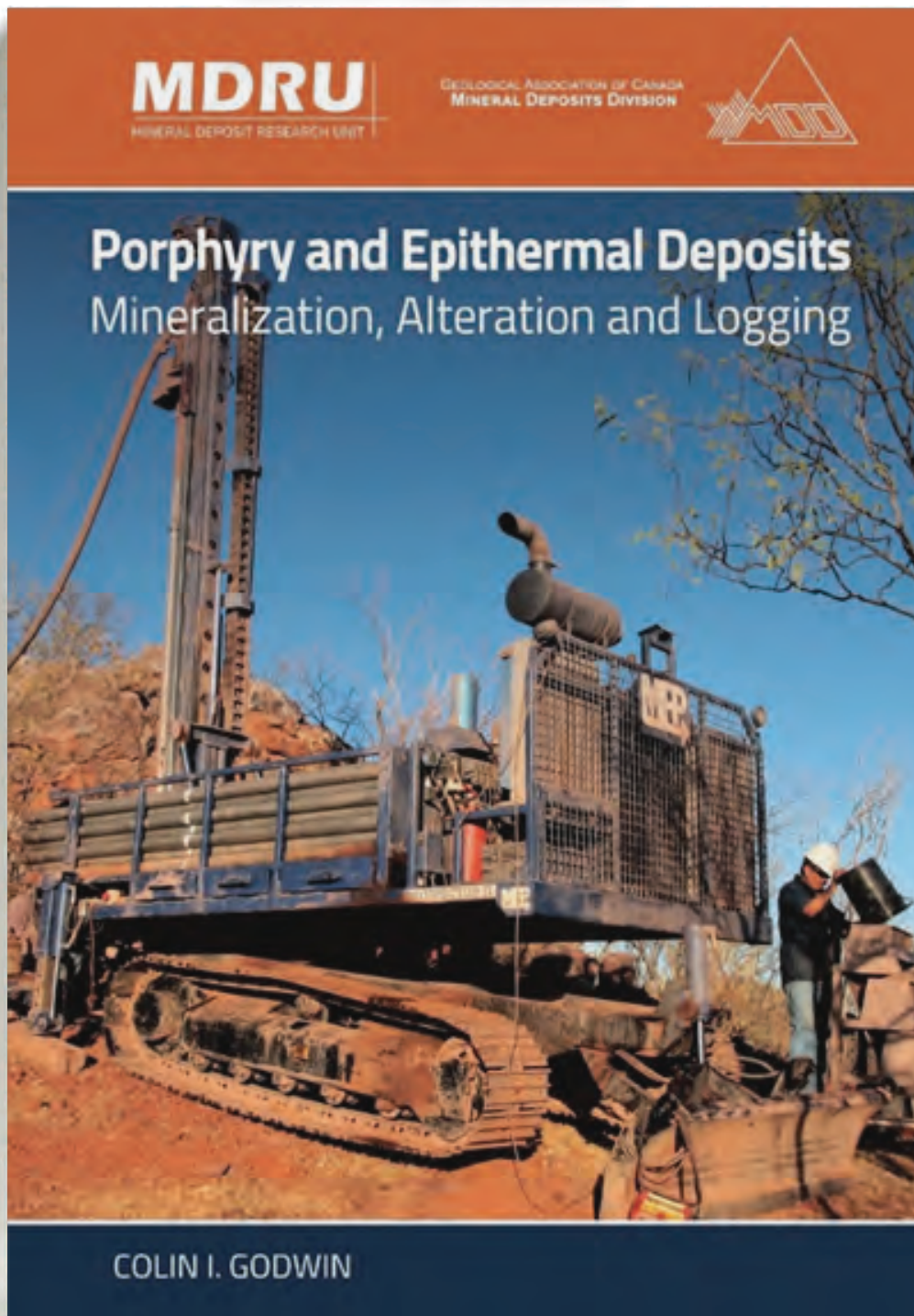


# THE GANGUE



GEOLOGICAL ASSOCIATION OF CANADA - MINERAL DEPOSITS DIVISION • Newsletter • November 2022 • Issue 106

## NEW PUBLICATION EXCLUSIVE OVERVIEW AND EXCERPTS IN THIS ISSUE OF THE GANGUE!



2023 GAC-MAC  
Joint Meeting  
Sudbury, Ontario  
May 24-27

The first circular is out - explore the technical program, field trips, workshops, deadlines, and more on p. 25-31

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Also in this issue - an amazing account from the 2022 Tom Lane Students Field Trip Award Winners and their field trip in Newfoundland...and much more!

