS2024-3-9d). Garnet appears in some portions of the pegmatite that are hematized.

Eaglenest Lake pegmatite group (ENL)

The Eaglenest Lake pegmatites visited during this project were CNM-123, -124, -125, -127 and -128 (Figure GS2024-3-2). The Eaglenest Lake pegmatites are hosted in granite and their contact with the hostrock appears gradational. These dikes seem to be pegmatitic phases transitioning from leucogranite with the same mineralogy (Figure GS2024-3-10a). Internally, the dikes are homogeneous or slightly concentrically zoned, with medium-grained albite+quartz+K-feldspar along the margins, passing gradually into a coarse blocky K-feldspar+quartz core with green mica (muscovite; Figure GS2024-3-10b–d). Garnet is usually found close to the margins. The Eaglenest lake pegmatites are barren at their present erosional surface.

Axial pegmatite group (AX)

The Axial pegmatite group is located in the Birse Lake granodiorite (e.g., CNM-165, -166; Figure GS2024-3-2). These pegmatites are generally concordant with the E-W foliation of this granodiorite body (Figure GS2024-3-11a). They pinch and swell, with attendant warping of the foliation. These pegmatites are composed of K-feldspar, plagioclase, green muscovite

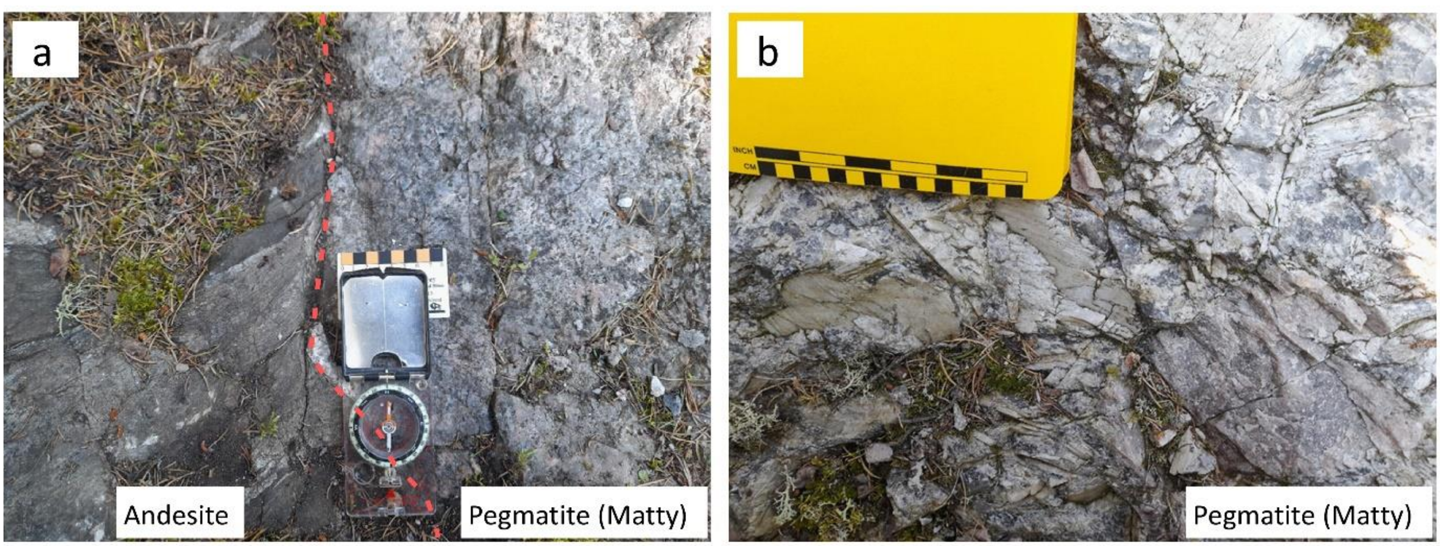

***Figure GS2024-3-8**: Field photos of the Lac du Bonnet pegmatite group (LdB): **a)** pegmatite emplaced in silicified-metamorphosed andesite and cutting across the main fabric of the hostrock; **b)** Li-mineralized pegmatite with coarse primary spodumene (slightly greenish).*

