AER/AGS Open File Report 2025-08

Summary of the Critical Mineral Potential of the Andrew Lake and Leland Lakes Areas, Northeastern Alberta

AER/AGS Open File Report 2025-08

Summary of the Critical Mineral Potential of the Andrew Lake and Leland Lakes Areas, Northeastern Alberta

N.O. Montenegro[1], R.P. Hartlaub[2], M.B.K. Belosevic[3], E.C. Morley[3] and D.M. Meek[4]

[1] Department of Earth Sciences, University of Regina
[2] Department of Mining and Mineral Exploration, British Columbia Institute of Technology
[3] Alberta Energy Regulator / Alberta Geological Survey
[4] Formerly of Alberta Energy Regulator / Alberta Geological Survey

February 2026

ISBN 978-1-4601-5739-8

If you use information from this publication in other publications or presentations, please acknowledge the AER/AGS. We recommend the following reference format:

Montenegro, N.O., Hartlaub, R.P., Belosevic, M.B.K., Morley, E.C. and Meek, D.M. (2026): Summary of the critical mineral potential of the Andrew Lake and Leland Lakes areas, northeastern Alberta; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Open File Report 2025-08, 13 p.

Publications in this series have undergone only limited review and are released essentially as submitted by the author.

Author addresses:

N.O. Montenegro
Department of Earth Sciences
University of Regina
3737 Wascana Parkway
Regina, SK S4S 0A2
Canada

Tel: 306.552.8842
Email: nmontenegro.geo@gmail.com

R.P. Hartlaub
Department of Mining and Mineral Exploration
British Columbia Institute of Technology
3700 Willingdon Avenue
Burnaby, BC V5G 3H2
Canada

Tel: 604.456.1094
Email: russell_hartlaub@bcit.ca

Published February 2026 by:

Alberta Energy Regulator
Alberta Geological Survey
Suite 205
4999 – 98 Avenue NW
Edmonton, AB T6B 2X3
Canada

Tel: 780.638.4491
Email: AGS-Info@aer.ca
Website: ags.aer.ca

Contents

Figures

Abstract

The rising global demand for critical minerals has spurred renewed interest in the mineral potential of the Canadian Shield in northeastern Alberta. This report focuses on the major findings from fieldwork conducted in the Andrew Lake and Leland Lakes areas, a region with extensive outcrop and documented critical mineral occurrences. Investigations in 2023 were conducted independently for these areas and targeted three significant suites of critical minerals: (1) granitoid- and pegmatite-hosted rare-earth elements (REEs) and lithium, (2) structurally controlled / fluid-related uranium and REEs, and (3) mafic-associated critical metals, including copper, nickel, chromium, and cobalt.

At Andrew Lake, granitoids and pegmatites exhibit significant enrichment in REEs, particularly in light rare-earth elements, which are hosted in minerals such as monazite and allanite. The Slave granitoid pluton in the Leland Lakes area shows strong potential for lithium-cesium-tantalum (LCT) pegmatite generation, supported by geochemical signatures that indicate advanced fractionation of the parental magma as well as close proximity to structurally favourable zones. Structurally controlled uranium mineralization was identified at Spider and Cherry lakes, where shear zones and faults facilitated fluid migration and uranium enrichment. However, these areas represent only a portion of the prospective zones across a shield that is marked by significant uranium equivalent radiometric anomalies, indicating broader uranium potential in the region. Mafic-associated critical metals, including Cu, Ni, Cr, and Co, are concentrated along structural zones in the Leland Lakes region, particularly along the Leland Lakes shear zone. The complex geological history of the Andrew Lake and Leland Lakes areas, marked by multiple deformation phases and dynamic tectonic processes, has created structurally and lithologically favourable conditions for a diverse array of mineral systems.

For a detailed description of all of the findings of this study, see AER/AGS Open File Report 2025-09: *Investigating the Critical Mineral Systems of the Canadian Shield of Northeastern Alberta: A Summary of 2023 Fieldwork in the Leland Lakes and Andrew Lake Areas.*

This work was completed under the Mineral Grant provided by the Government of Alberta dated June 22, 2021.

1 Introduction

The Precambrian rock of the Canadian Shield in northeastern Alberta covers an exposed area of more than 9000 square kilometres. Numerous mineral occurrences have been documented in the region (Pană et al., 2006; Pană and Olson, 2009; Rukhlov, 2011), some of which were discovered during a boom in uranium exploration that occurred in the late 1960s. Subsequent activity has focused primarily, but not exclusively, on uranium potential. Since the 1980s, sporadic, small-scale exploration work has been conducted in the Andrew Lake and Leland Lakes region with a more diverse focus, including precious metals, base metals, and rare-earth elements (REEs; Mann, 1991, 1995; Cantin, 1996; Friesen, 1998; Wiskel, 1999). This work included the investigation for precious metals and lanthanides near Harker Lake (Mann, 1991), continued exploration for gold mineralization at Waugh Lake (Cantin, 1996; Wiskel, 1999), and examination of a prominent linear magnetic high anomaly west of the Leland Lakes study area (Mann, 1995; Friesen, 1998). The most recent reported exploration activity on the Canadian Shield near Andrew Lake and Leland Lakes was conducted by North American Gem Inc. in 2006 and 2007 (Grant and Smith, 2007; Smith and Griffith, 2007). This regional exploration program discovered new anomalies while revisiting numerous known uranium and REE occurrences across the region.

The last campaign of detailed geological mapping in the region by the Alberta Geological Survey (AGS) was concluded in the 1970s. In response to the rising global demand for minerals and the renewed interest in the mineral potential of the Canadian Shield in Alberta, the AGS undertook this latest mapping campaign in 2023 to better understand the critical mineral systems that may be present in the area.

The Andrew Lake and Leland Lakes study areas offer excellent exploration potential due to the large extent of exposed Canadian Shield and presence of numerous critical mineral occurrences (Figure 1). However, it should be noted that a large portion of the Andrew Lake area falls within the Kazan Wildland Provincial Park created in 2018, which presents limitations for future exploration activity in the area. Even though the critical mineral potential of the exposed Canadian Shield in Alberta includes an array of critical minerals and metals, this report is focused on three major suites deemed to be significant in the study areas: (1) granite- and pegmatite-hosted REEs and lithium (Li), (2) structurally controlled / fluid-related uranium (U) and minor REEs, and (3) mafic-associated critical metals, including copper (Cu), nickel (Ni), chromium (Cr), and cobalt (Co).