# JOIN THE MDD!

Members of the Mineral Deposits Division (MDD) shall be in good standing of the Geological Association of Canada (GAC) and memberships to the MDD is therefore obtained through the GAC website:

<https://gac.ca/members/join-renew>. With a GAC membership, MDD is **FREE** to students and only an extra \$15 for other GAC membership categories.

How to join in 10 easy steps...

STEP 1: Visit GAC's website <https://gac.ca> and click the **'MEMBERS'** tab.

STEP 2: Click on **'Join/Renew'**.

STEP 3: Click **'START APPLICATION'** (note that a paper application is also available for download).

STEP 4: Pick your member category.

STEP 5: Complete page one of the GAC application form and click **'NEXT'** at the bottom of the page.

STEP 6: Complete page two of the GAC application form and ensure you ticked off the box in front of **'MINERAL DEPOSITS'**.

STEP 7: Complete page three of the GAC application form and click **'ADD TO CART'** at the bottom of the page.

STEP 8: Double-check your application and click **'PROCEED TO CHECKOUT'**.

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For more detailed step-by-step instructions on how to join the MDD, go to the MDD website: [www.mddgac.org](http://www.mddgac.org) and click **JOIN** in the top right-hand corner



## MDD GOALS AND OBJECTIVES

The Mineral Deposits Division of the Geological Association of Canada is Canada's foremost society for promoting the study of mineral deposits by supporting local and national meetings, symposia, short courses, and field trips. We sponsor the publication of research relating to ore deposits and metallogeny, and recognize the contributions of outstanding Canadian economic geologists by annually awarding the Duncan Derry and William Harvey Gross medals and the Julian Boldy Certificate.

### Information for contributors:

The objective of this newsletter is primarily to provide a forum for members and other professionals to voice new ideas, describe interesting mineral occurrences or expand on deposit models. Articles on ore deposits, deposit models, news events, field trips, book reviews, conferences, reprints of presentations to companies, mining groups or conferences, or other material which may be of interest to the economic geology community are welcome. Manuscripts should be in Word format. Illustrations should be camera-ready (ideally as jpeg or as digital files, e.g., Illustrator/Corel Draw); photos should be of good quality. Contributions may be edited for clarity or brevity.

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## PORPHYRY AND EPITHERMAL DEPOSITS: Mineralization, Alteration and Logging

by

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Earth Ocean and Atmospheric Sciences, The  
University of British Columbia

### BOOK OVERVIEW

**This 236-page book will be of specific interest to:**

- Geologists and prospectors wanting to upgrade and learn basic field skills in exploration,
- Managers wanting to train field geologists to a high level of expertise and consistency in exploration methodology,
- Geologists and managers needing an advanced and consistent way of training, coordinating, and expediting field exploration, and
- Executives or investors involved in exploration ventures and requiring an overview on how field exploration is conducted or can be enhanced.

**This book is a basic field toolbox** for studying and describing porphyry and epithermal deposits. It presents field-oriented approaches to:

- Mineral identification that includes recognition tips, zap tests (simple chemical tests to confirm such things as copper, nickel, and zinc) to aid identification,
- Panning to help isolate and identify key heavy minerals,
- Describe the habit of occurrence of ore and alteration minerals,
- Geological shorthand to record and describe geology, significant minerals and alteration habits in field notes and drill logs,
- Describe with computer compatible geological shorthand outcrops, trenches, and drill holes with details of lithology, and habit and mineralogy of alteration,
- Best practice QA- and QC-compatible logging procedures for logging chips from RAB, reverse circulation, and diamond drilling, with shorthand geological codes that helps with rapid, consistent, and digitizable descriptions of rocks and alteration,
- Design of logging formats for different types of drillholes in both porphyry and epithermal environments and
- Quick, rule-of-thumb ways to estimate tonnages and gross values of deposits to help determine potential project viability and when detailed evaluations might be required.

**The field-oriented methods in this guide** facilitate identification of geology, alteration and probable ore locations in porphyry and epithermal deposits. This approach is without recourse to modern techniques such as detailed analyses by thin section, portable X-ray fluorescence (XRF) and portable spectral mineral analyzers (e.g., short wavelength infrared analysis [SWIR]). Without these expensive tools, a field explo-

ration geologist should be able to determine important, overall patterns of geology and alteration related to ore discovery. Detailed modern approaches might be justified to crosscheck and verify field results through spot checks, and in some cases, define and map minerals or mineral mixtures particularly difficult to identify in the field.

### JUSTIFICATION AND REASON THIS BOOK WAS WRITTEN

**Ore deposit discoveries are declining**, and most well-exposed deposits have been found. Consequently, discovering new deposits will increasingly depend upon sharp observational abilities and insightful knowledge of field-oriented and discovery-motivated exploration geologists capable of recognizing, recording, and interpreting subtle clues from poorly exposed deposits. This book provides a base on which to build field exploration expertise and can help to replace the lack of mentorship available to undergraduate and recent graduates.

