GS2022-5

Critical minerals scoping study of the Suwannee River syenite intrusion, west-central Manitoba (part of NTS 64B4)

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In Brief:

- Detailed field description of Suwannee River syenite is presented; the syenite has not been studied since 1972
- The MGS continuously studies syenitic intrusions from the Kisseynew domain with potential to host critical mineral mineralization
- Goals of this study are understanding economic importance of syenite intrusions and its tectonic significance in the Trans-Hudson orogen

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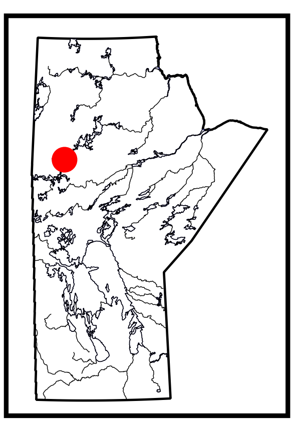

Summary

In the summer of 2022, a reconnaissance study was carried out focusing on the Suwannee River syenite intrusion, one of several syenite bodies in the Kisseynew domain of Manitoba. These types of intrusions can be associated with rare-earth–element mineralization. Rare-earth elements are considered critical by the governments of Manitoba and Canada. Field observations of the Suwannee River syenite were hindered by extensive lichen and moss coverage. The Suwannee River syenite is composed of a main hornblende-bearing phase that seems to be dominant in the majority of outcrops. Two additional phases of the syenite include a more leucocratic phase and a phase characterized by equant mafic clots. A similar syenite with mafic clots is also observed at other syenite complexes in the Kisseynew domain. The Suwannee River syenite is crosscut by leucogranite and pegmatite at various scales. Future work will include whole-rock geochemistry, petrography and isotope-geochronology studies.

Introduction

This report summarizes the preliminary findings of a critical minerals scoping study of the Suwannee River syenite in west-central Manitoba during July of 2022. The Suwannee River syenite is located roughly 38 km south of Leaf Rapids. The syenite outcrops are exposed over an area approximately 1.56 km in length and 1.27 km in width, and are only accessible by air. The area was mapped by Schledewitz (1972) and has not been studied in detail since then. The primary objective of this project is to examine the intrusive body along the Suwannee River for its potential to host critical element mineralization.

The rare-earth elements (REEs) are a group of elements considered critical for Manitoba (Manitoba Geological Survey, 2022b) and for Canada (Government of Canada, 2021). The current findings are part of a larger study initiated by the Manitoba Geological Survey (MGS) in 2011 that focuses on rare metals and the economic potential of different rocks that host critical elements in various parts of the province (Manitoba Geological Survey, 2022c). The Kisseynew domain (KD) in Manitoba hosts several syenite occurrences with potential for REE mineralization (e.g., Martins et al., 2011).

Geological setting

The Suwannee River syenite (Figure GS2022-5-1), mapped by Schledewitz (1972), is located in the north flank of the KD, a division proposed by Zwanzig (2008). The KD is a metasedimentary basin in the internal zone of the Trans-Hudson orogen dominated by metamorphosed greywacke and mudstone of the Burntwood group, which is interpreted to have been deposited in coalescing turbidite fans (Bailes, 1980; Zwanzig, 1999). The Burntwood group was deposited between ca. 1860 and 1840 Ma (Machado et al., 1999). Early folding and thrusting (D_1) occurred during 1842–1835 Ma and predated peak metamorphism in the KD. The D_1 deformation phase was accompanied by the intrusion of calcalkaline plutons from ca. 1840 to 1820 Ma. The youngest calcalkaline intrusions in the KD are represented by the enderbitic Touchbourne suite, which was intruded prior to the main tectonometamorphic event between ca. 1830 and 1820 Ma (Gordon et al., 1990; Machado et al., 1999). Two generations of nappe-like folding (F_2–F_3, 1820–1800 Ma) were accompanied by the intrusion of peraluminous granitoids (1820–1810 Ma; Kraus and Menard, 1997; White, 2005). The majority of the KD experienced low-pressure granulite-facies metamorphic conditions of 750 ±50°C and 5.5 ±1.0 kbar (Gordon, 1989) following D_2 (White, 2005). Peak metamorphic conditions continued through D_3. Folding and faulting continued during D_4 and D_5 until after ca. 1790 Ma (Zwanzig, 1999).