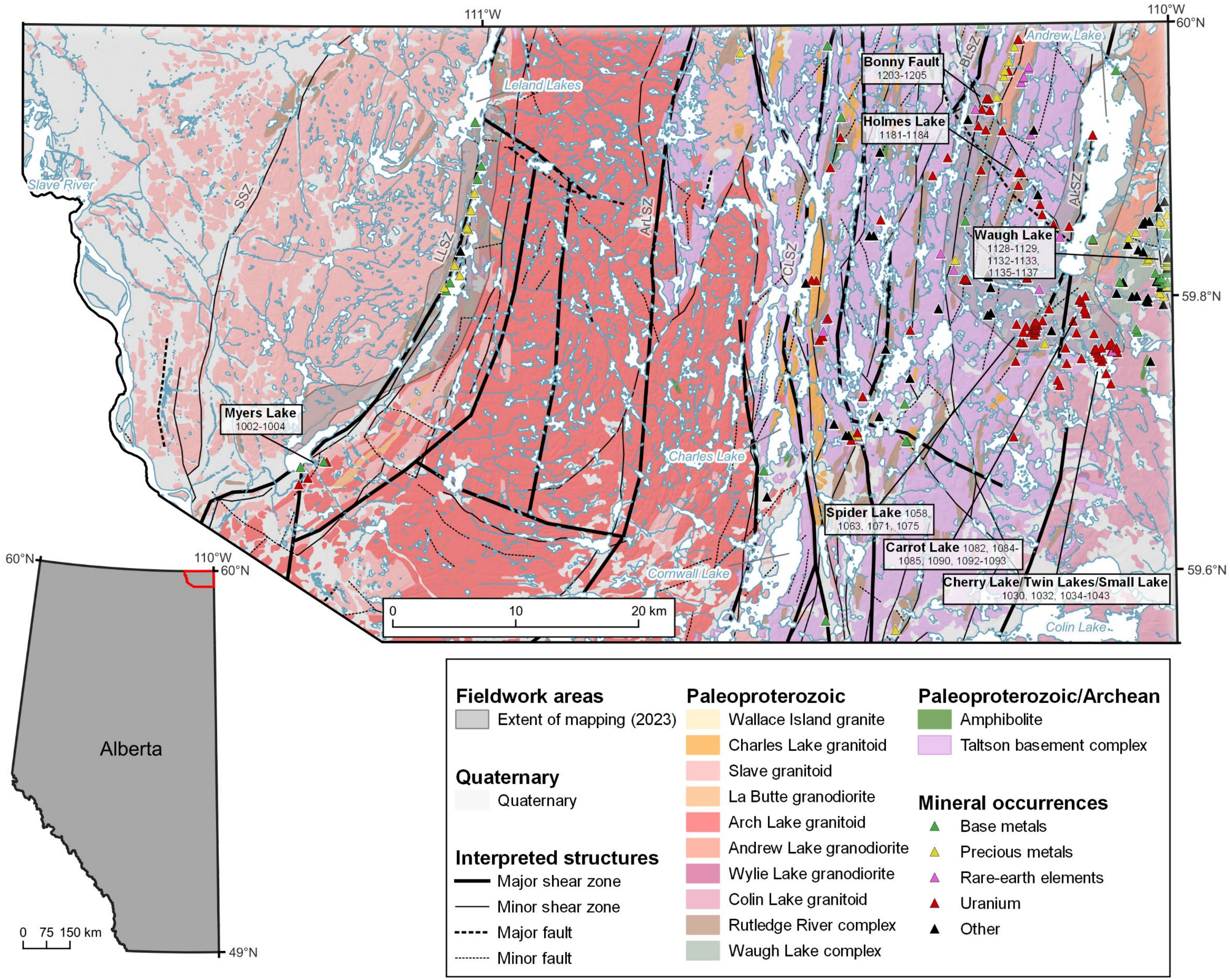

Figure 1. Extent of the 2023 fieldwork areas, northeastern Alberta, with simplified geology modified from Pană (2010) and structural interpretations from Lopez et al. (2024). Highlighted metallic mineral occurrences, geochemical anomalies, and showings from Lopez et al. (2020). Significant occurrences are identified on the map, with associated metallic mineral occurrences identifier, from Lopez et al. (2020). Inset map shows the location of the map area. Abbreviations: ALSZ, Andrew Lake shear zone; ArLSZ, Arch Lake shear zone; BLSZ, Bayonet Lake shear zone; CLSZ, Charles Lake shear zone; LLSZ, Leland Lakes shear zone; SSZ, Slave shear zone.

2 Granitoid- and Pegmatite-Hosted REEs and Lithium

2.1 Anatectic Pegmatites

Pegmatites in the Andrew Lake study area exhibit significant potential for REE mineralization (Figure 2). These pegmatites were formed under mid- to high-grade metamorphic conditions and occur as dikes, pods, and boudins. They are commonly situated in structurally controlled zones, exploiting planes of weakness linked to regional polyphase deformation. The REEs in these rocks are associated with elevated concentrations of thorium (Th), uranium (U), and zirconium (Zr) and are hosted in minerals such as monazite, allanite, zircon, and titanite within granitic to residual melt / cumulate pegmatites. The pegmatites at Andrew Lake show many similarities to those in the Alces Lake area, a significant REE project located approximately 120 km east of the Andrew Lake area in Saskatchewan. The mineralized zones at Alces Lake exhibit exceptionally high concentrations of REEs, particularly neodymium and praseodymium, compared to global occurrences (Workman, 2023). Both regions feature pegmatites that are enriched in light rare-earth elements (LREEs) and relatively depleted in heavy rare-earth elements (HREEs) with significant negative europium (Eu) anomalies (Poliakovska et al., 2023). One major difference is that pegmatites from the Andrew Lake area exhibit significantly lower REE concentrations than those at Alces Lake. This difference may be attributed to factors such as less-enriched source material in the Andrew Lake area, fewer regional tectonic partial melt cycles, monazite-rich restite remaining in the source region during partial melting, and possibly less efficient metasomatic processes (Normand, 2014; Poliakovska et al., 2022). When classified according to the scheme of Černý and Ercit (2005), the Andrew Lake pegmatites fall into the abyssal-LREE (U, Th, Ti) subclass, situating them within a known framework of REE-bearing pegmatite types.

Despite these differences, there is potential for discovering significant REE mineralization in the Andrew Lake area. The presence of structurally controlled pegmatites, favourable mineralogical characteristics, and geochemical enrichment in LREEs suggest that further exploration is warranted. Future work could focus on detailed mapping of shear zones, petrographic analyses, and geochemical assays to better understand the processes that led to REE enrichment and to identify potential targets for exploration.