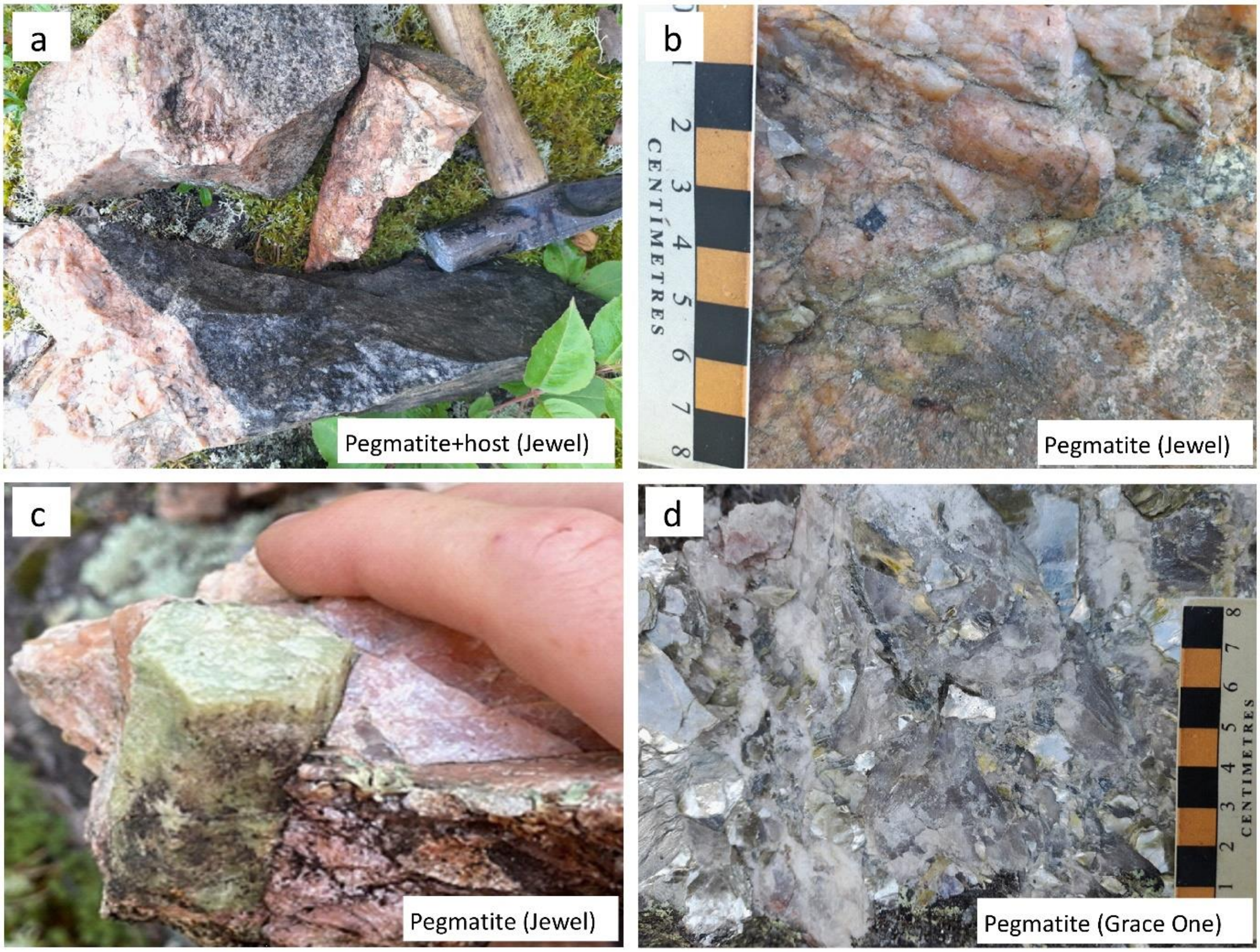

Figure GS2024-3-9: *Field photos of the Greer Lake pegmatite group (GL):* ***a)*** *beryl-mineralized pegmatite hosted by granodiorite;* ***b)*** *pink (K-feldspar–rich) pegmatite with beryl mineralization;* ***c)*** *euhedral Beryl (greenish) from the Jewel pegmatite;* ***d)*** *book of muscovite–rich pegmatite at the Grace One pegmatite.*

and quartz, often with dotted brown and black garnet (Figure GS2024-3-11b). In the Birse Lake pluton, there are some other pegmatite dikes that cut across the foliation of this body (Figure GS2024-3-11c). The observed crosscut pegmatite has biotite in addition to the main minerals of the other pegmatites indicated above (Figure GS2024-3-11d). Contacts of the Axial pegmatite group with the host are sharp (Figure GS2024-3-11a, c), implying a late emplacement of the pegmatite into the granodiorite. No rare-element minerals have been observed in Axial pegmatite group. These pegmatites are barren at their present surface, which corroborates the observations made by Černý et al. (1981).