The tectonic setting of the Kisseynew basin continues to be a matter of debate. It has been interpreted as a back-arc basin to the Flin Flon volcanic-arc domain (e.g., Ansdell et al., 1995; Ansdell, 2005; Corrigan et al., 2009). However, intra-arc– and forearc-basin–environments were also proposed

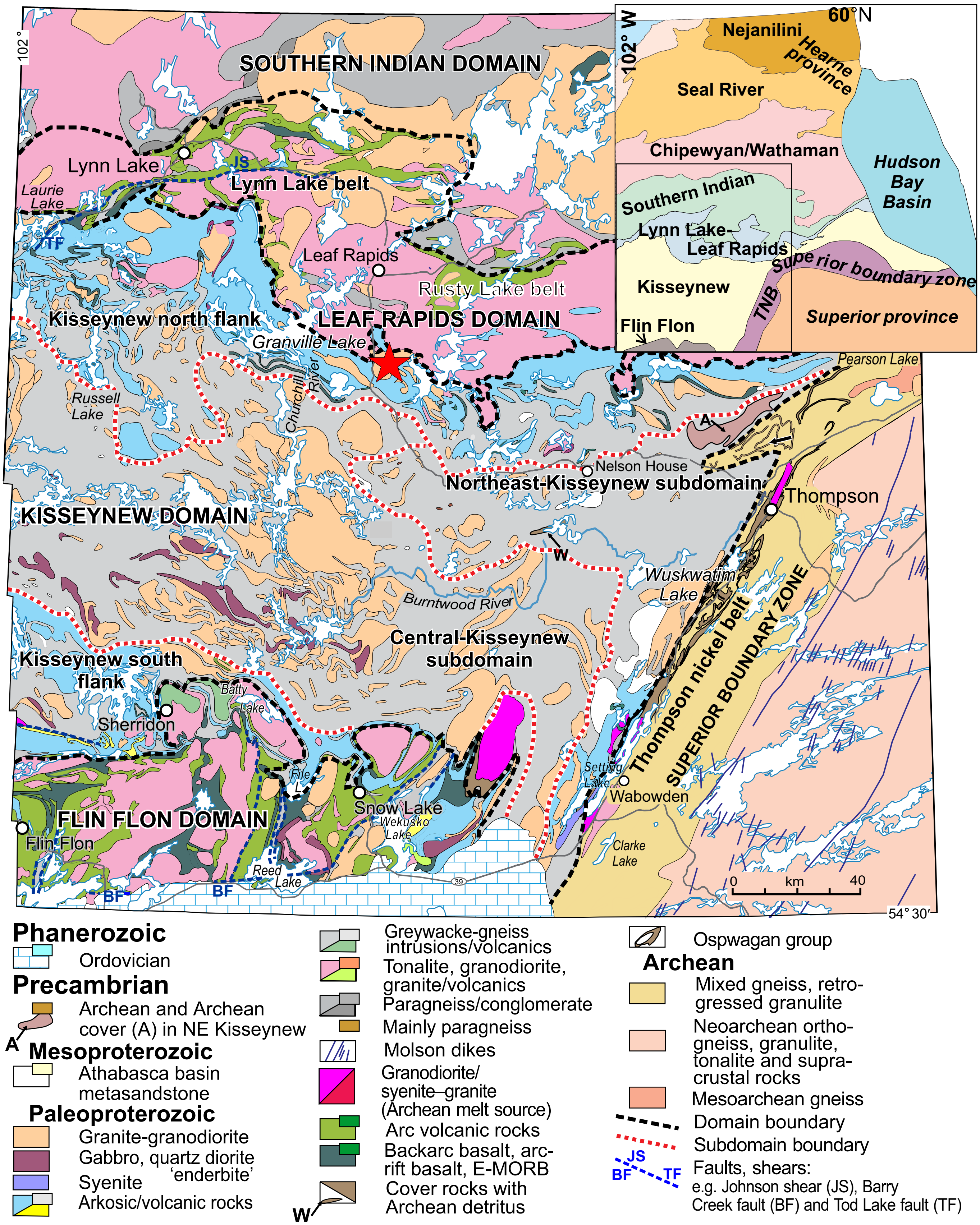

Figure GS2022-5-1: *Geology of the Kisseynew and surrounding domains, simplified and modified after Murphy and Zwanzig (2021). The location of the Suwannee River syenite is indicated with a star. The inset shows the domains of the Trans-Hudson orogen in Manitoba (after Manitoba Geological Survey, 2022a), with the location of the figure outlined. Abbreviations: E-MORB, enriched mid-ocean–ridge basalt; NE, northeastern; TNB, Thompson nickel belt; W, Wuskwatim Lake sequence.*

for the development of the KD, with a complex evolution during continental convergence and collision (Zwanzig, 1999; Zwanzig and Bailes, 2010; Murphy and Zwanzig, 2021).