2.2 Pegmatite-Hosted Lithium Potential—Slave Granitoid

The Slave granitoid, located west of the Leland Lakes shear zone (LLSZ), presents promising potential to host lithium-cesium-tantalum (LCT) pegmatites. Key geochemical indicators support this potential (Figure 3), including favourable magnesium to lithium (Mg/Li), potassium to rubidium (K/Rb), and niobium to tantalum (Nb/Ta) ratios, which suggest significant fractionation (Černý, 1989; Selway et al., 2005). Geochemical reanalysis of historical whole-rock samples from the Leland Lakes area reveals strong indicators of advanced fractionation, particularly along the eastern margin of the pluton adjacent to the LLSZ (Meek et al., 2023, 2025). The Nb/Ta ratios in samples collected along this shear zone are notably low, typically less than 5, suggesting a highly fractionated and fertile environment conducive to LCT pegmatite genesis (Selway et al., 2005). Additionally, low K/Rb ratios and low zirconium to hafnium (Zr/Hf) ratios further indicate advanced fractionation and are commonly associated with granitic melts capable of producing LCT pegmatites (Černý, 1991).

The peraluminous and S-type character of the Slave granitoid, combined with its proximity to lithium-rich metasedimentary rocks of the Rutledge River complex (RRC), enhances its potential for having hosted or generated LCT pegmatite melts. Furthermore, the highest concentrations of potassium identified from radiometric surveys occur along the western margin of the Slave granitoid, localized on the eastern margin of a newly recognized, north- to northeast-trending, high-strain zone named the Slave shear zone (SSZ); these potassium anomalies present exploration opportunities (Charbonneau et al., 1994; Lopez et al., 2024).

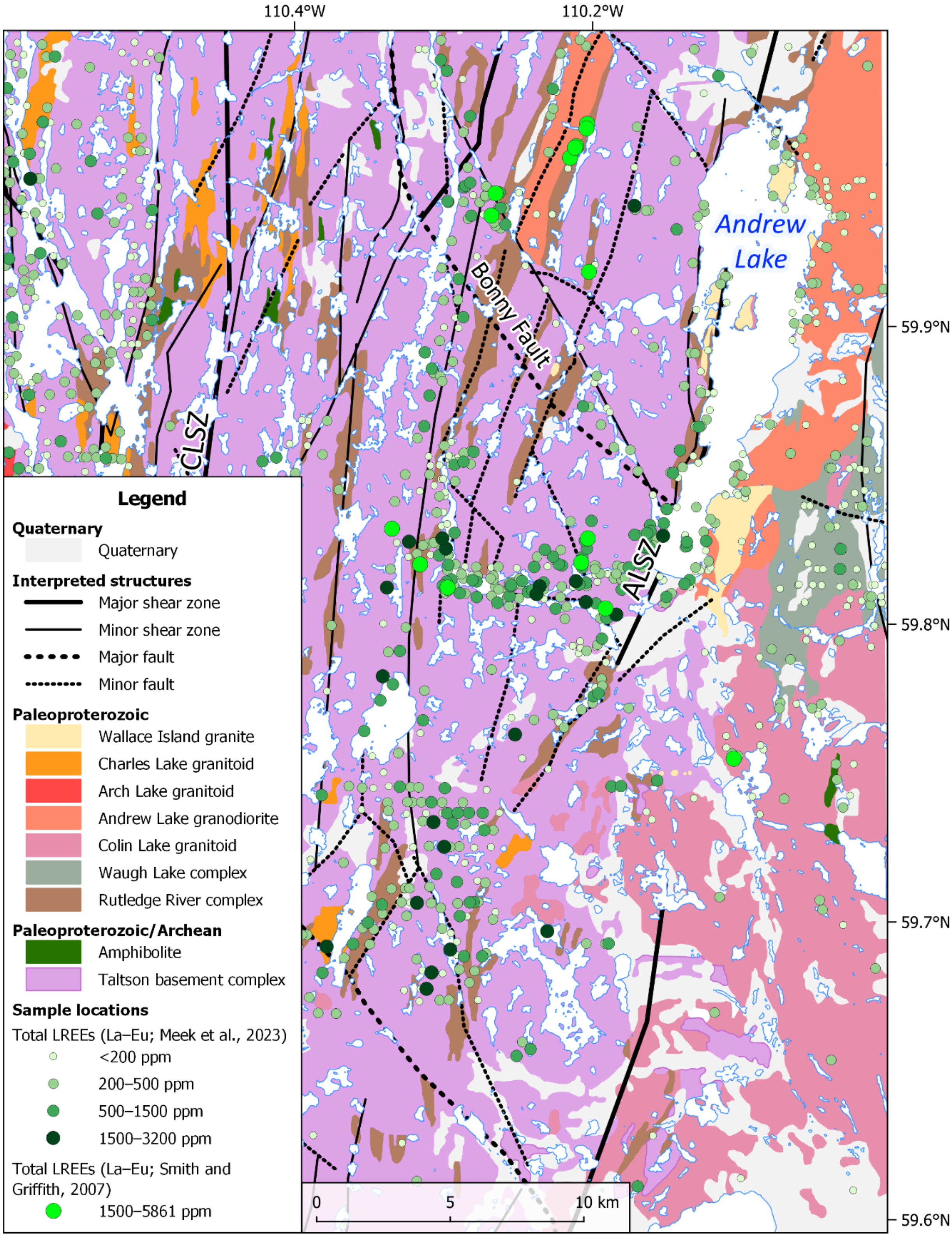

Figure 2. Total light rare-earth elements (LREEs) in analyzed samples from the Andrew Lake area, northeastern Alberta (Smith and Griffith, 2007; Meek et al., 2023), with bedrock geology from Pană (2010) and interpreted structures from Lopez et al. (2024). Abbreviations: ALSZ, Andrew Lake shear zone; CLSZ, Charles Lake shear zone.