Birse Lake pegmatite group (BIS)

This pegmatite group extends from Tin Lake to northwest of the north end of Birse Lake and the southeastern part of Osis Lake (Černý et al., 1981). In this group, the visited pegmatite locations are CNM-119, -121, -129, -130 and -132 (Figure GS2024-3-2). In the northwestern part, a huge outcrop of ONW pegmatite (CNM-119 and -121) investigated for this project appears in the zone with a high radiometric anomaly (New Age Metals, unpublished geophysical data). This pegmatite is composed of abundant coarse K-feldspar, black tourmaline, biotite, quartz, muscovite and accessory garnet (Figure GS2024-3-12a). It strikes almost E-W, parallel to the deformation fabric of the hostrock, and dips 70°S. The hostrock is an intermediate metavolcanic unit, possibly a deformed andesite. In the southeastern part (Tin Lake pegmatites), some of the visited pegmatites appear as dikes oriented N-S and dipping subvertically to 80°W These are around 20 m wide and cut across the deformed intermediate volcanic rock (andesite) with a foliation striking N44°W and dipping 72°NE. However, some others appear as massive bodies of pegmatite to pegmatitic granite with the same mineralogical composition as the elongated dikes and are often evolved, with high contents of muscovite and dotted black tourmaline (Figure GS2024-3-12b).

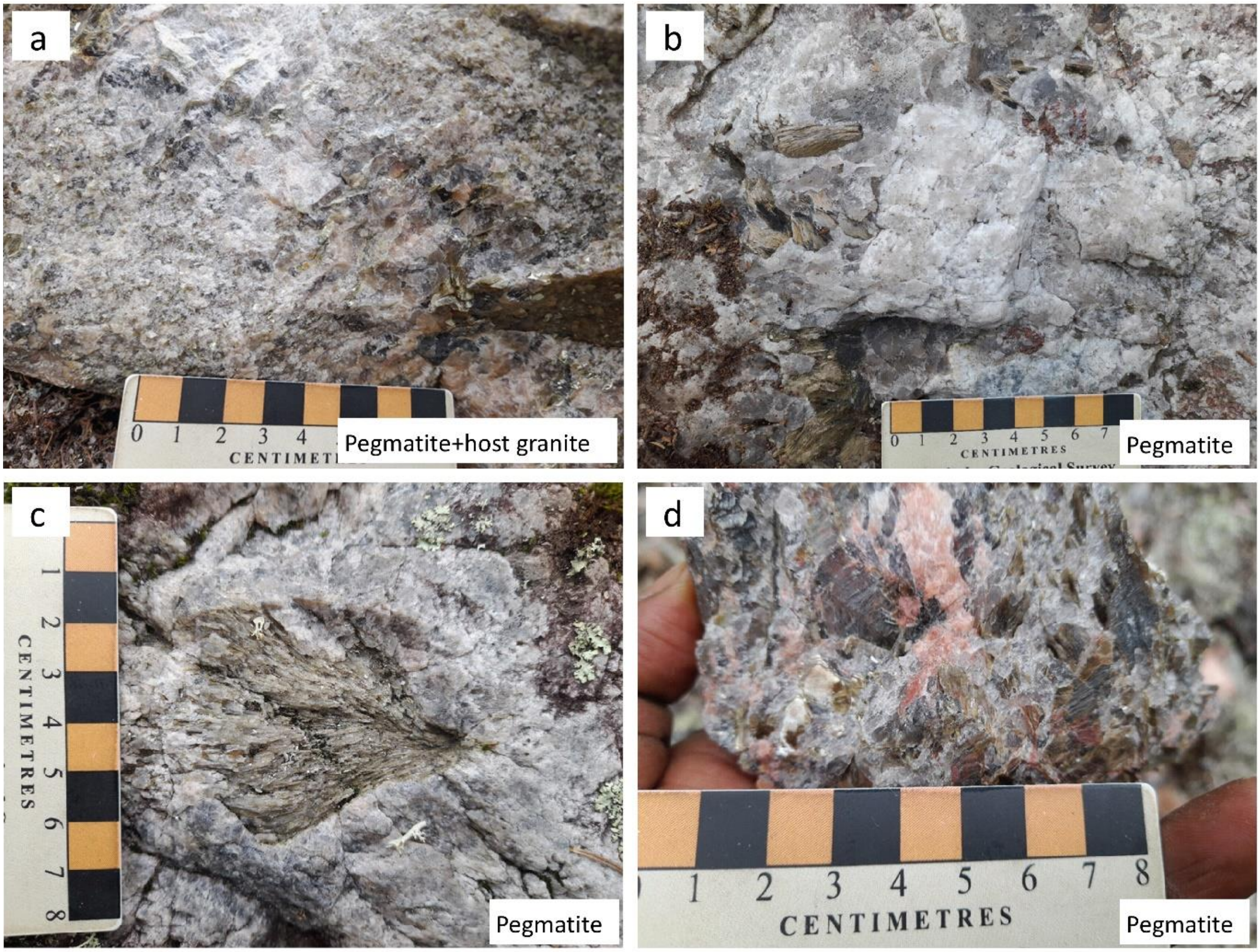

***Figure GS2024-3-10:** Field photos of the Eaglenest Lake pegmatite group (ENL): **a)** pegmatitic phases transitioning from leucogranite with the same mineralogy; **b–d)** pegmatite composed of coarse, blocky K-feldspar+quartz core with green mica (muscovite).*