Geology of the Suwannee River syenite

Schledewitz (1972) described the Suwannee River intrusion as a pear-shaped body of hornblende syenite occurring north of the Suwannee River. It is clearly defined in regional geophysical surveys by its intermediate magnetic intensity (Geological Survey of Canada, 1963) compared to the surrounding granitoid rocks. The body appears to be bound along its western margin by a fault, as indicated by a strong north-trending topographic lineament (Figure GS2022-5-2) and an abrupt aeromagnetic gradient (Schledewitz, 1972). Geological mapping by Schledewitz (1972) suggests that the syenite is surrounded by foliated quartz monzonite and granite. The foliation in the country rocks is interpreted as conformable with the margin of the syenite body; however, the contacts are not exposed.

The outcrops in the study area are extensively covered in lichen and moss, and surrounded by mature forest. These conditions make full and detailed observations of the outcrops difficult. The rock surrounding the syenite intrusion appears to consist of homogeneous pink granite that is coarse grained to pegmatitic, weakly foliated and magnetic. In an outcrop along the west side of the syenite intrusion (station 113-22-001; Figure GS2022-5-2), the granite is characterized by a weak, steeply dipping and northeast-trending fabric. The granite is composed of quartz (20–35%), biotite (3–5%), similar amounts of K-feldspar and plagioclase, and trace amounts of magnetite.

From the limited outcrop observations, the main phase of the syenite is relatively homogeneous, dark pink when fresh (locally reddish pink), buff-pink weathered, medium grained, foliated and locally magnetic (Figure GS2022-5-3a). It is composed of K-feldspar and plagioclase (40–50%), hornblende (10–20%), quartz (10–15%), clinopyroxene (7–15%), biotite (2–5%), titanite (1%), allanite (trace–1%) and trace amounts of magnetite. The mafic phases (i.e., hornblende, clinopyroxene, titanite and alla-