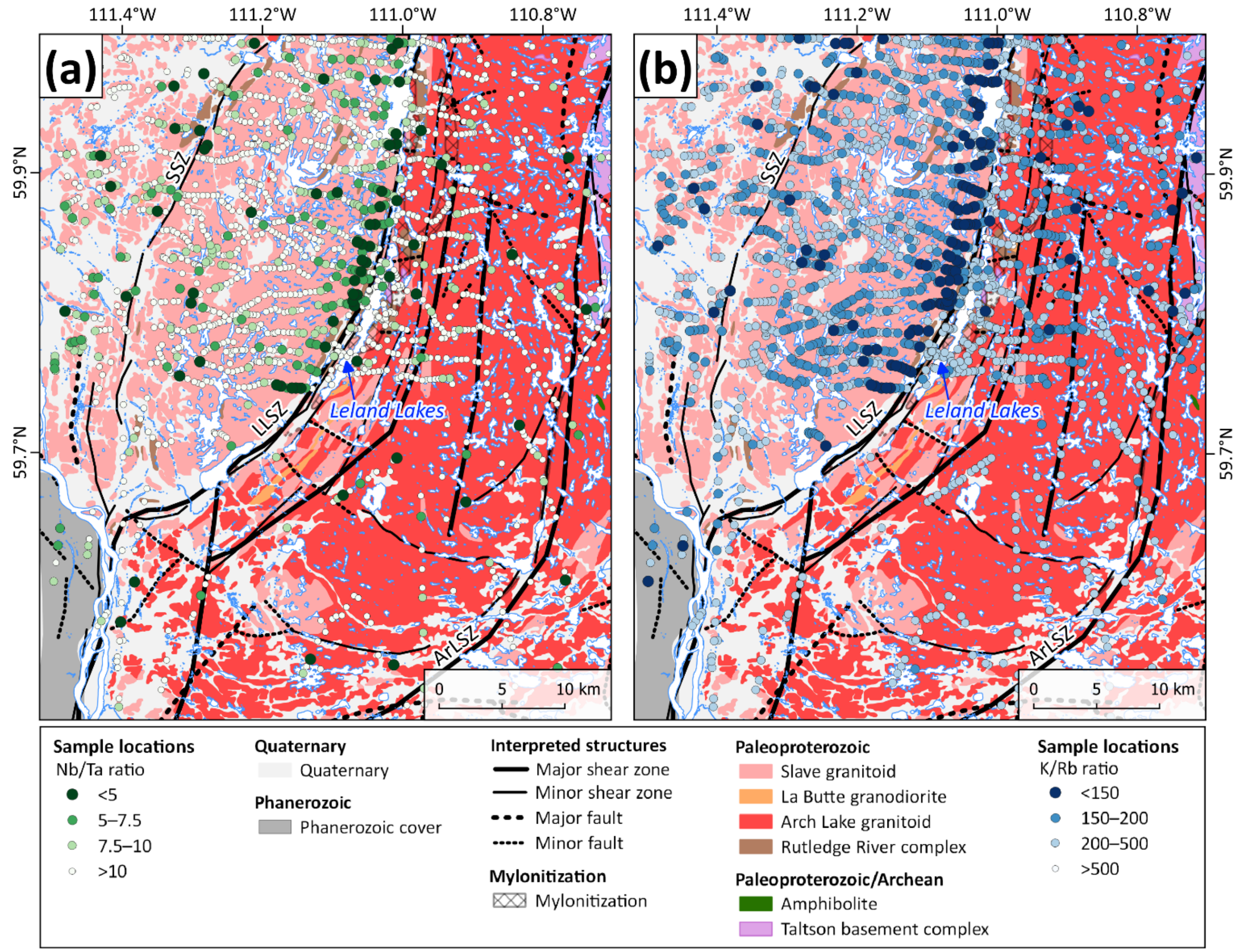

Figure 3. Granite fertility fractionation indicators in the Slave granitoid, Leland Lakes study area, northeastern Alberta, based on the geochemical reanalysis of historical whole-rock samples (Meek et al., 2023, 2026): (a) Nb/Ta ratios, with notably low values localized along the eastern margin of the pluton, along the Leland Lakes shear zone (LLSZ); (b) K/Rb ratios, with a concentration of low values similarly localized along the LLSZ. Bedrock geology from Pană (2010) with interpreted structures modified from Lopez et al. (2024). Abbreviations: ArLSZ, Arch Lake shear zone; SSZ, Slave shear zone.

Moreover, it is possible that granitoid dikes and pegmatites were emplaced up to 10 km from the parent granite along structural conduits such as faults and shear zones. In the Leland Lakes area, pegmatites with the greatest economic potential may occur within a 10 km zone surrounding the Slave granitoid batholith, as these pegmatites are more likely to contain abundant volatiles and other refractory phases (Selway et al., 2005). Given the voluminous character of the Slave granitoid, its geochemically evolved nature, and significant crustal assimilation, this pluton represents a promising target for future investigation, particularly towards the margins of the intrusion.

3 Structurally Controlled / Fluid-Related Uranium

The Spider Lake and Cherry Lake areas exhibit significant potential for structurally controlled uranium mineralization (Figure 4), supported by historical exploration (Godfrey, 1963; Lipsett and Trigg, 1968; Thorpe, 1969). These areas have been re-examined to better understand the geological controls on uranium enrichment.

At Spider Lake, uranium mineralization is associated with the sheared contact between high-grade, metatexitic basement gneisses of the Taltson basement complex (TBC) and mylonitized paragneisses of the RRC. This contact could be an extension of the Andrew Lake shear zone (ALSZ), which trends south-southwest to north-northeast, as supported by recent field mapping and geophysical analyses (Lopez et al., 2024). Furthermore, mineralization is concentrated within the leucosomal component of the RRC, interpreted as a phase of the Colin Lake white granite. Moreover, a gradational fault zone extending northeast from the northeastern shore of Spider Lake separates metatexitic paragneiss from diatexite, where pegmatitic intrusions associated with the Colin Lake white granite exhibit elevated uranium concentrations.

Mineralogical and textural features within the RRC paragneiss provide insights into its metallogenic significance. Gossanous schistose pelitic interlayers are common, and contain minor graphite. Moreover, the presence of orthopyroxene and sulphides in the metasedimentary sequences suggests that the original sedimentary rocks were likely chemically modified before metamorphism. These characteristics reflect complex fluid-rock interactions that could have influenced redox conditions, metal mobility, and the localization of uranium. Such conditions, coupled with structural focusing along shear zones and fault networks, likely played a pivotal role in concentrating uranium-bearing fluids (Montenegro et al., 2026).

Radioactive zones were originally identified by the AGS to the west and north of the northern end of Cherry Lake (Godfrey, 1958, 1963), where mineralization is dispersed throughout voluminous bodies of the Colin Lake white granite. The Cherry Lake area is characterized by northwest-southeast-trending shear zones as well as minor northerly trending shears and brittle-ductile faults, which served as pathways for fluid flow and uranium mobilization. Elevated equivalent uranium (eU) anomalies identified from radiometric surveys correlate with these structural features (Charbonneau et al., 1994; Lopez et al., 2024). A sample collected by the AGS in 2023 from the northern shore of Cherry Lake recorded handheld gamma-ray spectrometer readings of approximately 40 000 counts per second and assay values up to 930 ppm U, without enrichment in other metals (Montenegro et al., 2026). Farther northwest of Cherry Lake, historical trenches exposed pegmatites with increased radioactivity. Historical samples from these trenches returned values of up to 0.18% U_3O_8 (Burgan, 1971), and subsequent AGS sampling yielded 17 957 ppm U (Langenberg et al., 1993). These occurrences are associated with fault gouge zones within granite gneiss, emphasizing the role of structural deformation in enhancing uranium mineralization.