Previous studies classified the Birse Lake pegmatite group as not very differentiated, weakly albitized, beryl-bearing, blocky, muscovite-microcline pegmatites with incipient tendency to more diversified mineralization only in the most fractionated bodies (Černý et al., 1981). However, no rare-metal mineralization was observed in the exposed pegmatites during the current fieldwork.

Rush Lake pegmatite group (RL)

This pegmatite group is located north and west of Rush Lake, and west of the westernmost extent of the Osis Lake pegmatitic granite (Černý et al., 1981). In this group, the visited pegmatite locations are CNM-26, -27, -29, -31, -32, -34, -101, -104 (Blue Bird pegmatite), -105 (Odd pegmatite), -106 (Odd-west pegmatite) and -107 (Cubo/Stannite pegmatite), along with related drillcores CNM-114, -115, -175, -176, -180, -183, -189 and -190 (Figure GS2024-3-2). The Rush Lake pegmatites are generally concordant with the layering and E-W foliation of their hostrocks (e.g., CNM-26, -27, -31, -32, -105, -106 and -107), with only minor local discordances at very low angles (e.g., CNM-29, -34, -101 and -104). The contact reaction is commonly characterized by formation of black tourmaline between the pegmatite and metasedimentary hostrock (Figure GS2024-3-13a). Some of the E-W–oriented pegmatites were subjected to N-S fracturing in both the pegmatite and the hostrock (Figure GS2024-3-13a). However, the emplacement of pegmatite often filled both the E-W and N-S openings (Figure GS2024-3-13b).

Rush Lake pegmatites are generally composed of plagioclase, green muscovite, K-feldspar, quartz, black tourmaline and garnet (Figure GS2024-3-13c, d). A difference in mineralogy is the blue tourmaline observed at the Blue Bird pegmatite (Figure GS2024-3-13d). The Blue Bird pegmatite outcrops over more than 50 m^2 and trends N60°E. Rare-element mineralization, such as Ta and Nb-oxide minerals, occurs mostly as small irregular grains and is