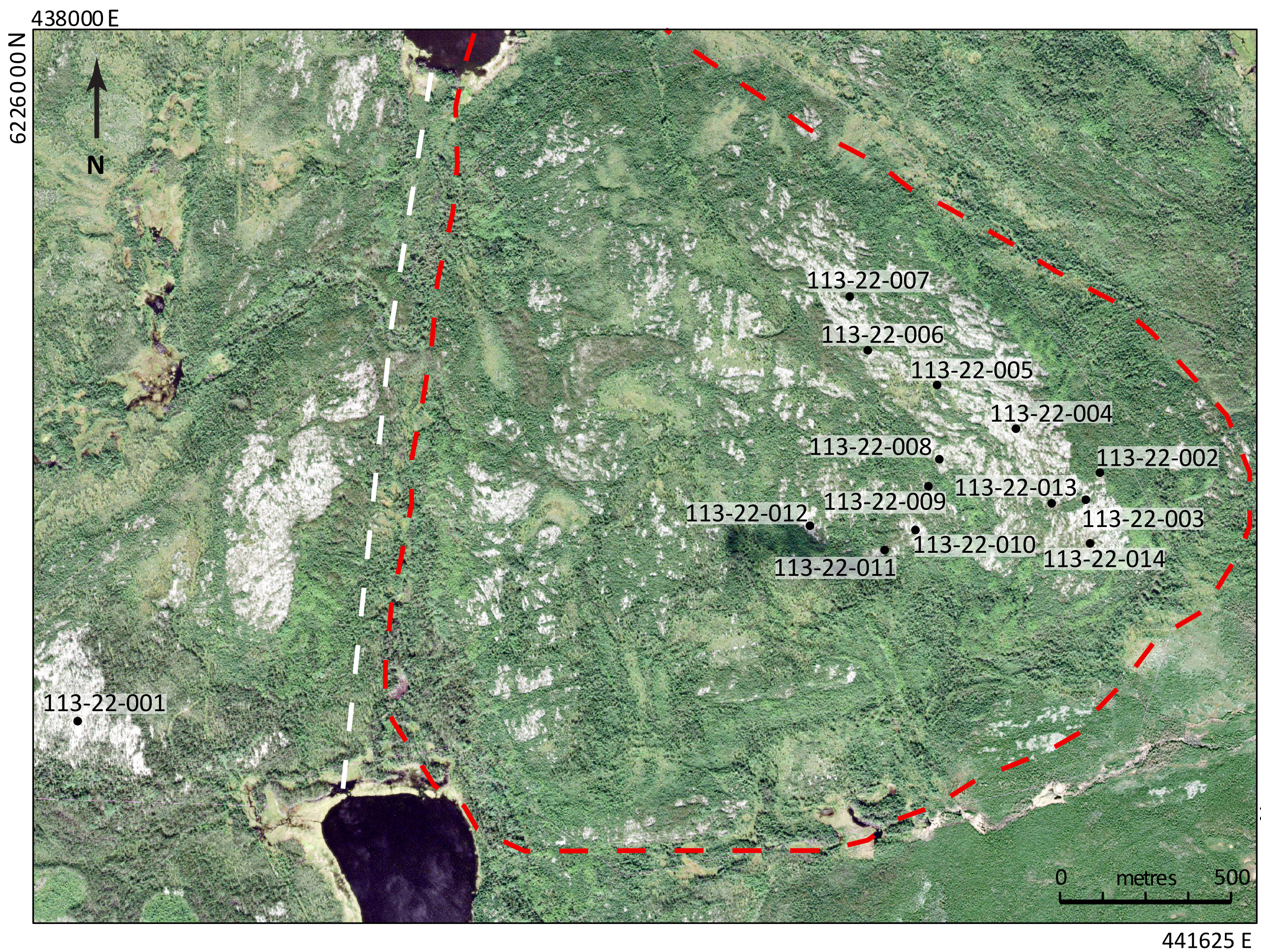

Figure GS2022-5-2: *Satellite image of the Suwannee River syenite. The white dashed line marks a strong topographic lineament and the red dashed line delineates the syenite body (after Schledewitz, 1972). Sources: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.*

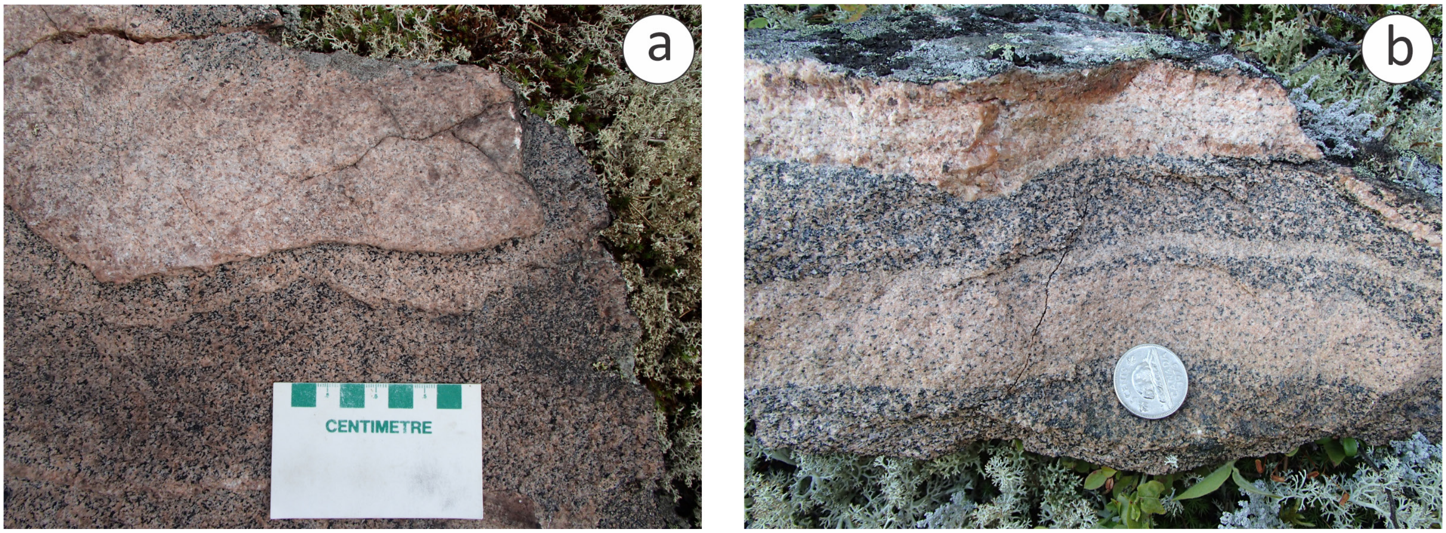

Figure GS2022-5-3: *Outcrop photographs of the main phase of the Suwannee River syenite and its textural variation:* ***a)*** *main phase of foliated hornblende syenite (under scale card), with a more leucocratic phase of the syenite at the top of the image;* ***b)*** *banded aspect of the syenite, showing alternating mafic compositions.*