**My mentorship in geology** contrasts with most currently graduating students. I started by working with exploration companies during vacations, beginning the summer after Grade 11 in High School. I mostly cut lines, but I also helped field geologists with mapping, logging drill holes, and conducting geochemical and geophysical surveys. I had the luck to have rubbed shoulders with some great geologists, including Peter Hirst, Harry Warren, Robert Delavault, John Fortescue, Charley Ney, Johnny Anderson, Joe Brummer, Dave Barr, Jerry Noel and Hugh Gabriels. By the time I received my undergraduate degree, I had six years of inspiring summer guidance. Unfortunately, field experiences like this are seldom available to current undergraduate geologists.

**Recently graduated geological students often do not have the background needed by a field geologist.** Yet they commonly are expected to immediately be able in the field to map, log drill core or chips, and make geological evaluations. They lack practical knowledge. For example, in the many prospective field geological personnel interviews of undergraduates and new graduates from several universities, I failed to get correct answers to two simple questions: 1) What is scorodite, and why is it important? And 2) How much does a 1 metre by 1 metre by 1 metre block of granite weigh? In addition, few had drill hole logging ability or knew how to pan sediments for heavy minerals that are ore deposit pathfinders. To address this gap in experience, this book promotes a simplistic approach designed to provide the straightforward and practical background emerging field geologists need. It champions methods that should be familiar to all exploration geologists. It also represents an earlier generation's approach to field geology—in danger of



being lost by the glitter of new, expensive instrumentation.

## BOOK CONTENTS

**Contents of this guide** provide an essential methodology for the study and description of deposit geology and alteration. The following headings in the book are fundamental to detailed examinations of porphyry and epithermal deposits:

1. Ore Mineralization and Alteration: Basic Definitions and Vocabulary,
2. Key Field Identification Properties for Minerals,
3. Zap Tests: Aids to Identify Minerals,
4. Panning with a Prospector's Gold Pan,
5. Describing the Habit (Texture) of Ore and Alteration Mineral Modes of Occurrence,
6. Codes to Describe Geology and Alteration,
7. Logging Formats to Describe Drillholes, Trenches and Outcrops,
8. Enhanced Chip-board Logging Procedures to Evaluate Drill Cuttings/Chips, and
9. Rule of Thumb Tonnage and Gross Value Calculations for Block and Tabular volumes.

**Appendices are:**

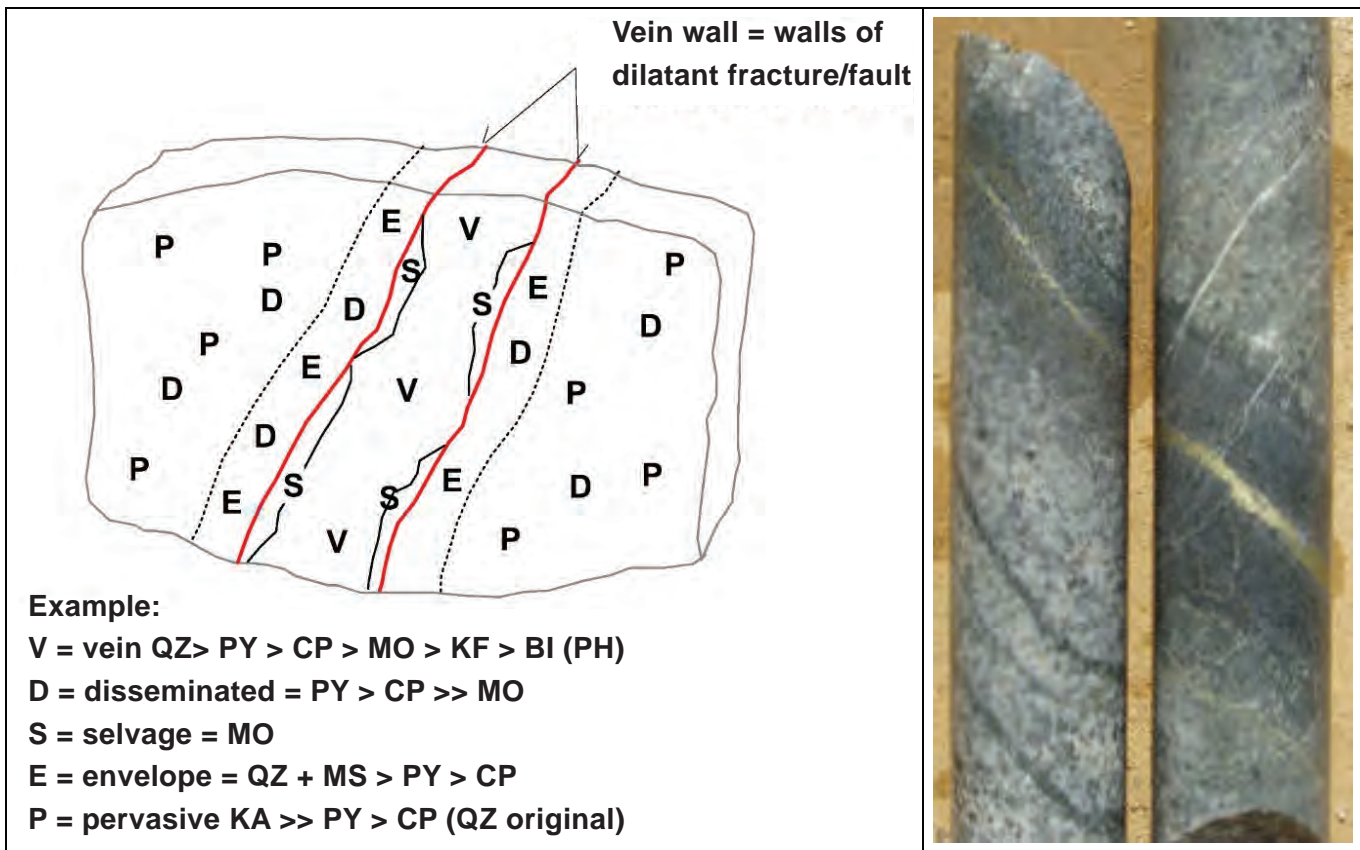
- A. Mineral Identification Table,
- B. Common Zap Tests to Aid Mineral Identification,
- C. Codes to Efficiently Describe Rock and Alteration Features,
- D. Templates to Describe Drillholes, Trenches and Outcrops, and
- E. Problem Sets.