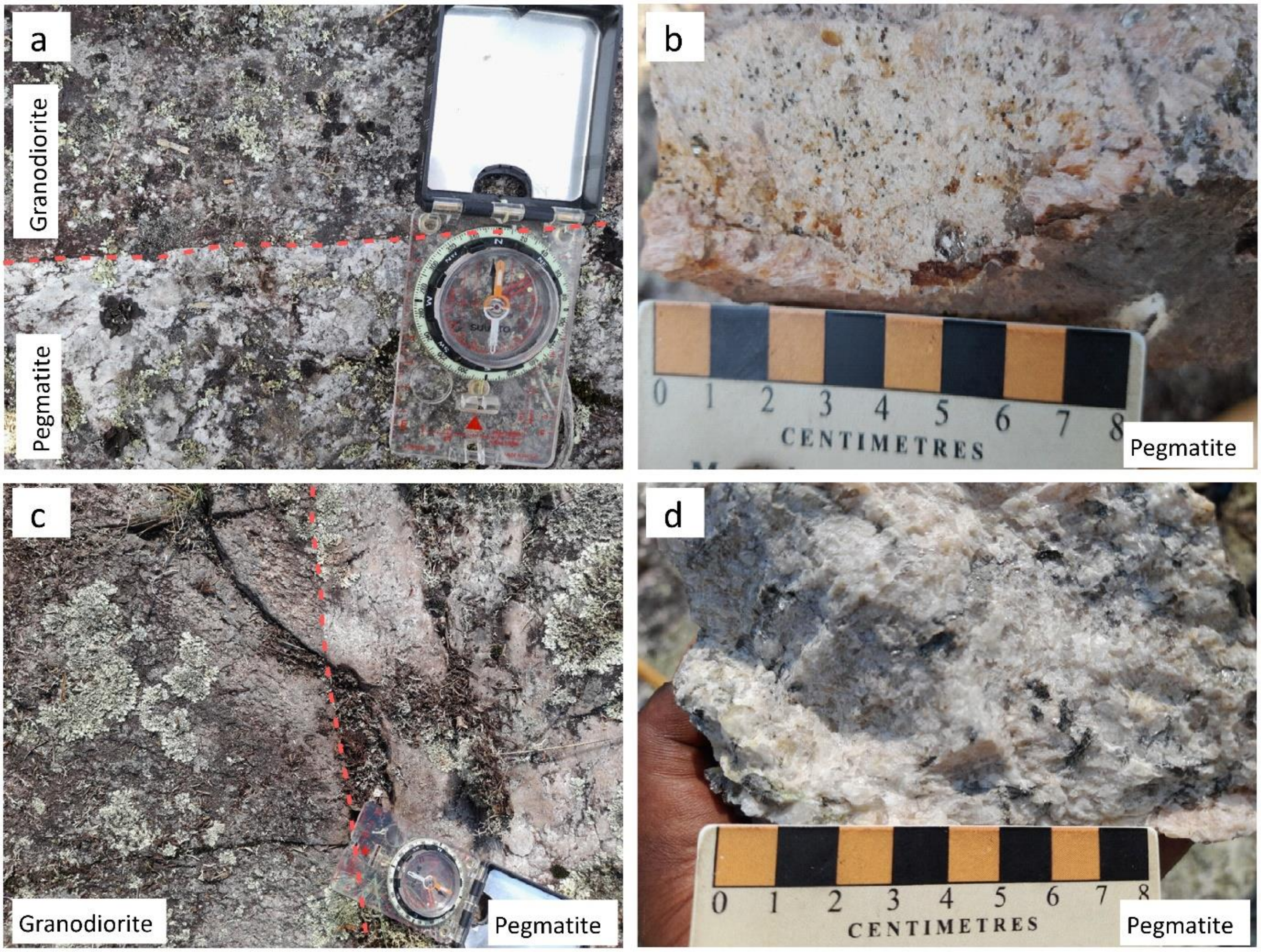

***Figure GS2024-3-11:** Field photos of Axial pegmatite group (AX): **a)** pegmatite in the Birse Lake granodiorite, with sharp contact but generally concordant with the foliation of the hostrock; **b)** pegmatite with dotted brown and black garnet; **c)** pegmatite dikes in the Birse Lake pluton that cut across the foliation of the hostrock; **d)** crosscut pegmatite with biotite, in addition to the main minerals observed in other pegmatites, from the Birse Lake pluton.*

indistinguishable from cassiterite in some pegmatites. Previous studies indicate that the pegmatites of the Rush Lake group can be classified as fully differentiated, partly to extensively replaced spodumene, albite-microcline and petalite-albite-microcline pegmatites, with or without lepidolite, and have remarkable Cs enrichment (Černý et al., 1981). However, no Li-bearing minerals were observed in the pegmatite at surface during the current fieldwork.

Bernic Lake pegmatite group (BL)

Exposures of this group are concentrated at the eastern end of Bernic Lake, the only exception being the Tanco pegmatite at its northwestern extremity. In this group, the visited pegmatite locations are CNM 01-13 (Tanco pegmatite), CNM 153 (west of Tanco, around Bernic Lake), CNM 155 (Jack nut pegmatite) and CNM 157-159 (Pegmatite 7 (Coe) –9 (Buck), eastern end of Bernic Lake; Figure GS2024-3-2). The Tanco pegmatite is zoned with mineral content that possibly indicates progressive differentiation of the pegmatite and an increasing extent of metasomatic reactions. The Tanco pegmatite zones have been described extensively in previous work (e.g., Černý et al., 1998; Černý, 2005; Stilling et al., 2006; Breasley et al., 2022). Near the eastern end of Bernic Lake, pegmatite dikes trend mainly E-W, parallel to the structural fabric of the gabbro hostrock, and dip 40°N (Figure GS2024-3-14a). The pegmatite evidently filled conjugate directions of fractures/joints in the hostrock (Figure GS2024-3-14b).

The contact zone is mainly characterized by K-feldspar that developed in the pegmatite toward the contact with the hostrock, while black tourmaline developed in both the pegmatite and the hostrock (Figure GS2024-3-14a, b). The most obvious rare-element mineralization observed from the outcrop is white beryl (Figure GS2024-3-14c), white spodumene (Figure GS2024-3-14d) and tantalite in the aplitic zone. The shapes and orientations of the Bernic Lake pegmatites are controlled in part by the rheology