nite) commonly occur as aggregates that are locally flattened and occasionally weathered to a combination of clay minerals and oxides. Local recessive weathering of the mafic minerals gives the rock a mottled appearance. In a few outcrops, the syenite shows vuggy weathering over areas ranging from 7 to 20 cm across. The main phase of the syenite locally alternates with bands of more leucocratic syenite (Figure GS2022-5-3b). The more leucocratic phase is pink, medium grained and foliated. Composition is similar to the main phase of syenite: K-feldspar and plagioclase (50–60%), hornblende (5–10%), quartz (10–15%), clinopyroxene (7–10%), biotite (2–5%), titanite (1%) and trace amounts of allanite and magnetite.

Another syenite phase, characterized by equant mafic clots composed of mostly hornblende, was observed at a few stations (Figure GS2022-5-4a). It contains K-feldspar (50–60%), quartz (20–30%), hornblende (7–10%) and trace amounts of titanite. A syenite phase with a similar texture was previously described at Eden Lake (colloquially called ‘chicken pox’ syenite; Couëslan, 2005; Mumin, 2010) and was also recently discovered at Brezden Lake (Hnatiuk et al., 2022). This syenitic phase is either cut by the main phase of the syenite body or contains xenoliths of the main phase. Limited outcrop exposures do not allow for definitive interpretation. Schledewitz (1972) described a similar phase of the syenite with a pink feldspathic groundmass distinctively spotted with equant greenish black hornblende.

A clinopyroxene-rich rock was identified in one outcrop at the contact with a pegmatite dike and a xenolith of quartz-rich biotite gneiss (Figure GS2022-5-4b). The clinopyroxene-rich rock is dark green, coarse to very coarse grained, massive and nonmagnetic. Clinopyroxene forms discrete euhedral prisms varying in size from 1 to 3 cm. This coarse-grained rock contains clinopyroxene (30–60%), quartz (10–20%), K-feldspar (10–20%), titanite (2–3%) and allanite (trace–1%). It is possible that this rock is the product of alkali metasomatism.

Leucogranite (Figure GS2022-5-4c) crosscuts the main phase of the syenite. This was also observed by Schledewitz (1972), who described the syenite as cut by fine-grained microcline-quartz veins and dikes. The leucogranite is pink, coarse grained, nonmagnetic and massive. It contains K-feldspar (40–60%), quartz (30–40%), plagioclase (10–15%), hornblende (2–5%), clinopyroxene (1–2%), allanite (trace–2%) and titanite (trace amounts). Quartz often occurs as discrete equant crystals. Allanite occurs as glassy to resinous black grains up to 2 mm in size. The leucogranite locally forms the dominant phase of outcrops and contains rafts of the main-phase syenite <1 m across. Pegmatite dikes (up to 1.5 m in width) also crosscut the main phase of the syenite. The granitic pegmatite contains quartz, feldspars and muscovite, and has pods of massive quartz <30 cm thick that locally form the cores of dikes. Other pegmatite dikes contain a core area enriched in K-feldspar (or possibly plagioclase stained by Fe oxides) with albitic rims, and were observed with comb-textured feldspar at the contacts with the syenite (Figure GS2022-5-4d).

Economic considerations

In 2021, the Government of Canada released a list of 31 elements considered critical for the sustainable economic success of the country and its allies, and to position Canada as a leading mining nation (Government of Canada, 2021). Rare-earth elements are part of this list and are used for a number of applications, most notably permanent magnets and batteries (Alonso et al., 2012), which are essential for the transition to clean energies and decarbonization of Canada’s economy. Canada continues to renew its intention to grow domestic and global supply chains for the green and digital economy, as highlighted in the govern-

