



GAC-NL

2024 Annual Technical Meeting

Program and Abstracts

Memorial University - February 20-21



Silver Mine Head Path, Halfway Cove-Torbay

2024 ANNUAL TECHNICAL MEETING

The Geological Association of Canada Newfoundland and Labrador Section (GAC-NL) extends a warm welcome to registrants and participants in the 2024 Annual Technical Meeting, hosted this year at the department of Earth Science, Memorial University. As always, this meeting is brought to you by volunteer efforts and would not be possible without the time and energy of the executive and other members of the section.

GAC-NL EXECUTIVE

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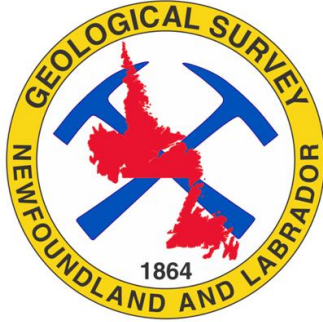
ACKNOWLEDGMENTS

GAC-NL Section meetings are critically dependent upon direct financial sponsorship and upon in-kind support and service donations. We gratefully acknowledge this year's sponsors.

IN-KIND SUPPORT

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DIRECT ASSISTANCE



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CALL FOR GRANT APPLICATIONS

Geoscience Education Trust of Newfoundland and Labrador
(Formerly named the St. John's 88/01 Trust Fund)

Funding for Geoscience Education Projects 2024

Applications are invited from interested individuals or groups for an award or awards to be made to Geoscience Education Projects in Newfoundland and Labrador. A maximum of \$1000 will be awarded to one or more deserving projects in this competition. Projects should emphasize the Earth Sciences, in the broad sense of the term, and should be beneficial to the professional development of the Newfoundland and Labrador geoscience community. They must be open to participation by a significant segment of that community. Examples include funding of visiting speakers, field trips (normally held within the province), technical workshops, and activities related to the development of Earth Sciences skills at the secondary education level.

An application form is available on the "Grants" page of <http://www.gac-nl.ca/>.

For inquiries and advice, please contact the chair of the Geoscience Education Trust Committee

Committee:

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Applications must be received by April 26, 2024 to be eligible.

Decisions on funding will be made by May 10, 2024.

GAC-NL 2024 ANNUAL TECHNICAL MEETING

OVERVIEW OF MEETING PROGRAM

Technical and poster sessions located on third floor, Department of Earth Science, Memorial University.

Lunches provide in Graduate Lounge, Department of Earth Science, Memorial University.

Tuesday, February 20th

9:00 a.m. – 12:00 p.m.	Morning session
12:00 p.m. – 12:30 p.m.	GAC-NL 2024 AGM
12:30 p.m. – 1:20 p.m.	Lunch break
1:20 p.m. – 4:00 p.m.	Afternoon session
7:00 p.m. – 9:00 p.m.	Evening social; sponsored by Altius Minerals Corp. Gahan House Harbourview, Harbour Drive

Wednesday, February 21st

9:00 a.m. – 11:00 a.m.	Morning session and poster session
12:20 p.m. – 12:45 p.m.	Closing remarks and student awards
12:45 p.m. – 1:30 p.m.	Lunch break

Tuesday, February 20th

Morning session

- 8:50 Introductory remarks from GAC-NL
Zsuzsanna Magyarosi, Outgoing GAC-NL President
- 9:00 The geodynamic evolution of the Hopedale Block: New timing constraints on the assembly of the North Atlantic Craton
Alana M. Hinchey, Nicole M. Rayner, David Diekrup, Hamish A.I. Sandeman and Daniella Mendoza Marin
- 9:20 Zircon chemistry and Hf isotopes of felsic samples from volcanogenic massive sulfide (VMS) deposits of the Victoria Lake Supergroup, Newfoundland
Alicia, P. Escribano, Stephen J. Piercey, John G. Hinchey and Nicole M. Rayner*
- 9:40 Structural characterization and tectonic evolution of 1.3 Ga REE-bearing Fox Harbour Volcanic Belt, southeast Labrador.
Nicolas, Prieto and Eric J Thiessen*
- 10:00 Understanding rare earth element mineralization in peralkaline rocks from southeastern Labrador. How can zircon help?
Nicole M. Rayner and Zsuzsanna Magyarosi
- 10:20 Refreshment break

Sponsored by Churchill Resources



- 10:40 LCT pegmatites – concepts, exploration, and the Killick pegmatite field
Kiersty M Malay, Donnelly B. Archibald and James Conliffe*

* Student Presenter

* Student Presenter

- 11:00 Granite-related critical mineral potential of the Gander and Western Avalon zones, southern Newfoundland
James Conliffe, Donnelly B. Archibald, Deepyaman Saha, Kiersty Malay, David Lowe and Neil Rogers
- 11:20 Exploring the potential for ultra-trace aqueous geochemistry to detect small-footprint Li-Cs-Ta pegmatite mineralization in Southern Newfoundland
Shramana Sarkar, Michael G. Babechuk, James Conliffe and Duc Huy Dang*
- 11:40 Enhancing mineral exploration with machine learning: Applications and case studies
Michael, W. Dunham and Shawn B. Hood
- 12:00 GAC-NL 2024 AGM
All GAC-NL members welcome
- 12:30 Lunch provided by Alexander Murray Geological Club

Sponsored by New Found Gold Corp.



Afternoon session

- 1:20 A late Maiolingian Series (Middle Cambrian) Dorypyge pygidium from the Manuels River (Harcourt Group), Red Bridge Road Quarry, Conception Bay South, Avalon Peninsula Newfoundland
W. Douglas Boyce and Benjamin W.T. Rideout
- 1:40 CO₂ Mineralization Potential of Newfoundland
Timilehin A. Oguntuyaki, Zhanae A. Sutherland, Matt J. Gill, Ben T. Taylor, Penny L. Morrill*

2:00 Gaseous Biosignatures in Ultra-Basic Serpentinite-Hosted Groundwater Springs

*Mary J. Whelan**, Penny L. Morrill and Matthew J. Gill

2:20 Geophysical Study of the Historical Landfill at Wishingwell Park

*Tshering Dendup**, Colin G. Farquharson and Alison Leitch

2:40 Refreshment break

Sponsored by Fishhawk Gold



3:00 Deciphering metamorphic patterns through phase equilibria modeling and textural relationships: Preliminary results of the Central Grenville Province

*Arlin Fonseca** and Aphrodite D. Indares

3:20 Geology of the Aurora Vent Field: First Exploration of Hydrothermal Vents Under Ice in the Arctic Ocean

*Charles Lapointe**, John W. Jamieson, Eoghan P. Reeves, Stefan Bünz, Eva Ramirez-Llodra and Caroline Gini

3:40 Petrochemistry, mineralogy and Nd isotopic data for Tithonian (ca. 148 Ma) alkaline lamprophyric intrusions, Notre Dame Bay, Newfoundland, Canada