**EXAMPLE ILLUSTRATIONS FROM THE BOOK**

The following are a few example illustrations. These are but a few of the examples from the book. Explanations for these, and many other features, are discussed and detailed in this book.

**Mineralogy, mode of occurrence and coding** for features that are common in porphyry deposits are illustrated in Figure 1.

**Brain rock with UST texture** is shown in Figure 2. The origin of this texture is controversial. However, it is an important "index fossil" for porphyry and greisen deposits.



**Figure 1.** Description of Habit of occurrence. Left picture defines habit of alteration (with codes) as a vein (V), its selvage (S), altered bordering envelope (E) and more distant pervasive (P), with disseminated (D) minerals (pyrite [PY] chalcopyrite [CP] and molybdenite [MO]) occurring variously. Right photo is of drill core (about 5 centimetres in diameter) illustrating a vein (V) of chalcopyrite (CP), with an envelope (E) of sericite and quartz (MS and QZ), bordered outward by pervasive kaolinite (KA).





**Figure 2.** Brain rock with UST texture is an important “index fossil” for porphyry and greisen deposits. Quartz crystals (QZ, white) in convoluted bands all point one way. Black matrix between the quartz bands is manganiferous muscovite (MU) and quartz (QZ) weathered on the surface to black pyrolusite (PE).



**Angel wing texture**, expressed by acute angles between quartz (QW) laths, is in Figure 3. This texture occurs within epithermal systems and indicate boiling. Specifically, boiling, will precipitate gold if it is present in the causative hydrothermal solutions. Hence the “Angel” moniker.

**A Chip Board**, pictured in Figure 4, was prepared from cuttings from a reverse circulation drill exploring a greisen deposit. Although arduous to make, these boards can provide excellent and compact detail on geology and mineralization. Drill chips more commonly are saved in plastic boxes without additional preparation. However, it is very difficult to obtain detailed information from these plastic boxes.

### SUMMARY

This compact guide is spiral bound to enhance use in the field. It introduces the methodology of describing the geology and alteration of porphyry and epithermal deposits by tried-and-true field-oriented and traditional

methods. It provides:

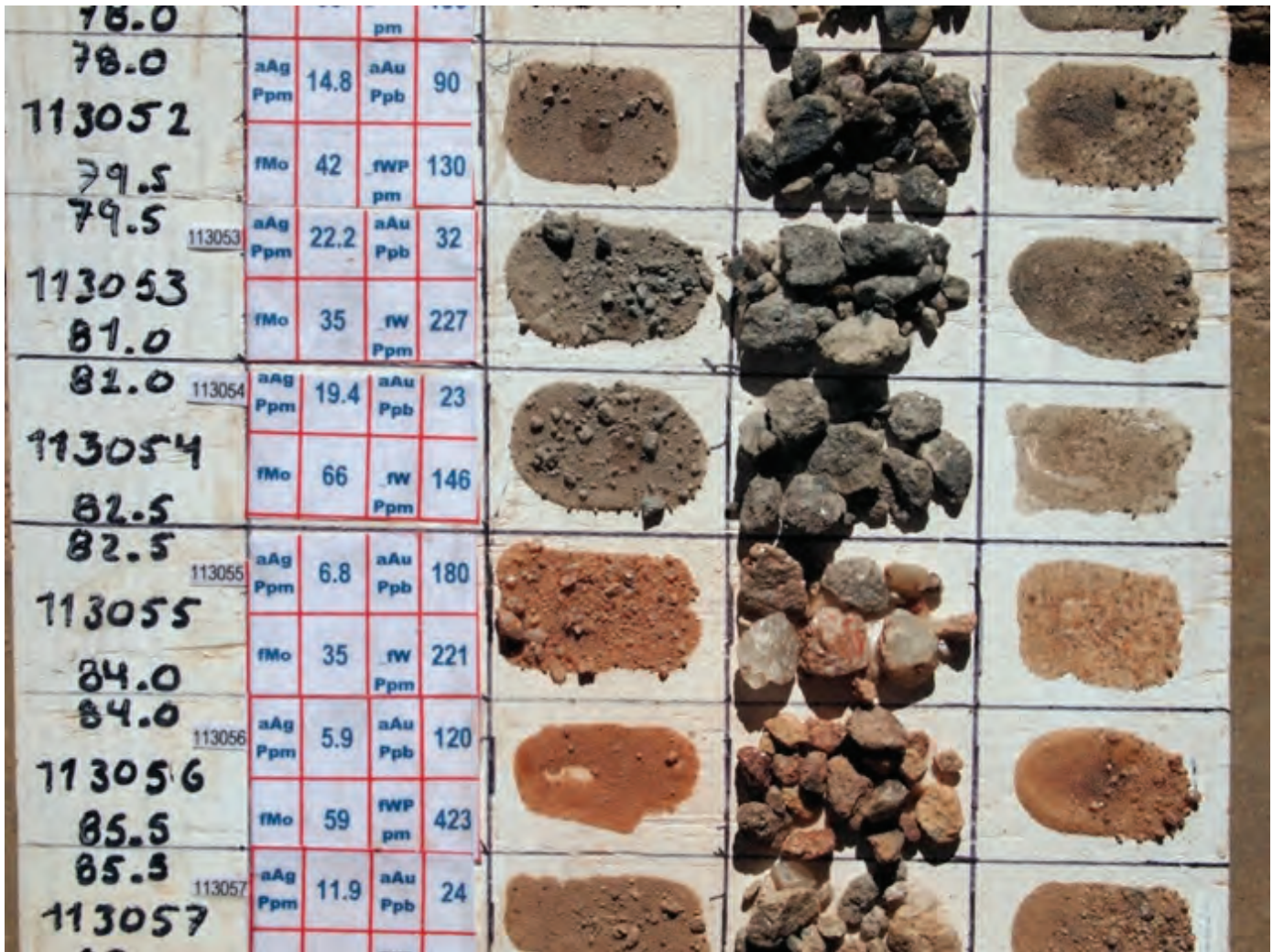
- Field-oriented methods of basic mineral identification including zap tests and panning,
- The main habits of textures of “how” mineralization occurs in porphyry and epithermal deposits,
- A method for achieving detailed descriptions of geology, alteration and mineralization in drill core, chips, trenches, and outcrops, and
- Methodology that can be applied to understanding and describing the geology, alteration, tonnage and gross value of porphyry, epithermal, and other types of deposits.

**Keywords:** exploration geology, field-oriented, mineral identification, zap test mineral identification aid, panning, habit of occurrence, tonnage calculation, gross value calculation, mineral codes, rock codes, comment codes, drill hole logging, chipboards, computer compatible logging templates, self-tests.

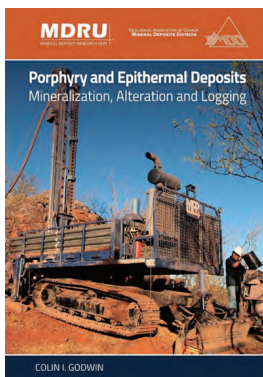


**Figure 3.** Angel wing texture in quartz (QW) is an “index fossil” for gold in epithermal deposits. The acute angles assumed by the quartz are reported to be after pre-existing carbonate that precipitated because of boiling.