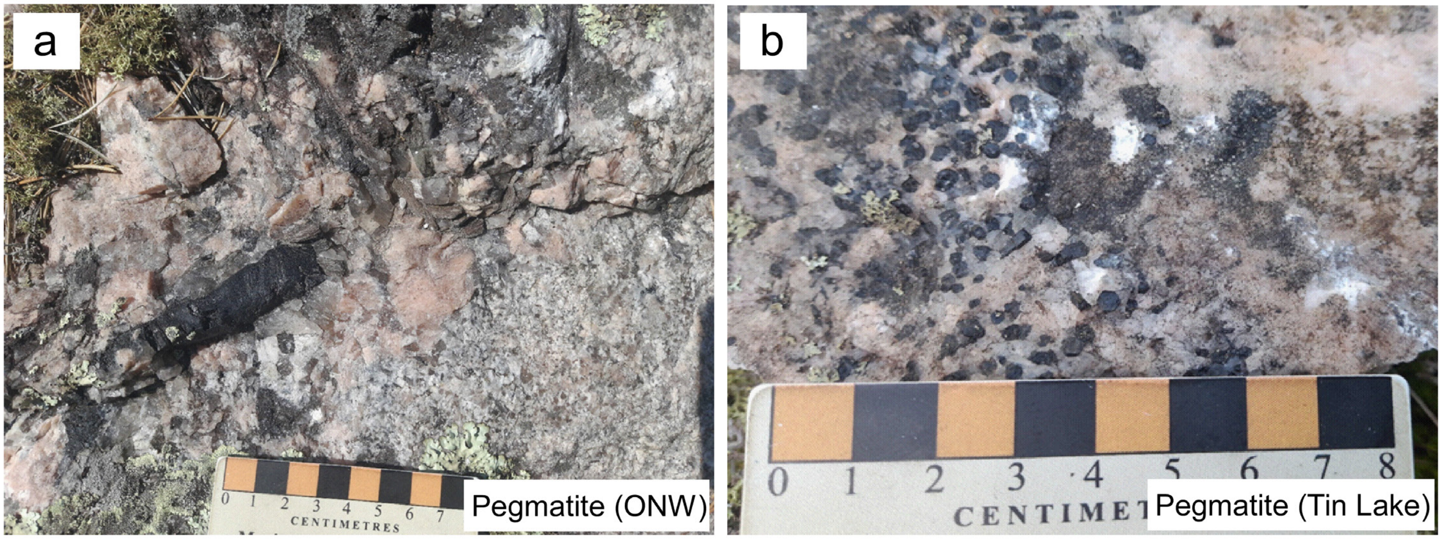

Figure GS2024-3-12*: Field photos of Birse Lake pegmatite group (BIS):* ***a)*** *pegmatite with abundant coarse-grained K-feldspar, black tourmaline, biotite, quartz, occasional muscovite and accessory garnet;* ***b****) evolved pegmatite, with high contents of green muscovite and dotted black tourmaline.*