Hamish A.I. Sandeman, Alexander Peace, J. Kim Welford, Greg Dunning and Alfredo Camacho

* Student Presenter

Wednesday, February 21st

Morning session

- 9:00 The Brass Buckle Trend - An unexplored, Au rich, fault/shear structure in the Pacquet Harbour Group, Baie Verte Peninsula
Peter M. Dimmell
- 9:20 Regional and Property Geology, Kingsway Gold Project, Glenwood Area
John Clarke
- 9:40 Examining host-rock stratigraphy and mineralization styles of orogenic gold prospects along the Appleton Fault Zone, northeast-central Newfoundland
*Lillian N. Glodowski**, *Stefanie M. Brueckner*, *Ian W. Honsberger* and *Hamish A.I. Sandeman*
- 10:00 Hot syn-orogenic granites of the Central Grenville Province: characteristics and tectonic settings
*Cheuk-Yin Yip**, *Aphrodite D. Indares* and *Gregory R. Dunning*
- 10:20 Refreshment Break and Poster Session

Sponsored by Titjaluk Logistics



- 11:00 Hummocky-like stratification and links to faulting on the passive Laurentian margin
*Jorge Iturralde** and *David Lowe*
- 11:20 Volcaniclastic Deep-water Architecture and Provenance of an Arc Adjacent Lobe Fan System: The Mistaken Point Formation, St. John's, Newfoundland
*Grace Khatrine** and *David Lowe*

* Student Presenter

11:40 The inception, evolution, and terrane-scale significance of a Late Ediacaran foreland basin in the Eastern Avalon Zone of Newfoundland

David Lowe, Santiago Serna Ortiz, Grace Khatri and Juvani Bryce

12:00 Updates to the geology of the Twillick Brook map area (NTS 2D/4), south-central Newfoundland

Gabriel S. Santos

12:20 Closing remarks, student awards and photo contest announcement

Student awards sponsored by CIM NL

Nic Lachance (photo contest)

Rod Smith, Incoming GAC-NL President



12:45 Lunch provided by Alexander Murray Geological Club

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ABSTRACTS IN ALPHABETICAL ORDER

A late Maiolingian Series (Middle Cambrian) *Dorypyge* pygidium from the Manuels River
(Harcourt Group), Red Bridge Road Quarry, Conception Bay South, Avalon Peninsula
Newfoundland

W. Douglas Boyce¹, Benjamin W.T. Rideout²

¹ *Volunteer, The Rooms Provincial Museum*

² *Independent co-author*

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A fragmentary pygidium of *Dorypyge* Dames, 1883 has been recovered from a single piece of shale talus within the Manuels River Formation (Harcourt Group) at the Red Bridge Road (Kelligrews) Quarry, Conception Bay South. A correlation with the *Plutonides* (formerly *Hydrocephalus*) *hicksii* Biozone to the *Paradoxides davidis* Biozone of Avalonia is indicated, placing it within the late Maiolingian Series (Drumian Stage) of the Middle Cambrian. The genus *Dorypyge* is uncommon in Avalonia, whereas it is a common constituent of Middle Cambrian deposits in Gondwana.

Regional and Property Geology, Kingsway Gold Project, Glenwood Area

John Clarke

Labrador Gold

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Since acquiring the Kingsway project in 2020, Labrador Gold Corp. has discovered seven new significant gold occurrences. These orogenic gold prospects are hosted within fine to coarse-grained Ordovician to Devonian? sedimentary sequences as well as Silurian gabbroic intrusives. Geological mapping of the property has demonstrated that Silurian sedimentary rocks are more widespread than previously recognized and extend east of the Appleton Fault.

Over 100 new fossil localities have also been discovered. Species identified include graptolites, bryozoa, crinoids, nuculites, bivalves and possible stromatolites/stromatoporoids. Trace fossils include possible Rusophycos, Skolithos and Paleophycus. Very few of these occurrences have been positively classified to date. Detailed palaeontological and sedimentological studies are required to frame the regional geologic context of these newly discovered gold occurrences.

Granite-related critical mineral potential of the Gander and Western Avalon zones, southern Newfoundland

James Conliffe¹, Donnelly B. Archibald², Deepyaman Saha², Kiersty Malay^{2,3}, David Lowe³, Neil Rogers⁴

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The Gander and western part of the Avalon zones in southern Newfoundland are host to several known critical mineral deposits and prospects associated with granitic rocks. These include lithium–cesium–tantalum (LCT) pegmatites in the Burgeo area, where two zones of LCT pegmatites were first discovered in 2021 (Kraken pegmatite field and Hydra pegmatite). Other significant known deposits and prospects include vein hosted W deposits (e.g., Grey River Deposit), porphyry Mo–Cu deposits (Moly Brook Deposit), Sn-greisen (Moulting Pond Prospect) and fluorite deposits (St. Lawrence fluorite). In addition, the potential of these lithotectonic zones to host other deposits is highlighted by numerous smaller Li, W, Mo, Sn, Bi and Be occurrences, as well as abundant peraluminous granites intruded into greenschist to amphibolite facies metasedimentary and metavolcanic rocks.

Despite the high prospectivity of this region, a number of fundamental geological questions and research avenues remain. These include the mineralogy, age, origin, tectonic setting, and economic potential of intrusive rocks in southern Newfoundland, the relative importance of crustal anatexis and crustal structures in the localization of mineralization, and regional correlations with similar deposits in peri-Gondwanan terranes across the Appalachian and Caledonian orogenies. Ongoing multidisciplinary research between government, academic and industry partners aims to fill these knowledge gaps by combining field data with petrography, geochemistry, mineral chemistry, and geochronology to improve our understanding of the tectonic history of southern Newfoundland, and the geological processes that resulted in formation of granite-related critical mineral deposits. In addition, mineralogy and mineral chemistry will be compared between mineralized bodies to help define advanced exploration vectors and aid in future mineral exploration.

Geophysical Study of the Historical Landfill at Wishingwell Park

Tshering Dendup, Colin G. Farquharson, Alison Leitch

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The City of St. John's, like many other populous and modern cities, suffered challenges in keeping up with increasing demands on disposal infrastructure and sustainable waste management. Stretches along most riverbanks and at the outskirts of the city continued to be illegal dump sites for many years after institution of a municipal council in 1902. The Wishingwell area was chosen as the city's first public landfill to resolve the issues. Due to complaints from the nearby community about the smell, it was officially abandoned in 1963 after burying accumulated wastes in trench(es). Later, the area was covered and converted to the present-day park.

There is no traceable record of any remediation efforts and only one previous investigation using a seismic technique. The present research integrates four geophysical methods – magnetics, electromagnetics, ground penetrating radar (GPR) and geoelectrical – to study the area non-invasively. The surveys show highly conductive anomalies buried under the embanked cover. These responses are likely from buried metallic wastes, including vehicle wreckages, as seen in archival images.