**Figure 4.** An example section of a Chip Board prepared from reverse circulation drill chips from a greisen deposit. From left to right columns are as follows a) from-to interval with assay number, b) resulting assays for silver (Ag Ppm) and gold (Au Ppb), c) total material as provided (equivalent to material commonly collected in plastic chip trays), d) selected, washed coarse fraction (large chips enhance ability to determine rock and alteration types), and e) panned concentrate from interval sampled (as soon as a significant heavy mineral shows up (e.g., pyrite [PY], magnetite [MG] or chalcopyrite [CP]) it is readily identified in this panned fraction. All drill chips are glued to a white-painted plywood board with water-soluble white-glue.



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<https://gac.ca/publications/bookstore/>.

Regular price is \$75. Price is discounted to \$41.25 for GAC Members.

**Keywords:** exploration geology, field-oriented, mineral identification, zap test mineral identification aid, panning, habit of occurrence, tonnage calculation, gross value calculation, mineral codes, rock codes, comment codes, drill hole logging, chipboards, computer compatible logging templates, self-tests.



# Deposits and Tectonics – A Trip Across A Golden Island

*Society of Economic Geologists Student Chapter Field  
Trip Newfoundland, Canada, May 2022*

**Winner of the 2022  
Tom Lane Student Field Trip Award**

by

*Liam Maw*

*(ULaval-INRS SEG Student Chapter President)*

&

*Siobhán Keane*

*(Queen's University SEG Student Chapter President)*

## INTRODUCTION

The SEG Student Chapters of INRS-ULaval and Queen's both commonly run international field trips; however, this became increasingly challenging after the onset of the COVID-19 pandemic for logistical and public health reasons. Acknowledging this challenge, the groups decided that Newfoundland would be an ideal location to run a field trip – it has incredible geology and a history of mining, it is culturally distinct from central Canada where Queen's, INRS and ULaval are located, and most of all, Newfoundland is currently undergoing a modern-day staking rush with an abundance of companies developing exploration projects targeting multiple commodities across the island (Fig. 1).

This trip is designed to cross-cut the island, thus providing an idealized section through the Northern Canadian Appalachians and its allochthonous terranes that host many mines – both past-producing and producing – and advanced exploration projects, including the largest in Canada currently underway, New Found Gold's Queensway project (Table 1).

The visits throughout this trip occurred between May 19th and May 30th. The trip was primarily run by the INRS-ULaval and Queen's Chapters, with the company of five students from the Memorial University of Newfoundland SEG Student Chapter from May 20th to May 24th.

## FIELD TRIP OBJECTIVES

The main objectives of this trip were to:

- Acquire first-hand knowledge of the economic geology and tectonics of Newfoundland and the Northern Canadian Appalachians through guided tours with an experienced professor from the area, and by visiting active exploration and mine sites with industry personnel;
- Visit different deposit styles for multiple commodities – including orogenic gold, volcanogenic massive-sulphide (VMS), alkaline epithermal Au, podiform chromite

and asbestos;

- Visit mining districts that have operated for centuries and see the long-term effects of mining and the difference between historical and modern operations;
- Expose students to the various roles of geologists in industry;
- Present different exploration methods for different styles of mineralization and orebody geometries;
- Educate students with various backgrounds on the differences between operating mines, early and advanced-stage exploration projects;
- Discuss the environmental, social and governance impacts (ESG), as well as technical and financial challenges facing exploration companies and their operations in the area;
- Offer networking opportunities to students that could lead to employment or mentoring during and after their studies.

## GENERAL GEOLOGY

The geology of Newfoundland is composed of a diverse assemblage of terranes in the Northern Canadian Appalachians, and is divided into 4 distinct zones, from east to west: the Avalon, Gander, Dunnage and Humber (Fig. 1). This section has been compiled from Coleman-Sadd et al., (1990).

The Avalon zone is composed primarily of Late Proterozoic submarine and subaerial volcanic rocks and thick successions of turbiditic, deltaic and fluvial sedimentary rocks. The Avalon is a distinct crustal block from the remainder of Newfoundland, bounded by the Hermitage Bay and Dover faults. The Avalon is interpreted as a fragment of continental Africa that remained attached to the developing eastern North American continental margin during the opening of the Atlantic Ocean. Various deposits occur in the Avalon, such as the Bell Island iron mine, hosted within siliciclastic shelf sedimentary rocks, and the Saint-Lawrence fluorspar mine, associated with a late Devonian granite. The Burin Peninsula and the north-eastward continuation of its geology are dominated by bimodal volcanic rocks and granitoid intrusions, which host high-sulphidation epithermal gold deposits and are a current focus of ongoing exploration.