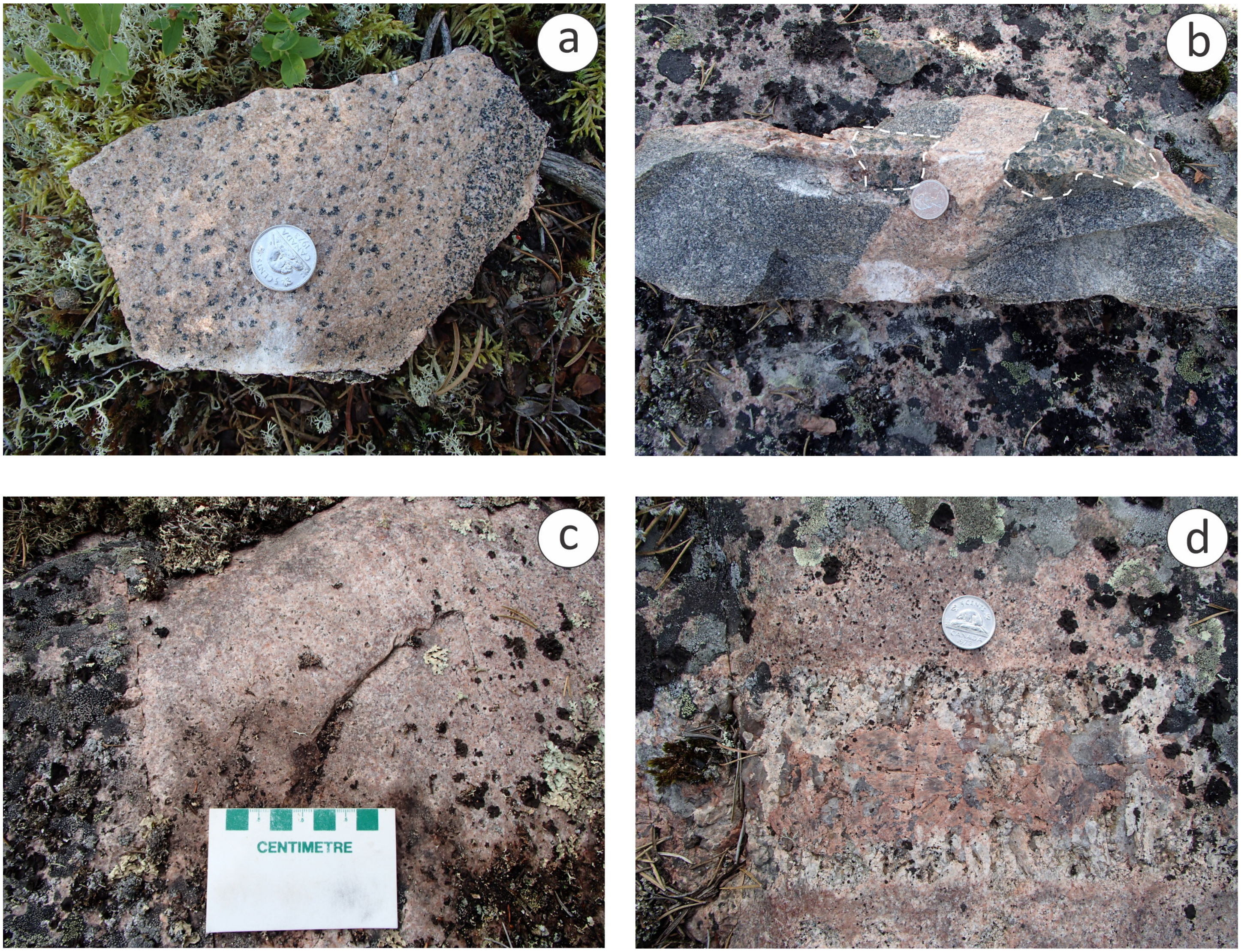

Figure GS2022-5-4: *Outcrop photographs of the Suwannee River syenite with textural variations and later intrusive phases:* ***a)*** *syenite phase with equant mafic clots;* ***b)*** *very coarse grained clinopyroxene rock (outlined in white) at the contact with pegmatite and a raft of quartz-rich biotite gneiss;* ***c)*** *detail of the leucogranite;* ***d)*** *crosscutting granitic pegmatite with pink feldspar core.*

ment's most recent discussion paper (Government of Canada, 2022).

Preliminary results from fieldwork suggest that the mineralogy (e.g., clinopyroxene, titanite, allanite) and some textures (e.g., mafic clots) of the Suwannee River syenite are similar to those of the syenite bodies observed at Brezden Lake (Martins et al., 2012; Hnatiuk et al., 2022), Burntwood Lake (Martins et al., 2011) and Eden Lake (Chakhmouradian et al., 2008), which are known for their potential to host REE mineralization. Future work planned for the Suwannee River syenite includes whole-rock geochemical analyses from representative samples, along with detailed petrographic work from thin sections. Additional analyses could include Sm-Nd isotopes and in-situ laser-ablation geochronology studies. Results from these studies will help in understanding the full economic potential of the Suwannee River syenite and its tectonic implications.

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