Magnetic maps of the area depict distinct linear features roughly trending east-west, some of which can also be observed in inverted geoelectrical sections plotted transverse to the magnetic features. This observation supports conjecture from seismic data of wastes being buried in a long trench running roughly S85E although the new work indicates the existence of more than one trench. GPR data depicts the contact between cover and undisturbed ground and scattering around the conductive features seen in geoelectrical sections. Thus, the study confirms likely presence of metallic waste in the subsurface decades after their burial, and further highlights concerns about other non-biodegradable buried wastes in the area.

The Brass Buckle Trend - An unexplored, Au rich, Fault / Shear structure in the Pacquet Harbour Group, Baie Verte Peninsula

Peter M. Dimmell

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The Rambler South property, consisting of 17 claims, lies on the Baie Verte peninsula, 13 km southeast of the Baie Verte – Brompton Line, the western contact of the Dunnage Zone. A fault structure, termed the Brass Buckle Trend (BBT), extends through the property for approximately 4 km, through the basal portion of the Cape St. John Group (CSJ), crystal lithic tuffs; the Cape Brule Porphyry (CBP), quartz feldspar porphyry; the Pacquet Harbour Group (PHG), primarily mafic volcanics / intrusives; and is associated with intrusive units, quartz porphyry (QP) and quartz feldspar porphyry (QFP) dikes.

Gold values are found from the 660 showing in the CSJ in the north, to the Skidder Pond showing in the QFP dike, in the south. The high grade, Brass Buckle quartz/pyrite vein, 15-20 cm wide, along a QP/MV contact, gives consistent gold values in the 150 g/T range with tellurium (Te) values in the 100 to 200 ppm range.

The QFP dike, 15 m+ wide, possibly related to the CBP, follows the BBT structure and is offset by cross faults. It carries disseminated magnetite and variable minor pyrite. QP intrusives occur as linear bodies lying sub parallel to the BBT structure. They are variably altered, from incipient Si/Ser to entirely altered to Si/Ser and carry gold in quartz/pyrite and quartz tourmaline pyrite (QTP) veins. Strong potassic alteration, as chlorite / sericite, and silicification, is noted in the mafic units of the PHG (chlorite) and QP (Si/Ser).

Geochemistry, tills (up to 775 gold grains/74% pristine) and soils (up to 1741 ppb), give high grade gold values down ice (160 degrees) of the BBT. Geophysics (IP) shows a resistivity low along the BBT and a moderate chargeability anomaly extending from the BBT, which corresponds to a QP body that carries narrow (<5 cm) quartz/pyrite veins with gold values up to 15 g/T.

Enhancing mineral exploration with machine learning: Applications and case studies

Michael W. Dunham, Shawn B. Hood

ALS Goldspot Discoveries

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In mineral exploration, a pivotal component involves the collection of data to enhance our comprehension of geological structures and the potential for mineral deposits. Traditionally, the reconciliation of relationships, or patterns, believed to be indicative of mineralization has been achieved through manual interpretation of available geoscience data. While these conventional techniques retain their value and should remain in use, the adoption of machine learning (ML) technologies enables geoscientists to derive greater value from their data by facilitating automated data integration.

Machine learning can be applied to geoscience data in various ways, with three notable examples being super resolution, unsupervised learning, and prospectivity analysis. Super resolution, a deep learning approach, is trained to learn the statistical correlations between co-located low and high-resolution magnetic data. The advantages and limitations of this tool have been explored using public datasets from Western Australia. In unsupervised learning, clustering techniques are applied to geoscience data, segregating them into groups of similar characteristics. This is exemplified in a case study from British Columbia, where clustering with topological properties has been utilized to refine geological understanding. Meanwhile, prospectivity analysis, a form of supervised machine learning, integrates geochemical data (e.g., assays from drill core, or outcrop samples) with other geoscientific information (e.g., geophysics, lithology, structures, remote sensing) to predict the likelihood of mineralization for specific deposit types, such as porphyry Cu. The efficacy of ML-based prospectivity analysis is demonstrated through a Brazilian case study, which successfully identified areas for future exploration.

Periods of economic downturn in the mineral exploration sector offer prime opportunities to analyze existing data with ML, thereby optimizing future field campaigns and drilling programs in anticipation of improved financial conditions.

Crustal Structure In Trans-Hudson Orogen (Northern Canada) Through Receiver Function Analysis

Zahra Hossein Esfahani, J. Kim Welford, Alison Malcolm

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The northern segment of the Canadian Shield comprises both Archean and Proterozoic geological structures, notably the Trans-Hudson Orogen (THO), which is the largest Paleoproterozoic orogenic belt globally. The primary aim of this study is to investigate the development of crustal structure in various regions of the THO utilizing the receiver function method applied to passive seismic data. The objective is to image the discontinuities within the Earth's crust.

This study utilizes receiver functions extracted from the incident P wavefield of teleseismic earthquakes with magnitudes exceeding 5.9. The research area is monitored by combining permanent and temporary seismic stations, with an average spacing of approximately 1200 km between them. The dataset encompasses a broad spectrum of epicentral distances ranging from 30 to 95 degrees.

Our results show Moho depths consistent with previous studies: average Moho depths of 37 km beneath the TULEG station in the western part of Greenland and 40.3 km beneath the CLRN station. Azimuthal differences in Moho depth around each station are also observed, particularly toward northwestern THO, and western part of Greenland. Results from the ongoing analysis of the azimuthal variations in the receiver function structures and approaches will be presented.

Zircon chemistry and Hf isotopes of felsic samples from volcanogenic massive sulfide (VMS) deposits of the Victoria Lake Supergroup, Newfoundland

Alicia, P. Escribano¹, Stephen J. Piercey¹, John G. Hinchey², Nicole M. Rayner³

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Felsic volcanic and volcanoclastic rocks of the Cambro-Ordovician Victoria Lake Supergroup in central Newfoundland, host volcanogenic massive sulfide (VMS) deposits with varying mineralization styles and base and precious metal content. Mineral and Hf isotope geochemistry of zircon from felsic samples from the replacement-style Cu-Zn-(Pb) Duck Pond/Boundary deposit, the barite-rich exhalative-style Zn-Pb-(Ag-Ag-Cu) Lemarchant and low-tonnage Zn-Cu-Pb-(Ag-Au) Long Lake deposits, are used to understand the composition and petrogenesis of host rocks to mineralization and the role of magmatism in the formation of VMS deposits. Zircon from all deposit samples have low Th/U (< 1) and Th/Nb (< 90) ratios. Zircon only from the Duck Pond/Boundary deposit have U/Yb ratios of > 0.3, and zircon in the Duck Pond/Boundary and Lemarchant deposit samples have Dy/Yb ratios of < 0.3. The Duck Pond/Boundary and Lemarchant deposits have $\epsilon\text{Hf}(t)$ values and depleted-mantle model (TDM) ages between +5.9 and +9.4 and 761 and 1064 Ma, respectively, whereas zircon from the Long Lake deposit sample have $\epsilon\text{Hf}(t)$ values and TDM ages between +11.2 and +15.2 and 489 and 730 Ma, respectively. Mean log $f\text{O}_2$ values in zircon from the Duck Pond/Boundary and Long Lake deposit samples are -1.4 to -1.9, whereas zircon from the Lemarchant deposit sample have more oxidized values of -1.1. The $\epsilon\text{Hf}(t)$ values, TDM ages, and Dy/Yb ratios in zircon from the Duck Pond/Boundary and Lemarchant deposit samples suggest magmas derived from juvenile sources but with minor crustal contributions from Neoproterozoic basement, and that amphibole was co-crystallizing with zircon. Higher $\epsilon\text{Hf}(t)$ values, Dy/Yb ratios, and younger TDM ages in zircon suggest more juvenile components and less interaction with the basement for the Long Lake deposit. Ongoing research is focused on the interpretation of this data coupled with previous whole-rock litho-geochemical information.