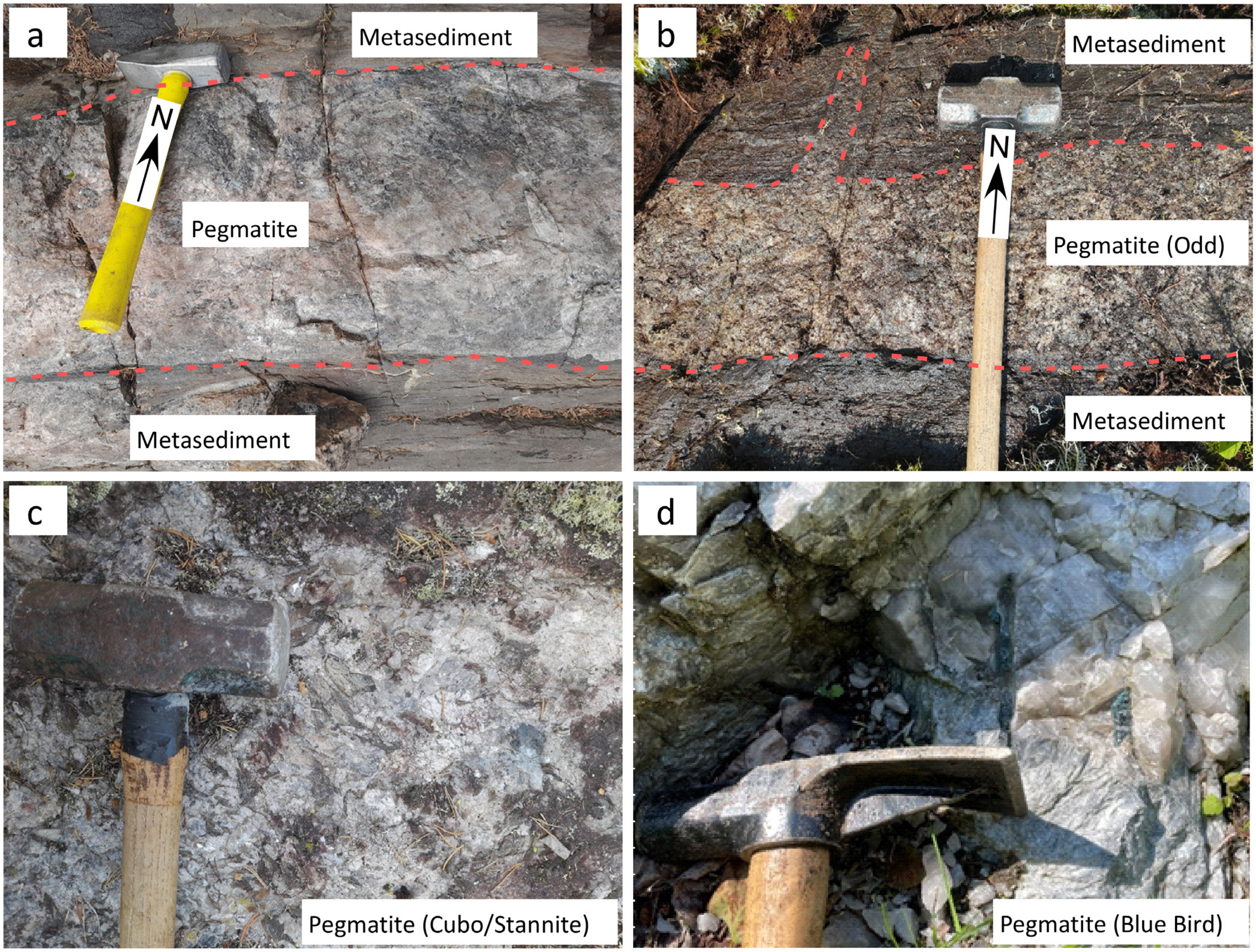

Figure GS2024-3-13: *Field photos of Rush Lake pegmatite group (RL):* ***a)*** *pegmatite emplaced parallel to E-W foliation of the metasedimentary hostrock, with formation of black tourmaline in the contact;* ***b)*** *emplacement of the pegmatite that filled both the E-W and N-S openings;* ***c)*** *main minerals forming the RL pegmatite (plagioclase, green muscovite, K-feldspar, quartz, black tourmaline and garnet);* ***d)*** *pegmatite with blue tourmaline in the outcrop*