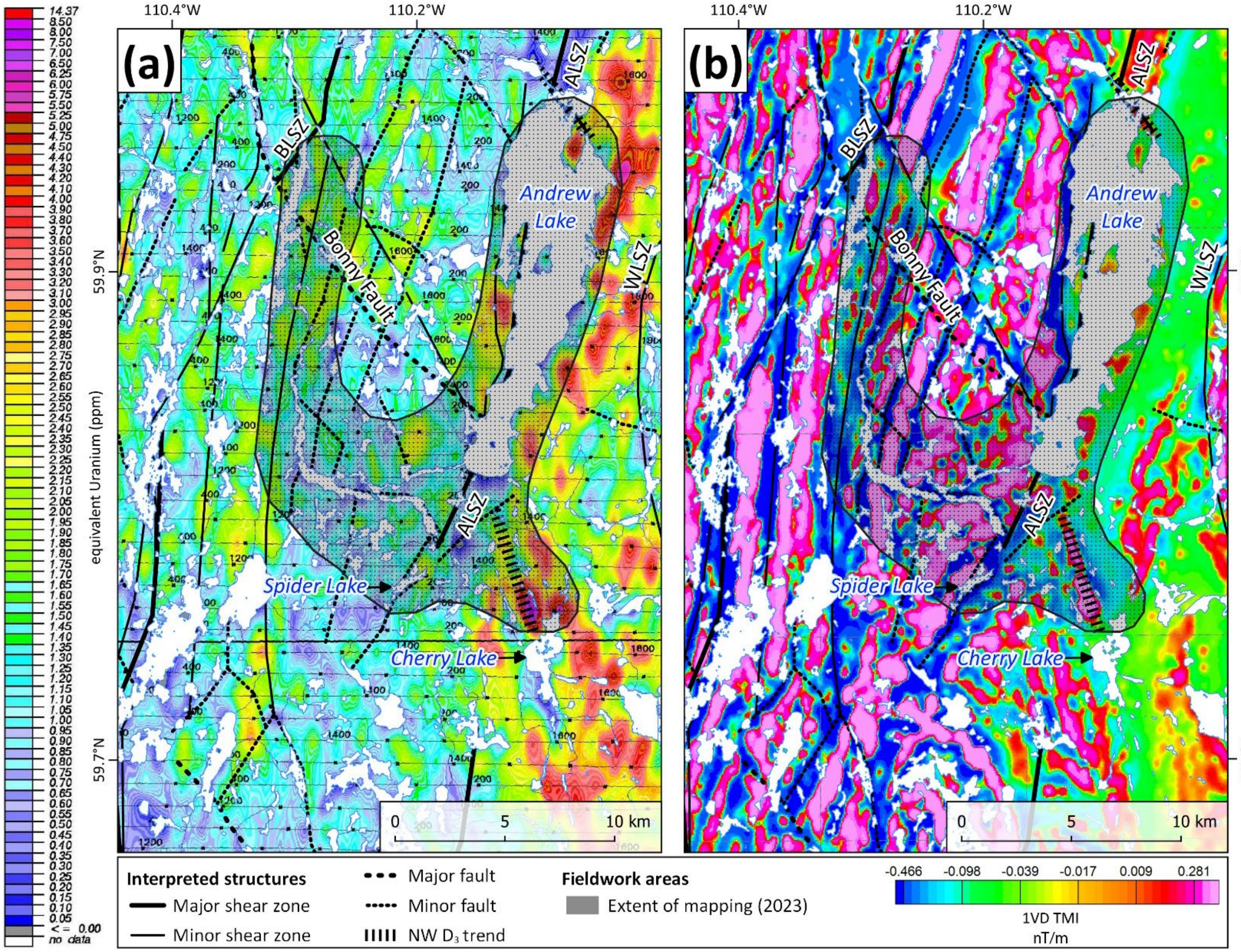

Figure 4. (a) Geological Survey of Canada radiometric map (modified from Charbonneau et al., 1994) exhibiting equivalent uranium values in the Andrew Lake region, northeastern Alberta. Structural interpretations from Lopez et al. (2024). (b) Structural first vertical derivative (1VD) aeromagnetic map, showing total magnetic intensity (TMI) in the Andrew Lake region, northeastern Alberta (Lopez et al., 2024). Abbreviations: ALSZ, Andrew Lake shear zone; BLSZ, Bayonet Lake shear zone; nT, nanotesla; WLSZ, Waugh Lake shear zone.

4 Mafic-Associated Critical Metals

Numerous Cu, Ni, Cr, and Co anomalies occur along the LLSZ (Langenberg et al., 1994). In 2023, investigation along this structural zone identified additional anomalies (Montenegro et al., 2026) as well as a clear correlation between these critical metals and exposures of basement gneiss, amphibolite, and metasedimentary rocks (Figure 5a). Although the Leland Lakes area does not have large kilometre-scale amphibolite bodies, there are abundant mafic layers, bands, and xenoliths within the basement heterogeneous gneiss unit that is exposed along the LLSZ. As noted in Montenegro et al. (2026), the mafic rocks in the Leland Lakes study area have a basaltic geochemistry with a normal (N-type) mid-ocean-ridge basalt (N-MORB) normalized REE pattern, which displays LREE enrichment. Some of these samples also display a negative Eu anomaly.