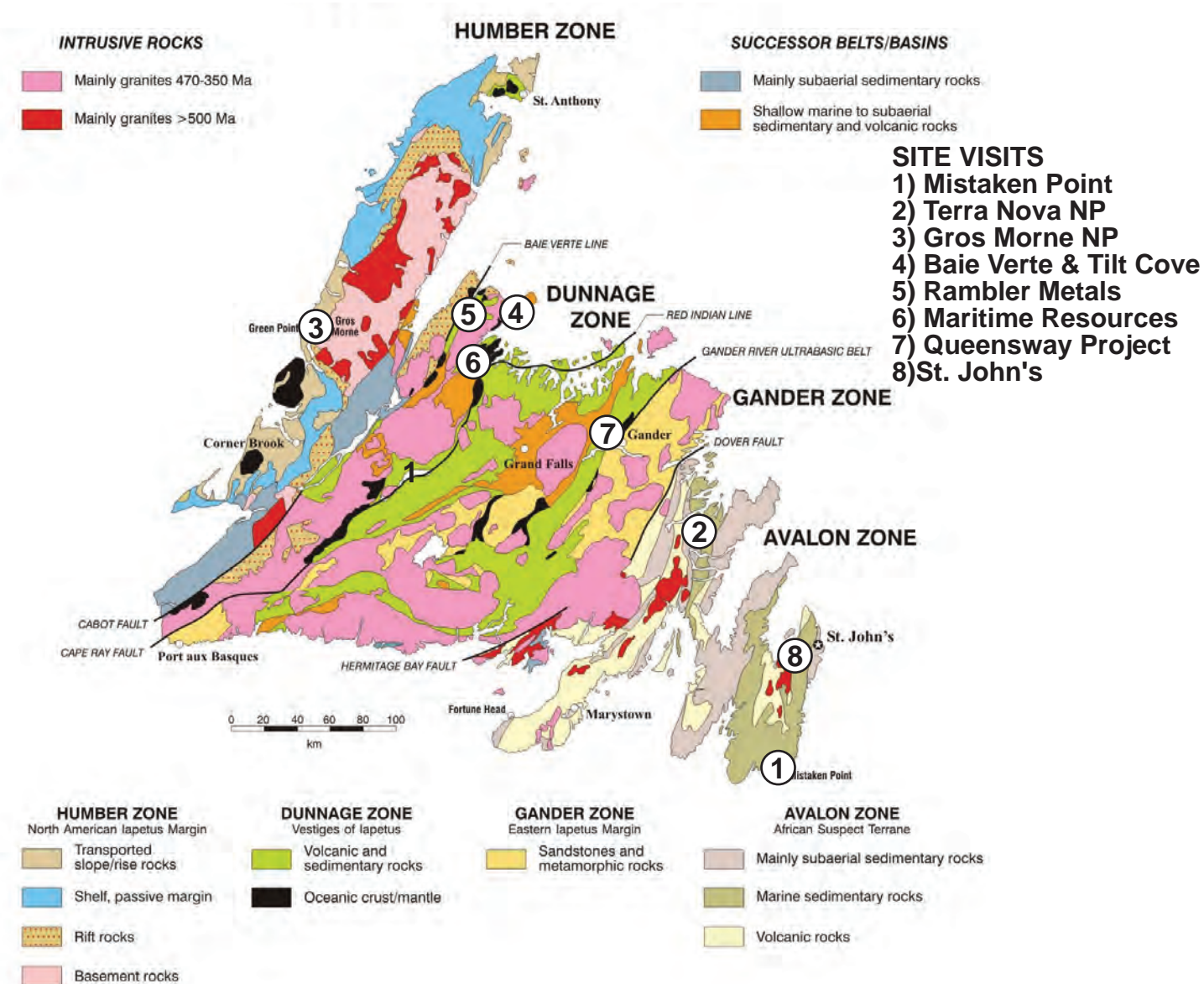
The Gander zone is composed of Cambrian to Ordovician quartz-rich siliciclastic rocks of the Exploits, Gander Lake, Meelpaeg and Mount Cormack subzones. These supracrustal subzones are heavily intruded by Silurian to Devonian granitoid suites. New Found Gold's Queensway project is located along the Appleton Fault Zone, which has drawn a great deal of attention to the area, looking for similar epizonal orogenic gold deposits. These are often compared to the Fosterville deposit in Australia, and have spectacular intercepts with abundant free gold in vuggy, white quartz veins hosted within tightly folded shales and siltstones.