Building the foundation for a 3D offshore model of Newfoundland

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Offshore Newfoundland has a very rich geological history in terms of energy production. The Continuously Evolving Newfoundland Offshore Model (CENOM) will comprise all geophysical data sets available, including seismic, potential field, and well logs, reconstructed over geological time. The goal is to create an interactive, evolving visual of offshore Newfoundland. CENOM will be continuously updated and improved as more data is released. My work has been focused on establishing the foundation for this project using various software packages such as QGIS, Petrel, GPlates and Excel. To aid in future development of CENOM, "The Pantry" database was created in Excel, containing information from all of the well logs available on the Grand Banks and on the Northeast Newfoundland Shelf Area. CENOM will involve synthesizing all existing models and databases and will continue to grow along with our knowledge of the area.

Deciphering metamorphic patterns through phase equilibria modeling and textural relationships: Preliminary results of the Central Grenville Province

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The Mesoproterozoic Grenville Province formed by continental collision between Laurentia and presumably Amazonia during the assembly of supercontinent Rodinia at 1.09–0.98 Ga. Much of the exposed rocks record granulite-facies metamorphism but were exhumed from different crustal levels, yielding crucial insights into the thermal evolution of the Mesoproterozoic orogenic crust. A so far little investigated crustal segment in the southern part of the Central Grenville Province (Quebec) is characterized by exposure of 1.08 to 0.98 granitoids and aluminous gneisses containing pressure-temperature (P-T) sensitive minerals. A meticulous examination of textures in the gneisses combined with phase equilibria modeling allows to constrain the P-T conditions of metamorphism and tectono-thermal setting of this segment during the Grenville orogeny.

Mineral assemblages of the aluminous gneisses are dominated by garnet, sillimanite, biotite, K-feldspar, plagioclase, and quartz, with locally cordierite or orthopyroxene. Petrographic textures, such as films or fingers of inferred former melt (now plagioclase) enclosing garnet, K-feldspar, sillimanite, or plagioclase, overgrowth (symplectite) between biotite and plagioclase, and composite inclusion in garnet consisting of biotite and sillimanite in a pool of plagioclase, are evidence of melt production during metamorphism. Where present, cordierite is part of the peak mineral assemblage, suggesting low-P conditions. Additionally, phase equilibria modeling, specifically the pseudosection approach, is utilized to further constrain the P-T condition of metamorphism by depicting the stability field of the peak assemblage on the P-T field for specific rock composition and carefully comparing the calculated isopleths for mineral composition with the measured compositions. Maximum P-T conditions for aluminous gneisses in the southern Central Grenville Province were inferred in the range of 6.0–8.0 kbar and 820–860°C. The estimated pressure in this area is lower than the adjacent Mid-P segment to the north, providing additional insights on the orogenic architecture.

Examining host-rock stratigraphy and mineralization styles of orogenic gold prospects along the Appleton Fault Zone, northeast-central Newfoundland

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The Appleton Fault Zone (AFZ) in the Exploits Subzone, northeast-central Newfoundland, is a north-northeast to south-southwest-trending deformation zone with considerable orogenic gold mineralization. Fifteen partial drill holes along the AFZ containing significant gold mineralization (e.g., >3 g/t Au) were selected from the Queensway (New Found Gold Corp.), Kingsway (Labrador Gold Corp.), and Bullseye and Titan (Exploits Discovery Corp.) projects. The selected holes were logged and sampled to better understand the setting and mineralization of orogenic gold systems in this area. The prominent mineralized lithologies in the chosen drill core include grey siltstone and shale with intervals of graphitic black shale and fine- to medium-grained sandstone, interpreted as parts of the Ordovician Davidsville Group. These epiclastic rocks in the drill holes contain disseminated, anhedral to euhedral pyrite and arsenopyrite (≤ 2 mm). Most of the sedimentary rocks are classified geochemically as shales based on whole rock lithogeochemical data obtained from non-mineralized samples. Medium-grained gabbroic intrusions containing disseminated sulfides including pyrite, arsenopyrite, and chalcopyrite also host gold mineralization along the AFZ. Trace element lithogeochemical data from non-mineralized gabbroic host-rocks indicates intermediate to mafic compositions of andesite to subalkaline basalt. The sedimentary and gabbroic host lithologies are cut by milky white to grey, coarse quartz \pm carbonate veins up to 4 m wide. Low- to moderate-grade gold intervals (< 3 g/t Au) are associated with disseminated sulfide mineralization (arsenopyrite and pyrite), commonly near quartz \pm carbonate veins. Moderate- to high-grade gold intervals (> 3 g/t Au) and disseminated gold flakes (≤ 1 mm) are found within quartz \pm carbonate veins.

Overall, orogenic gold mineralization along the AFZ is hosted by epiclastic sedimentary rocks and gabbroic rocks in disseminated and vein-hosted styles. Subsequent research will include geochemical and microanalytical analyses of select mineralized samples to thoroughly characterize orogenic gold systems along the AFZ.

The geodynamic evolution of the Hopedale Block: New timing constraints on the assembly of the North Atlantic Craton

Alana M. Hinchey¹, Nicole M. Rayner², David Diekrup¹, Hamish A.I. Sandeman¹, Daniella Mendoza Marin¹