Numerous historical anomalies lie within the high-grade metamorphic and mylonitic gneisses within the LLSZ. One prominent anomaly within garnet-rich metasedimentary rocks and gneisses returned an assay value of 215 ppm Cu (Langenberg et al., 1994, M.O. 13, sample 14-03; Figure 5a). A recent forest fire improved the bedrock exposure in this area and enabled the identification of new mineral occurrences in 2023. These discoveries include a gossanous pyrite-rich metasedimentary rock with thin quartz veins that yielded 556 ppm Cu (sample LL-23-1103-1; Figure 5a) and a green fuchsitic vein that yielded 408 ppm Cu, 444 ppm Ni, 1250 ppm Cr, 91 ppm Co, and 619 ppm As (sample LL-23-1102-3; Figure 5a). These occurrences lie adjacent to a mafic amphibolite with elevated Co and As values (sample LL-23-1102-2; Figure 5a). Approximately 170 m northeast of this area, a mafic sample taken from an enclave within the basement gneiss returned values of 700 ppm Cr, 228 ppm Ni, and 14.1 ppm Cs (sample LL-23-1002-1; Figure 5a). Farther north, on the eastern shore of Leland Lakes, a sample collected from a mafic enclave interlayered with gossanous metasedimentary rock returned values of 1730 ppm Cr, 658 ppm Ni, 71 ppm Co, 79 ppm Cu, and 0.157% S (sample LL-23-2044-1; Figure 5a). To the south-southeast, a similar sample from a gabbroic amphibolite enclave within the basement gneiss returned values of 1790 ppm Cr, 69 ppm Co, 433 ppm Ni, 237 ppm Zn, and elevated Cu, Ge, Sn, and Cs values (sample LL-23-2010-2; Figure 5a). The combination of historical Cu occurrences and newly discovered Cu-polymetallic occurrences stretches for more than 14 km along the Leland Lakes. Recently, the AGS (Meek et al., 2023) submitted historical igneous and metamorphic samples, collected during regional mapping in the 1950s, 1960s, and 1970s, for whole-rock and trace-element geochemical analyses. The results of this work clearly indicate that Co, Cr, Cu, and Ni values are elevated within the basement gneisses and along the length of the LLSZ (Figure 5b). Gold was not measured as part of the recent geochemical analyses projects (Meek et al., 2023, 2026; Montenegro et al., 2026) though a number of historical gold occurrences also occur along the LLSZ (Figure 5a).

The association of Au, Cu, Cr, Ni, and Co mineralization with a significant structural zone and mafic igneous rocks indicates that the LLSZ area may be prospective for a variety of mineral deposit types, including orogenic gold (e.g., Goldfarb et al., 2001), volcanogenic massive sulphides (VMS), and magmatic nickel-copper, platinum-group elements (PGE), and chromium (e.g., Naldrett, 2004). The polymetallic nature of the occurrences, with elevated Cr, Ni, and Co values, indicates significant ancient magmatic contributions to metal enrichment. These characteristics warrant further detailed mapping, geophysical surveys, and geochemical analyses to better define the mineralizing systems and guide future exploration efforts.

The Andrew Lake study area hosts numerous large gabbro and amphibolite units within the TBC. These mafic units also hold potential for magmatic Ni-Cu-Co and PGE mineralization but lack the elevated metal contents that are seen in grab samples from the Leland Lakes study area.

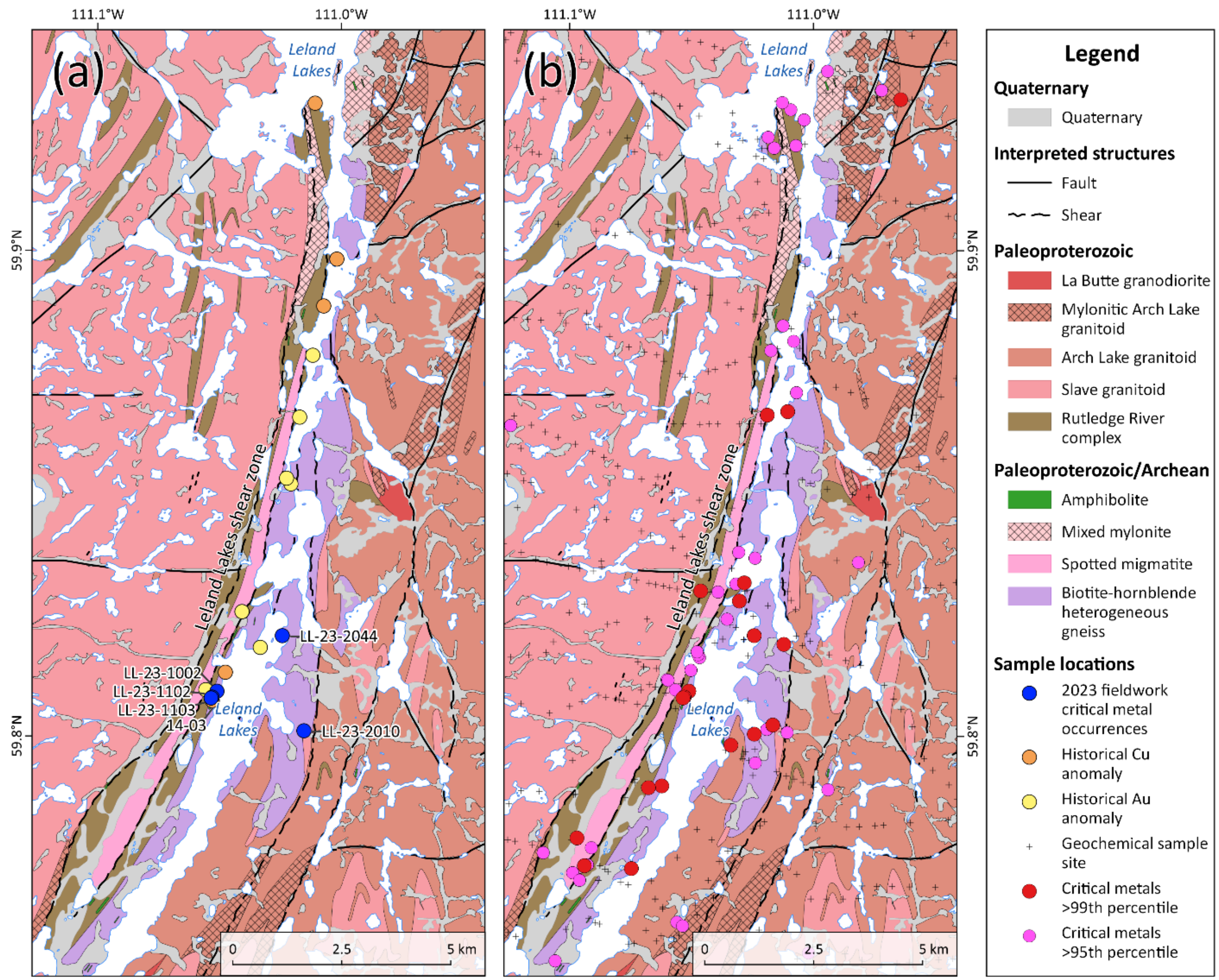

Figure 5. Geology of the northern part of the Leland Lakes study area in northeastern Alberta (modified from Godfrey and Langenberg, 1986) with bedrock interpretations from 2023 fieldwork: (a) critical metal occurrences observed in 2023, and historical copper and gold occurrences (Langenberg et al., 1994); (b) location of all geochemical samples (Meek et al., 2023, 2026) with critical metal concentrations in the >95th percentile (Co >25 ppm and/or Cr >220 ppm and/or Cu >41 ppm and/or Ni >52 ppm) and >99th percentile (Co >49 ppm and/or Cr >641 ppm and/or Cu >94 ppm and/or Ni >124 ppm). Structural interpretations from Godfrey and Langenberg (1986) and Montenegro et al. (2026).