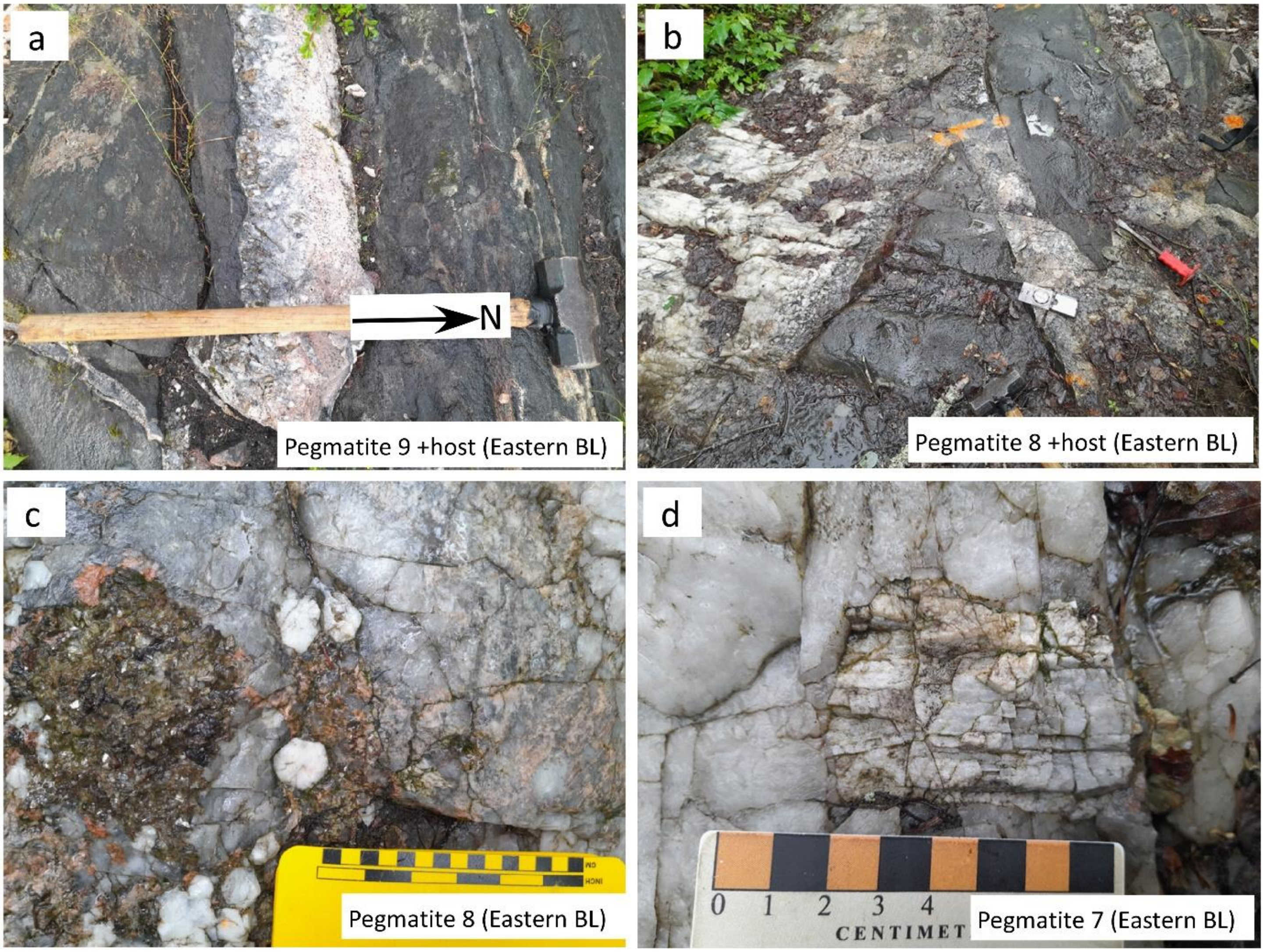

Figure GS2024-3-14*: Field photos of Bernic Lake group (BL):* ***a)*** *pegmatite trending E-W, parallel to the structural fabric of the hostrock (gabbro) with shallow dip;* ***b)*** *E-W pegmatite that bisected and filled fractures/joints in the hostrock;* ***c)*** *euhedral beryl (white) mineralization in the pegmatite;* ***d)*** *Li-mineralized pegmatite with coarse white spodumene.*

of the hostrocks into which they were emplaced. Rheologically competent lithologies responded to strain by brittle fracture and the pegmatites occurring therein are flat and tabular; rheologically incompetent lithologies responded to strain by ductile-brittle deformation and the pegmatites therein are irregular, folded and/or boudinaged (Kremer, 2010).

Economic considerations

The Cat Lake–Winnipeg River pegmatite field contains lithium and other critical elements (e.g., tantalum, tin, niobium, cesium, beryllium), and mining is currently underway for lithium in Tanco's world-class pegmatite deposit. Preliminary field investigations in the Cat Lake–Winnipeg River pegmatite field indicate that the pegmatites emplaced in mafic hostrocks and/or intermediate hostrocks are highly evolved and enriched in potential critical minerals, including lithium, tantalum, tin, beryllium and cesium deposits. Those emplaced in more felsic hostrocks are barren at their present surfaces. Based on these field investigations, combined with knowledge of the type of hostrock and mineralogy of the pegmatites, the economic potential of various groups of pegmatite in the Cat Lake-Winnipeg River pegmatite field is ranked and shown in Figure GS2024-3-15.

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Cat Lake–Winnipeg River pegmatite field		Pegmatite group	Hostrock
Rare-element mineralized pegmatite	High	Bernic Lake group (BL)	Gabbro
	↑	Maskwa Lake pegmatite series (MWL)	Anorthosite gabbro
		Eagle-Irgon pegmatite group (EAI)	Gabbro and/or granodiorite ± amphibolite
		Lac du Bonnet pegmatite group (LdB)	Pillow basalt/andesite
		Shatford Lake pegmatite group (SHL)	Amphibolite, metabasalt, andesite
		Greer Lake pegmatite group (GL)	Granodiorite
		Cat Lake pegmatite group (CAT)	Gabbro/amphibolite
	Low	Rush Lake group (RL)	Metasedimentary
Barren pegmatite (as per surface exposure)		Eaglenest Lake pegmatite group (ENL)	Granite
		Axial pegmatite group (AX)	Granodiorite (within Birse Lake pluton)
		Birse Lake pegmatite group (BIS)	Rhyolite/andesite
Most potential pegmatite for Li-mineralization (spodumene)	High	Bernic Lake group (BL)	Gabbro
	↑	Maskwa Lake pegmatite series (MWL)	Anorthosite gabbro
		Eagle-Irgon pegmatite group (EAI)	Gabbro and/or granodiorite ± amphibolite
	Moderate	Lac du Bonnet pegmatite group (LdB)	Pillow basalt/andesite

Figure GS2024-3-15: *Summary of Cat Lake–Winnipeg River pegmatite groups with consideration of their economic potential.*

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