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In Labrador, the North Atlantic Craton comprises the Saglek and Hopedale blocks. New SHRIMP U-Pb zircon geochronological data further refines the Archean tectono-magmatic evolution of the Hopedale Block. The oldest dated event is the formation of the protoliths of the Maggo gneiss at *ca.* 3262–3245 Ma. Between *ca.* 3141 and 3105 Ma, the area experienced a magmatic event that included at least three plutonic pulses and the deposition of the Hunt River Group. Based on cross-cutting relationships and new geochronological data a newly identified package of volcano-sedimentary rocks older than *ca.* 3124 Ma are identified and possibly another older than 3262 Ma. Between *ca.* 3032 and 2979 Ma, events included the intrusion of plutonic suites and the deposition of the Florence Lake Group. These rocks were collectively intruded by the *ca.* 2892–2832 Ma Kanairiktok Plutonic Suite. This was followed by a plutonic event at *ca.* 2720 to 2710 Ma and the youngest Archean event is the emplacement of the *ca.* 2578 to 2545 Ma Aucoin Plutonic suite. The oldest evidence of metamorphism is cryptic at *ca.* 2961–2953 Ma, preserved as zircon overgrowths on two samples. Most of the metaplutonic suites in the block preserve evidence of widespread metamorphism at *ca.* 2846–2796 Ma and *ca.* 2732–2700 Ma (as zircon overgrowths and titanite growth). The *ca.* 2846–2796 Ma metamorphic events are geographically widespread and synchronous, in part, with the intrusion of the Kanairiktok Plutonic Suite. The Kanairiktok Plutonic Suite is hypothesized to represent a continental magmatic arc that formed during the initiation of plate tectonics in the region. Based on widespread occurrence in both blocks, the 2732–2700 Ma metamorphic event likely corresponds to the collision between the Saglek and Hopedale blocks. One outcrop preserves evidence of a *ca.* 2554–2542 Ma metamorphic event (as zircon overgrowths), and as this event is only documented locally it may be restricted to the western Hopedale Block. No evidence of the previously proposed Hopedalian metamorphic event is observed and little evidence for the Fiordian event.

Hummocky-like stratification and links to faulting on the passive Laurentian margin

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The Cambro-Ordovician Cow Head Group of Western Newfoundland are allochthonous strata that provide a record of submarine carbonate sedimentation on the Laurentian margin. The most striking facies are catastrophic boulder limestone megaconglomerates (chaotic boulder conglomerate large blocks up to > 5 m) of the Upper Cambrian Downes Point and terminal Cambrian to Lower Ordovician Stearing Island members of the Shallow Bay Formation. While most authors agree that seismicity was involved in the initiation of megaconglomerate transport, the cause of slope failure and sedimentation has also been linked to eustatic regression. To detail the potential effects of faulting on sedimentary processes and elucidate tectonic versus eustatic control, facies analyses was undertaken from the Late Cambrian and Early Ordovician sections of the Shallow Bay Formation. Most facies are consistent with submarine sedimentation below storm wave base, suggesting a slope setting. However, the discovery of Hummocky cross-stratification (HCS) and oscillatory ripples occupying the Tc interval of Bouma sequences suggests a significant influence of waves and perhaps a much shallower sedimentary environment. Nevertheless, paleobathymetric constraints can be used to contextualize and understand these wave-formed features. For example, megaconglomerates are generally clast-supported with extrabasinal white algal boulders and blocks surrounded by intrabasinal lime mudstone to grainstone clasts, and lack cohesive matrix, indicating sedimentation as slumps with short transport distances. Paleoflow directions are dominantly toward the south and the coarsest clasts occur in the northern sections of the allochthon, suggesting the presence of a steep slope oriented 90° to the paleo-margin. Moreover, isotopic data suggest progressive basin confinement from the Late Cambrian onward. In this context, the genesis of HCS and oscillatory ripples are explained by the reflection of turbidity currents against fault scarps in a confined basin, resulting in the development of an internal shear boundary and propagation of oscillating currents to the bed during deceleration of turbidity flows.

Volcaniclastic Deep-water Architecture and Provenance of an Arc Adjacent Lobe Fan System: The Mistaken Point Formation, St. John's, Newfoundland

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The Mistaken Point Formation (MPF) is a ~400m thick late Neoproterozoic siliciclastic-volcaniclastic unit that crops out in the Avalon Zone of Newfoundland and is recognized as one of the world's leading Ediacaran fossil-bearing deep-water successions. The MPF sits as the uppermost part of a thick succession of the volcaniclastic submarine fan strata of the Conception Group, deposited at or near the transition of a fore-arc or back-arc basin to proposedly a foreland basin. Thus, MPF strata can provide insight into whether the basin transformation affected key elements of the local sedimentary environment during MPF sedimentation. Detailed stratigraphic, petrographic, and facies analysis were integrated, supporting a submarine fan depositional system with four lobe facies associations that stack to form two lobe complexes: MPF1 and MPF2. Stratal stacking patterns suggests a "back stepping" lobe abandonment with overall upward reduction in sediment concentrations, flow energy, and syn-sedimentary volcanism. Facies analysis provides evidence of ponded turbidites and HCS-like stratification that record progressive basin confinement through time. Paleocurrent measurements demonstrate a slight variation in sediment routing directions from S-SE to S-SW. QFL and QpLvmlsm ternary plots show an upward shift from a magmatic arc source to a dissected volcanic arc source. MPF1 detrital zircon ages define a polymodal peak at ca. 650 Ma consisting mostly of Ediacaran (66%), Cryogenian (13%), Mesoproterozoic (7%), and Paleoproterozoic (14%) ages, whereas the overlying MPF2 depicts a polymodal distribution with peaks at ca. 600 and 580 Ma comprising 76% Ediacaran ages, 6.5% Cryogenian, and 16.5% Meso- and Paleoproterozoic ages. This study highlights the evolution of the MPF submarine fan system through its basin transformation, which is critical to improving paleogeographic reconstructions of submarine fans, and in better understanding the basin and tectonic evolution of Ediacaran strata on the northeastern Avalon Peninsula.

Geology of the Aurora Vent Field: First Exploration of Hydrothermal Vents Under Ice in the Arctic Ocean

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The Arctic Ocean's ultraslow-spreading Gakkel Ridge remains poorly explored due to its remoteness, sea-ice cover, and harsh conditions. Consequently, little is known of the hydrothermal activity on the ridge and of its place within the global mid-ocean ridge system. The Aurora vent field is the only such site to be located and explored on the Gakkel Ridge, and is hosted on an axial volcano at its southern terminus. In 2021, the first direct sampling of hydrothermal vents on the Gakkel Ridge took place during the HACON21 expedition on the Norwegian Icebreaker Kronprins Haakon. Using the remotely operated vehicle Aurora Borealis, 14 hydrothermal rock samples and 13 hours of high-resolution video footage were gathered as part of a multidisciplinary geological, geochemical, and biological survey and sampling of the vent field.

In this presentation, we will provide a geological overview of this newly explored field, discuss results in the context of geological controls on hydrothermal systems along ultraslow-spreading ridges, and describe some of the unique challenges of exploring the seafloor below perennial sea-ice. The site consists largely of inactive and collapsed hydrothermal sulfide edifices that extend over an area of 140 x 100 m on a sedimented pillow basalt substrate. Three high-temperature (>350°C) black smokers (the Enceladus, Ganymede, and Hans Tore vents) were discovered within a ~10 m diameter cluster in the northeastern region. Adjacent low-temperature diffuse venting is associated with Fe-oxide deposits. Results from compositional characterization (petrography, x-ray diffraction analysis, trace element geochemistry) of sulfide-rich samples indicate a dominance of the high-temperature associated minerals chalcopyrite, anhydrite and pyrrhotite. Lower-temperature minerals such as sphalerite, barite, and amorphous silica are notably absent. Relatively high Ni and Co concentrations within sulfides suggest an interaction of hydrothermal fluids with ultramafic rocks at depth, as evidenced by water column plume CH₄:Mn ratios.