5 Conclusions

The Canadian Shield in northeastern Alberta exhibits significant potential for critical mineral exploration, particularly for rare-earth elements (REEs), lithium, uranium, and mafic-associated critical metals such as copper, nickel, chromium, and cobalt. The Taltson basement complex and associated pegmatites at Andrew Lake show significant light rare-earth element (LREE) enrichment, indicating potential for anatectic REE mineralization. Pegmatites in this area classify within the abyssal-LREE (U, Th, Ti) subclass and exhibit similarities to those at the significant Alces Lake REE project in Saskatchewan. The Slave granitoid in the Leland Lakes area demonstrates promising potential for lithium-cesium-tantalum pegmatites, supported by favourable geochemical indicators and structural settings. Structurally controlled uranium mineralization is evident at Spider and Cherry lakes, where shearing and faulting enhanced fluid flow and remobilization of uranium, leading to concentrated mineralization. The association of critical metals with strongly deformed mafic igneous and metasedimentary rocks is consistent with the geological settings of several deposit types, including orogenic gold, volcanogenic massive sulphides, and magmatic nickel-copper, platinum-group elements, and chromium. The Leland Lakes shear zone has the highest potential for these critical metal deposits.

6 References

Burgan, E.C. (1971): Report of work, quartz mineral exploration permit #158, Hudson's Bay Oil and Gas Company Limited; Alberta Energy and Minerals, Mineral Assessment Report 19710009, 6 p., URL <https://content.energy.alberta.ca/xdata/MARS/MAR_19710009.pdf> [January 2024].

Cantin, R.G. (1996): Waugh Lake assessment report, permit 9393100018; Alberta Energy and Minerals, Mineral Assessment Report 19960007, 26 p., URL <https://content.energy.alberta.ca/xdata/MARS/MAR_19960007.pdf> [January 2024].

Černý, P. (1989): Exploration strategy and methods for pegmatite deposits of tantalum; *in* Lanthanides, tantalum and niobium, P. Möller, P. Černý and F. Saupé (ed.), Society for Geology Applied to Mineral Deposits, Special Publication 7, p. 271–299.

Černý, P. (1991): Rare-element granitic pegmatites. Part 1: anatomy and internal evolution of pegmatitic deposits; Geoscience Canada, v. 18, no. 2, p. 49–67.

Černý, P. and Ercit, T.S. (2005): The classification of granitic pegmatites revisited; The Canadian Mineralogist, v. 43, no. 6, p. 2005–2026, doi:10.2113/gscanmin.43.6.2005.

Charbonneau, B.W., Holman, P.B. and Hetu, R.J. (1994): Airborne geophysical survey, northeast Alberta; Geological Survey of Canada, Open File 2807, 13 maps, 1:250 000 scale, URL <https://ostrnrcan-dostrncan.canada.ca/handle/1845/193546> [April 2023].

Friesen, E.J. (1998): Geological report on Dog River mineral permit number 9392060003, 9392060004, 9392070001, 9392070004 for GRQ Mining Inc.; Alberta Energy and Minerals, Mineral Assessment Report 19980020, 13 p., URL <https://content.energy.alberta.ca/xdata/MARS/MAR_19980020.pdf> [January 2024].

Godfrey, J.D. (1958): Mineralization in the Andrew, Waugh, and Johnson Lakes area, northeastern Alberta; Research Council of Alberta, RCA/AGS Earth Sciences Report 1958-04, 24 p., URL <https://ags.aer.ca/publication/esr-1958-04> [April 2023].

Godfrey, J.D. (1963): Geology of the Andrew Lake, South District, Alberta; Research Council of Alberta, Alberta Geological Survey, Earth Sciences Report 1961-02, 35 p., URL <https://ags.aer.ca/publication/esr-1961-02> [April 2023].

Godfrey, J.D. (1986): Geology of the Precambrian Shield in northeastern Alberta (NTS 74M and 74L N1/2); Alberta Research Council, Alberta Geological Survey, Map 180, scale 1:250 000, URL <https://ags.aer.ca/publication/map-180> [April 2023].

Godfrey, J.D. and Langenberg, C.W. (1986): Geology of the Fitzgerald, Tulip-Mercredi-Charles Lakes District, Alberta; Alberta Research Council, Alberta Geological Survey, Earth Sciences Report 1984-07, 43 p., URL <https://ags.aer.ca/publication/esr-1984-07> [April 2023].

Goldfarb, R.J., Baker, T., Dubé, B., Groves, D.I., Hart, C.J. and Gosselin, P. (2001): Orogenic gold and geologic time: a global synthesis; Ore Geology Reviews, v. 18, issues 1–2, p. 1–75, doi:10.1016/S0169-1368(01)00016-6.

Grant, M. and Smith, D. (2007): North American Gem Inc. 2005 to 2007 exploration of the Bonny Fault property, northeast Alberta; Alberta Energy and Minerals, Mineral Assessment Report 20070018, 8 p., URL <https://content.energy.alberta.ca/xdata/MARS/MAR_20070018.pdf> [January 2024].

Langenberg, C.W., Salat, H., Turner, A. and Eccles, D.R. (1993): Evaluation of the economic mineral potential in the Andrew Lake-Charles Lake area of northeast Alberta; Alberta Research Council, Alberta Geological Survey, Open File Report 1993-08, 100 p., URL <https://ags.aer.ca/publication/ofr-1993-08> [April 2023].

Langenberg, C.W., Salat, H.P. and Eccles, D.R. (1994): Mineral occurrences of the Selwyn and Leland Lakes areas, northeast Alberta; Alberta Research Council, Alberta Geological Survey, Open File Report 1994-05, 28 p., URL <https://ags.aer.ca/publication/ofr-1994-05> [April 2023].

Lipsett, E. and Trigg, C.M. (1968): Airborne scintillometer survey of the New Senator option, northeast Alberta, McIntyre Porcupine Mines Limited; Alberta Energy and Minerals, Mineral Assessment Report 19680004, 4 p., URL <https://content.energy.alberta.ca/xdata/MARS/MAR_19680004.pdf> [January 2024].