The inception, evolution, and terrane-scale significance of a Late Ediacaran foreland basin in the Eastern Avalon Zone of Newfoundland

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The Ediacaran to Cambrian (*ca.* 590–510 Ma) arc-platform transition in Avalonia is widely attributed to ridge-trench subduction based on constraints from Avalonian terranes in the Maritimes and the western Avalon Zone in Newfoundland, where arc activity was followed by rifting. However, coeval successions from the eastern Avalon Zone contain evidence of post-arc compression, ascribed to the Avalonian Orogeny, which has been used as evidence to support an alternative model of oblique terrane collision leading to arc shutdown. To attempt to resolve these conflicting tectonic regimes and understand the role of compression during the arc-platform transition, we summarize sedimentologic and provenance results from the upper Conception Group to the Signal Hill Group (*ca.* 565–550 Ma) on the eastern Avalon Peninsula of Newfoundland. The *ca.* 566–564 Ma Mistaken Point Formation records basin reorganization, with back-stepping, rerouting, and confinement of submarine fans, a change from volcanoclastic to siliciclastic sedimentation, and changes in provenance. The overlying St. John's Group (*ca.* 564–557 Ma) records a change in sediment routing with an increase in sedimentation rates, retreat of submarine fans, slumping, and deltaic progradation. The overlying Signal Hill Group (*ca.* 557–540 Ma) records deltaic to fluvial progradation, with evidence of forced regression, blind thrusting, and hinterland exhumation at *ca.* 556 Ma. The fluvial Flatrock Cove Formation (*ca.* 551–549 Ma) records growth strata development during fold limb rotation, followed by the emergence of a thrust with 3.5 km of vertical throw, and renewed hinterland exhumation. Commonly cited as a strike-slip basin, the *ca.* 565–550 Ma stratal record in the eastern Avalon Zone is more consistent with a foreland basin. This probably represents a retro-arc basin; formed either on a coherent West Avalonian terrane during the subduction of a spreading ridge, or on a subsidiary West Avalonian terrane prior to collision.

LCT pegmatites – concepts, exploration, and the Killick pegmatite field

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Canada's efforts to develop low-carbon technologies has increased the demand for critical minerals. Critical elements such as Li, Cs, Rb, Nb and Ta can be sourced from lithium-cesium-tantalum (LCT) pegmatites. These critical elements are concentrated in minerals such as spodumene, pollucite, columbite, and tantalite. Recently, lithium exploration has seen a resurgence with a focus on hard rock LCT pegmatite resources due to their high concentration of lithium. The deposit model for LCT pegmatite formation is complex but there are several important exploration methods currently being used industry wide. Southern Newfoundland is a region displaying favourable geological conditions to host lithium pegmatites including metasedimentary host rocks (Bay du Nord Group), a major crustal-scale shear zone (Bay d'Est shear zone), and voluminous, geochemically evolved, two-mica granitic plutonic rocks (Peter Snout and Rose Blanche plutons). LCT pegmatites were first discovered in southern Newfoundland in 2021 and form part of the Killick pegmatite field. Preliminary work shows that both the granitic plutons and LCT pegmatites are hosted in the Dolman Cove Formation, which is metamorphosed to upper greenschist to amphibolite facies metavolcanic to metasedimentary rocks. So far, a swarm of LCT pegmatite dykes have been discovered at the Killick pegmatite field over more than 10 km of strike length, including the Kraken pegmatites and the Hydra pegmatite. The Hydra dyke is unique to the rest of the Killick pegmatites because it is rich in pollucite ($\text{Cs}(\text{Si}_2\text{Al})\text{O}_6 \cdot n\text{H}_2\text{O}$), as opposed to the predominantly spodumene ($\text{LiAlSi}_2\text{O}_6$) bearing dykes that comprise the Kraken pegmatites. Hydra is the first high-grade Cs discovery in Atlantic Canada. Preliminary work shows that the Hydra dyke is 5-6 m wide and can be traced ~100 m at surface. The dyke trends NE-SW, it is steeply dipping, and shows zonation in the exposed area. The modal percentage of minerals in these zones varies, but so far, we have identified quartz, albite, microcline, pollucite, spodumene, white micas, tourmaline, coltan, zircon, garnet, and apatite.

CO₂ Mineralization Potential of Newfoundland

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This study aimed to identify potential sites of CO₂ mineralization associated with serpentinized ultramafic rocks of Newfoundland and Labrador (NL), Canada, and estimate the CO₂ mineralization potential of the province. Mapping and metadata analysis were performed to identify ultramafic occurrences in NL and determine parameters such as the volume of ultramafic rocks and the percentage of serpentinization. These parameters were used to calculate the CO₂ mineralization potential of serpentinite. The majority of NL's ultramafic rocks are located on the island of Newfoundland with little to no ultramafic rocks identified in Labrador. Additionally, some of the parameters needed for the calculation were not available for all Newfoundland's ultramafic units. Units where data were missing were generally minor and conservative values were used for them in the calculation. Using a previously published conversion factor of 0.0563 Gt of CO₂ sequestered per km³ of serpentinite, a CO₂ mineralization potential estimate of 59 Gt of CO₂ was calculated for the province. This estimate is ~15,000 times greater than the amount of CO₂ emitted in 2020 by the province's major industries. Some units contribute more significantly to the estimate, given their large surface area and volume. For example, the Bay of Island Complex contributed at least 70% of the total CO₂ mineralization estimate of the province; such complexes present opportunities for further research to constrain the optimum conditions that enhance their CO₂ mineralization capacity.

Structural characterization and tectonic evolution of 1.3 Ga REE-bearing Fox Harbour Volcanic Belt, southeast Labrador.

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The eastern Grenville Province, southeastern Labrador, preserves a complex geological history, marked by Paleoproterozoic to Mesoproterozoic subduction-accretion orogens separated by intermittent extensional periods between *ca.* 1.8 and 0.9 Ga. These stages are preserved across different shear-bounded terranes, which are underlain by Labradorian basement (1.7-1.6 Ga) rocks. The study zone near to St. Lewis-Labrador, is situated within a high-strain corridor over 300 km-long and 20 km-wide that experienced pervasive high-temperature deformation around 1.6 Ga with minor focused deformation at 1.0 Ga during Grenvillian orogenesis. The recent discovery of the 1.3 Ga Fox Harbour bimodal volcanic belt (FHVB) introduces highly deformed peralkaline rhyolites hosting Rare Earth Element (REE) mineralization and prompts a reassessment of the high-strain corridor's timing, magnitude, and continuity, with a focus on the potential prominent role of Grenvillian deformation. This project aims to characterize structural patterns governing the FHVB's geometry and associated shear zones, coupled with age constraints on deformation fabrics and related metamorphism.