Lopez, G.P., Pawlowicz, J.G., Weiss, J.A. and Jean, G.M. (2020): Metallic mineral occurrences of Alberta (tabular data, tab-delimited format); Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Digital Data 2019-0026, URL <https://ags.aer.ca/publication/dig-2019-0026> [January 2024].

Lopez, G.P., McGill, D. and McKenzie, J. (2024): Airborne geophysics data analysis and interpretation, Canadian Shield, northeastern Alberta; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Special Report 119, 111 p., URL <https://ags.aer.ca/publication/spe-119> [May 2024].

Mann, A.G. (1991): Assessment report, Alberta, metallic mineral exploration permit number 6890090002, Andrew Lake, northeast Alberta for E.J. Friesen & Associates Inc.; Alberta Energy and Minerals, Mineral Assessment Report 19910001, 35 p., URL <https://content.energy.alberta.ca/xdata/MARS/MAR_19910001.pdf> [January 2024].

Mann, A.G. (1995): Geological report on Fort Smith and Fort Fitzgerald area exploration project in northeastern Alberta for E.J. Friesen & Associates Inc.; Alberta Energy and Minerals, Mineral Assessment Report 19950011, 20 p., URL <https://content.energy.alberta.ca/xdata/MARS/MAR_19950011.pdf> [January 2024].

Meek, D.M., Lopez, G.P. and Knudson, C. (2023): Geochemistry of plutonic and metamorphic rock samples from the Canadian Shield, northeastern Alberta (74L, 74M), version 2 (tabular data, tab-delimited format); Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Digital Data 2023-0015, URL <https://ags.aer.ca/publication/dig-2023-0015> [April 2023].

Meek, D.M., Montenegro, N. and Hartlaub, R.P. (2026): Station observations and whole-rock lithogeochemistry data from 2023 fieldwork on the Canadian Shield in northeastern Alberta (tabular data, tab-delimited format); Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Digital Data 2025-0001, URL <https://ags.aer.ca/publication/dig-2025-0001>.

Montenegro, N.O., Hartlaub, R.P., Belosevic, M.B.K., Morley, E.C. and Meek, D.M. (2026): Investigating the critical mineral systems of the Canadian Shield of northeastern Alberta: a summary of 2023 fieldwork in the Leland Lakes and Andrew Lake areas; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Open File Report 2025-09, 102 p.

Naldrett, A.J. (2004): Magmatic sulfide deposits: geology, geochemistry and exploration (1st edition); Springer, Berlin, Germany, 728 p., doi:10.1007/978-3-662-08444-1.

Normand, C. (2014): Rare earths in Saskatchewan: mineralization types, settings, and distributions; Saskatchewan Ministry of the Economy, Saskatchewan Geological Survey, Report 264, 105 p., URL <https://publications.saskatchewan.ca/#/products/79893> [January 2024].

Pană, D.I. (2010): Precambrian geology of northeastern Alberta (NTS 74M, 74L and part of 74E); Energy Resources Conservation Board, ERCB/AGS Map 537, scale 1:250 000, URL <https://ags.aer.ca/publication/map-537> [April 2023].

Pană, D.I. and Olson, R.A. (2009): Overview of uranium exploration work along the northern rim of the Athabasca Basin, northeastern Alberta; Energy Resources Conservation Board, ERCB/AGS Open File Report 2009-19, 228 p., URL <https://ags.aer.ca/publication/ofr-2009-19> [April 2023].

Pană, D.I., Olson, R.A. and Byron, S.J. (2006): Geological reconnaissance work in the Andrew Lake area of northeastern Alberta; Alberta Energy and Utilities Board, EUB/AGS Earth Sciences Report 2006-02, 22 p., URL <https://ags.aer.ca/publication/esr-2006-02> [January 2024].

Poliakovska, K., Annesley, I.R., Ivanik, O., Sykes, J., Guest., N. and Otsuki, I. (2022): Geological setting, geochemistry and petrology of the granitic pegmatites hosting REE-Th-U mineralization at the Alces Lake area, northern Saskatchewan, Canada; *in* Proceedings of the 16th SGA Biennial Meeting, virtual, March 28–31, 2022, v. 1, p. 325–328.

Poliakovska, K., Annesley, I.R. and Hajnal, Z. (2023): Geophysical constraints to the geological evolution and genesis of rare earth element–thorium–uranium mineralization in pegmatites at Alces Lake, SK, Canada; Minerals, v. 14, no. 1, art. 25, 33 p., doi:10.3390/min14010025.

Rukhlov, A.S. (2011): Review of metallic mineralization in Alberta with emphasis on gold potential; Energy Resources Conservation Board, ERCB/AGS Open File Report 2011-01, 93 p., URL <https://ags.aer.ca/publication/ofr-2011-01> [April 2023].

Selway, J.B., Breaks, F.W. and Tindle, A.G. (2005): A review of rare-element (Li-Cs-Ta) pegmatite exploration techniques for the Superior Province, Canada, and large worldwide tantalum deposits; Exploration and Mining Geology, v. 14, no. 1–4, p. 1–30, doi:10.2113/gsemg.14.1-4.1.

Smith, D. and Griffith, F. (2007): North American Gem Inc. 2007 summer exploration of the Bonny Fault property, northeast Alberta; Alberta Energy and Minerals, Mineral Assessment Report 20070025, 6 p., URL <https://content.energy.alberta.ca/xdata/MARS/MAR_20070025.pdf> [January 2024].

Thorpe, W.H. (1969): McIntyre Porcupine Mines Limited, New Senator-Rouyn option, N.E. Alberta; Alberta Energy and Minerals, Mineral Assessment Report 19690002, 7 p., URL <https://content.energy.alberta.ca/xdata/MARS/MAR_19690002.pdf> [January 2024].

Wiskel, B.N. (1999): Preliminary geological assessment of the Waugh Lake mineral property for Esmeralda Exploration International Inc.; Alberta Energy and Minerals, Mineral Assessment Report 19990014, 14 p., URL <https://content.energy.alberta.ca/xdata/MARS/MAR_19990014.pdf> [January 2024].

Workman, A.W. (2023): A technical review of the Alces Lake rare earth mineral exploration project, Beaverlodge domain, Saskatchewan, Canada; prepared for Appia Rare Earths & Uranium Corporation, Canadian Securities Administrators, SEDAR public securities filings, NI43-101 technical report, filed January 31, 2023, 170 p., URL <https://www.sedarplus.ca/csa-party/records/document.html?id=f0c412816f5890a3f2d9c57f20fe602526f67bdb8d55f9f3dce7f761a7eef6aa> [June 2024].