We employed current geophysical data in conjunction with existing geological maps, to identify distinct tectonic domains and bounding shear zones, integrating detailed field observations, structural and microstructural petrographic analyses. Furthermore, U-Pb chemical abrasion LA-ICPMS analysis on zircon provided insights into protolith, depositional, and deformation ages, whereas timing of tectonic fabric development across different high-strain zones was constrained using in-situ titanite U-Pb petrochronology. The findings challenge previous interpretations, revealing pervasive Grenville-aged high-temperature deformation (1.0 Ga) and significant bounding shear zone activity around 1.0 Ga after peak metamorphism. This activity facilitated the exhumation of the FHVB domain, characterized three shear-parallel tabular bodies that locally exhibit buckle-folding structures, intersected by late strike-slip lower-temperature shears. This work provides a modern understanding of the nature and structural modification within this poly-deformed terrane in southeastern Labrador, testing existing models of Proterozoic tectonics in the region.

Understanding rare earth element mineralization in peralkaline rocks from southeastern Labrador. How can zircon help?

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The area of Port Hope Simpson in southeastern Labrador is home to the most advanced rare earth-element (REE) project in Atlantic Canada. These are found in the Fox Harbour Volcanic Belt (FHVB) in the Mealy Mountains terrane of the Grenville Province and consists of three, parallel, mineralized, belts of metamorphosed and mylonitized peralkaline and non-peralkaline volcanic rocks. REE mineralization also occurs in pegmatites and their parent intrusions south of the FHVB in the Pinware terrane.

Over the course of a multi-year, collaborative project between the Geological Survey of Newfoundland and Labrador and the Geological Survey of Canada, 16 samples of peralkaline volcanic rocks, pegmatites, parent intrusions and host rocks have been dated by SHRIMP zircon U-Pb geochronology. Volcanic rocks at Deep Fox (eastern extent of FHVB) yield crystallization ages of ca. 1310 Ma and 1260 Ma, as do parent granites and pegmatites further south along the coast in the Pinware terrane. This is not unexpected as REE bearing Mesoproterozoic peralkaline complexes are well known in Labrador (e.g., Strange Lake, Flowers River, Red Wine complexes). Zircons from all samples also record Grenvillian metamorphism (1070–980 Ma) and in many cases there is limited data indicating Mesoproterozoic crystallization. Grenvillian age zircons commonly exhibit unusual trace element zoning patterns and may contain inclusions of REE minerals including fergusonite.

Trace element abundances in zircon determined through LA-ICP-MS analysis, both as spots and maps, were recently collected to better constrain the timing of any mobilization of REE and begin to interrogate the role of Grenvillian metamorphism in the enrichment of REE in southeast Labrador. Presently there are more questions than answers, but this presentation hopes to stimulate discussion of the zircon isotopic and trace element results to advance the understanding of the genesis of REE mineralization hosted in alkaline-peralkaline systems.

The Kraken Lithium-cesium-tantalum (LCT) pegmatites in southern Newfoundland

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Canada's efforts to develop low-carbon technologies has increased the demand for critical minerals. For example, demand for lithium is driving global exploration for difficult-to-locate lithium pegmatites. Southern Newfoundland is a region displaying favourable geological conditions to host lithium pegmatites including metasedimentary host rocks (Bay du Nord Group), a major crustal-scale shear zone (Bay d'Est shear zone), and voluminous, geochemically evolved, two-mica granitic plutonic rocks (Peter Snout and Rose Blanche plutons). The present research is focussed on the Kraken pegmatites, a swarm of lithium-cesium-tantalum (LCT) pegmatites discovered in 2021 in southern Newfoundland. Preliminary fieldwork focussed on mapping and sampling multiple spodumene-bearing pegmatite dikes. Both the LCT pegmatite dykes and granitic plutons intruded the metasedimentary rocks. The mineralogy of the pegmatites is spodumene, quartz, K-feldspar, albite, muscovite, and garnet, with minor apatite, coltan, white beryl, and schorl tourmaline. Some of the spodumene dykes exhibit discernible internal zoning patterns, characterized by layered aplite in the footwall, a lower intermediate pegmatite zone, a core zone that contains the coarsest spodumene, and a hanging wall zone with abundant tourmaline. However, some of the exposed dykes are unzoned. This research aims to provide a better understanding of the age and mineralogy of the Kraken spodumene pegmatites and contribute to an enhanced understanding of processes that resulted in emplacement of spodumene pegmatites in southern Newfoundland and the broader Ganderia in the northern Appalachians.

Petrochemistry, mineralogy and Nd isotopic data for Tithonian (ca. 148 Ma) alkaline lamprophyric intrusions, Notre Dame Bay, Newfoundland, Canada

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The magma-poor Newfoundland Atlantic margin formed following lithospheric extension that led to rifting by the Late Jurassic. Mesozoic-Cenozoic magmatism on- and offshore Newfoundland was contemporaneous with this rifting and breakup. In north central Newfoundland, the Budgell Harbour and Dildo Pond Stocks, two Late Mesozoic alkali monzogabbro intrusions, an associated lamprophyre dyke swarm and a peridotite sill form the Notre Dame Bay Magmatic Province. Geochronological constraints (1 U-Pb TIMS and 5 ⁴⁰Ar/³⁹Ar laser step-heating plateau ages) demonstrate a short-lived (~4 Myr.) alkaline magmatic pulse on the Newfoundland margin at ca. 148 Ma (Tithonian), contemporaneous with rifting, and formation of offshore petroliferous basins. Geophysical investigations demonstrate the highly magnetic, dense, central coarse-grained monzogabbro stocks represent two coalescing, epizonal funnel-like bodies with upward-reaching apophases that likely fed the lamprophyric dykes. The stocks include coarsely modally layered phlogopite-enstatite-ilmenite-magnetite-kaersutite olivine gabbro or essexite. The radially disposed lamprophyre dykes are variably textured camptonites ranging from aphyric to ilmenite-magnetite-diopside ± olivine ± kaersutite ± phlogopite porphyritic and contain feldspathic- and/or carbonate-dominant ocelli. Silica-undersaturated alkaline mineral phases form small, late anhedral grains in the groundmass of the dykes between the carbonate-rich ocelli and the feldspathic groundmass, and as the paragenetically latest phases in the stocks. Collectively the intrusions represent an early phase of the Peri-Atlantic Alkaline Pulse and occur along the intersection of broadly northeast-trending, inherited, Appalachian lithospheric-scale faults and localized Moho depth variations along the northeast Newfoundland coast. These converging lithospheric structures and Moho variations likely focussed the ascent of low degree partial melts driven by distal, edge-driven upwelling associated with continued extension in the northwest Atlantic.

Updates to the geology of the Twillick Brook map area (NTS 2D/4), south-central Newfoundland

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In 2023, a new 1:50 000-bedrock-mapping project commenced in the Twillick Brook map area (NTS 2D/4). The area is located in the Exploits Subzone in south-central Newfoundland, and includes metasedimentary and subordinate metavolcanic rocks of the Riches Island, St. Joseph's Cove, Salmon River Dam, and North Steady Pond formations of the Ordovician Bay d'Espoir Group. In addition, plutonic phases of the North Bay Granite Suite, Missing Island Granodiorite, Matthews Pond Granodiorite, Rocky Bottom Tonalite, Partridgeberry Hills Granite and Round Pond composite pluton occur in the area. Metamorphism in the meta-sedimentary rocks of the Bay d'Espoir Group in the Twillick Brook area does not exceed greenschist facies.

The area has a complex deformation history. The earliest deformation event (D1) resulted in the transposition of beds and the formation of a northeast-striking cleavage, parallel to the axial planes of isoclinal folds in the Bay d'Espoir Group. A second event (D2) formed a new generation of isoclinal folds associated with a cleavage at shallow angles to D1 transposed beds. A third deformation event (D3) resulted in the formation of folds ranging from open to closed with an axial plane striking northwest. A possible fourth event (D4) is associated with the formation of the east–west cleavage that dominates the northern part of the map area. A previously unidentified NE-striking linear feature between the St. Joseph's Cove Formation and Salmon River Dam Formation of the Bay d'Espoir Group is discernible in the aeromagnetic data. The implications of this structure to the Bay d'Espoir Group are unclear.

Exploring the potential for ultra-trace aqueous geochemistry to detect small-footprint Li-Cs-Ta pegmatite mineralization in Southern Newfoundland

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With global critical mineral demand increasing and surpassing current availability, it is imperative to devise new methods of mineral deposit exploration. Lithium-Caesium-Tantalum (LCT) pegmatite deposits are an important source of lithium and other critical minerals, but the small footprint of mineralization and associated alteration halos hamper exploration for deposits. With geophysical properties generally yielding insufficient contrast amongst granites, pegmatites, and pegmatite host rocks, existing exploration strategies rely primarily on whole-rock and mineral chemistry derived from solid reservoirs (rocks, till, soil, sediment), which are efficient only within proximity to mineralization. However, the element suites co-enriched in pegmatites and/or in adjacent rocks during metasomatism include several elements (*i.e.*, Li, Be, Cs, Rb, K, W) that are soluble in natural waters and thus, amenable to release to the hydrosphere during weathering. This renders aqueous geochemical methods potentially advantageous for exploration in areas with favourable hydrology. Despite bearing some practical and analytical challenges, aqueous geochemical exploration strategies for LCT mineralization are considerably untested.

This project aims to test the presence and potential downstream environmental dispersion of dissolved-load element budgets linked to known LCT pegmatite mineralization. Stream waters have been targeted in an LCT pegmatite-prospective area of southern Newfoundland between La Poile and Grey River to test drainage basins with known Li-rich and Cs-rich pegmatites, as well as drainage basins with no currently identified upstream mineralization. The isolation of (potential) mineralization signatures from background environmental signatures, without sample contamination during handling, is anticipated to be analytically challenging and requires clean sampling and laboratory procedures. This work will compare inductively coupled plasma mass spectrometry (ICP-MS) data from an academic research laboratory to those from a high-quality hydrogeochemical package at a commercial laboratory to define the practical viability of the exploration strategy. Progress-to-date in terms of sampling strategies and preliminary data will be presented.

Gaseous Biosignatures in Ultra-Basic Serpentinite-Hosted Groundwater Springs

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Serpentinization is a hydration reaction that occurs when ultramafic bedrock incorporates water into the crystal structures of the constituent minerals (e.g., magnesite, brucite, pyroxenes). The minerals leach elements into the water, making it ultra-basic ($\text{pH} > 10$) and reducing (< -100 mV), with an enrichment of methane (CH_4) gas. Studies have shown that specialized microbes inhabit these systems, using the available chemical energy for metabolism. The fluid discharges on land at groundwater springs, which can be sampled and studied as a proxy for subsurface processes. In this study three sites of terrestrial serpentinization were studied through their groundwater springs: The Tablelands (NL, CAN), The Cedars (CA, USA), and Aqua de Ney (CA, USA). The CH_4 found in the groundwater springs at these sites has been determined to originate from each of the known CH_4 sources on Earth: through breakdown of organic matter, from methanogenic Archaea, and from secondary serpentinization reactions, respectively. This study set out to characterize the field sites, quantify the flux of CH_4 , and link the source of CH_4 to molecular and isotopic biosignatures found.

Aqua de Ney samples were associated with abiogenically derived CH_4 , which had the highest flux from the spring surface ($13.3 \text{ mol} \cdot \text{m}^{-2} \cdot \text{min}^{-1}$), while the other sites did not contain CH_4 in a high enough concentration to be detected by the flux experiments. Dissolved gas analysis from the microbially-derived CH_4 site (i.e., The Cedars) had a concentration of $5497 \mu\text{mol/L}$, while the field site with non-microbially derived CH_4 (i.e., Tablelands) contained $4931 \mu\text{mol/L}$ CH_4 .

Since sites of serpentinization have been found on other celestial bodies and support microbial life on Earth, these data may be used for characterization of extra-terrestrial sites of serpentinization found on future exploration missions and may play a role in the search for microbial life away from Earth.

Hot syn-orogenic granites of the Central Grenville Province: characteristics and tectonic settings

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Conventional models of collisional orogens predict S-type granitoid emplacement during the orogenic climax, whereas A-type granitoids can be formed by late-orogenic extension. Yet, syn-orogenic S-granites are scarce in the Grenville Orogen, compatible with the development of the orogen on a previous active margin and reflecting the limited introduction of fertile sedimentary rocks into deeper crustal levels. On the contrary, the hinterland of the Grenville Province displays A-type granitoid bodies that were sporadically emplaced throughout the 100 Myr duration of the Orogeny. These rocks are particularly abundant in the Central Grenville Province as kilometre-scale plutonic bodies in the mid-P and low-P belts and tens of kilometre-scale batholiths spatially associated with 1.1 Ga anorthosites in the low-P belt.

Here, we document key characteristics of syn-orogenic granitoids exposed along the Manicouagan–Escoumins Transect in the mid-P and low-P belts of the orogenic hinterland. These granitoids were emplaced intermittently between 1090 Ma and 1015 Ma with no apparent spatiotemporal trend. In thin sections, perthite is common, while some contain magmatic pyroxenes and display rapakivi texture. Based on geochemical classifications, the rocks are ferroan, metaluminous to weakly peraluminous, alkali-calcic to alkalic monzodiorite, monzonite and granite. A detailed investigation of four plutons reveals crystallisation P–T conditions at ca. 5.3–6.7 kbar and ~800–1000°C, based on amphibole and feldspar chemistry. The presence of zircon inherited cores of Laurentian affinity, and bulk Nd and *in-situ* zircon Hf isotopic signatures suggest that the granitoid magmatism originated by mixing and/or assimilation of mantle and crustal sources.

The proximity of the largest granitoid bodies to older anorthosites in the low-P belt is consistent with the reactivation of long-lived lithospheric discontinuities. Overall, the granitoid magmatism indicates a mantle-derived elevated thermal input throughout the Grenvillian Orogeny. How this can be accounted for in the continental collision model for the Grenville Orogen remains to be discovered