The Dunnage zone is one of the areas in Newfoundland with the greatest density of ore deposits,

**Table 1. Trip Itinerary.**

Day	Date	Location	Description
1	Thursday, May 19	St. John's	<ul style="list-style-type: none"> <li>- Arrival</li> <li>- Travel south along the coast to Calvert, NL</li> </ul>
2	Friday, May 20 <sup>th</sup>	Mistaken Point	<ul style="list-style-type: none"> <li>- Visit the Mistaken Point UNESCO World Heritage site with Ediacaran fossils</li> <li>- Travel west to Clarenville, NL.</li> <li>- <i>Guided by Mark King</i></li> </ul>
3	Saturday, May 21 <sup>st</sup>	Terra Nova National Park	<ul style="list-style-type: none"> <li>- Travel day to western Newfoundland, with stop at Terra Nova National Park to learn about sensitive habitats and ecological challenges in the area</li> </ul>
4	Sunday, May 22 <sup>nd</sup>	Gros Morne National Park	<ul style="list-style-type: none"> <li>- Gathering of all 3 SEG Chapters, and commence tour of Gros Morne National Park with focus on tectonics of the area. Visit Green Point International Stratigraphic Committee Cambrian-Ordovician contact, Cow Head and Rocky Harbour</li> <li>- <i>Guided by Dr. Greg Dunning of the Memorial University of Newfoundland</i></li> </ul>
5	Monday, May 23 <sup>rd</sup>	Gros Morne National Park	<ul style="list-style-type: none"> <li>- Second day with Dr. Dunning in Gros Morne. Visits of Grenville thrust slices and unconformity, base-metal mineralization in allochthonous mafic volcanic package, and trilobites. Finish with a hike through the Tablelands Ophiolite sequence, which hosts Cr mineralization</li> </ul>
6	Tuesday, May 24 <sup>th</sup>	Baie-Verte	<ul style="list-style-type: none"> <li>- Visit various sites in the Baie Verte mining district with Dr. Greg Dunning, including the past producing Tilt Cove mine, open-pit asbestos mine, local gold showings, virginite outcrop</li> <li>- Discuss tectonic setting of the camp and its relation to regional metallogeny.</li> </ul>
7	Wednesday, May 25 <sup>th</sup>	Rambler Mine, Baie-Verte	<ul style="list-style-type: none"> <li>- Visit the Rambler Mine, operated by Rambler Mining &amp; Metals, including a tour of the core shack, drills, and discussions with geologists</li> <li>- Finish the day learning about the history of the mine, and the negative impact of previous tailings storage methods that continue to produce acid rock drainage</li> </ul>
8	Thursday, May 26 <sup>th</sup>	Maritime Resources, Springdale	<ul style="list-style-type: none"> <li>- Visit Maritime's office, lithotech and core shack, followed by a tour of their Hammerdown project, a past-producing mine. Afterwards, we joined them on some logging roads outside of town to their stripped outcrops surrounding an alkaline epithermal prospect with elevated REE's</li> </ul>
9	Friday, May 27 <sup>th</sup>	New Found Gold Corp, Gander	<ul style="list-style-type: none"> <li>- Visit New Found Gold's headquarters in Gander, NL</li> <li>- Meet their geologists and receive a presentation on their property, and exploration methods.</li> <li>- Tour of the coreshack and show core with visible gold.</li> <li>- Visit surface showings of the Queensway property with VP of exploration Melissa Render and Exploration Manager</li> <li>- Hunt for visible gold in the quartz veins</li> <li>- Walk along beach-side exposures and sea stacks of felsic-intermediate volcanic complex adjacent to our cabins in Bellevue</li> </ul>
10	Saturday, May 28 <sup>th</sup>	St. John's	<ul style="list-style-type: none"> <li>- Visit National Historic Sites at Cape Spear and Signal Hill</li> <li>- Participate in a Newfoundland Screech-In ceremony</li> </ul>
11	Sunday, May 29 <sup>th</sup>	INRS-ULaval departure	<ul style="list-style-type: none"> <li>- Travel day for INRS-ULaval group. Queen's visited Signal Hill and downtown St. John's</li> </ul>
12	Monday, May 30 <sup>th</sup>	Queen's departure	<ul style="list-style-type: none"> <li>- Travel day back to Kingston for Queen's SEG Chapter</li> </ul>





**Figure 1.** Geologic map of Newfoundland with the National Parks and sites visited. Modified from Coleman-Sadd et al. (1990).

namely VMS deposits and orogenic gold hosted within the Cambrian to Middle Ordovician submarine volcanic rocks, and Early Ordovician ophiolite suites that dominate the stratigraphy. Volcanic rocks in this zone have geochemical affinities typical of island arc and back-arc environments. It is also heavily intruded by various granitoid suites.

The Humber zone extends from southwest to northwest Newfoundland, dominating the Great Northern Peninsula of Newfoundland. The zone has a basement of continental crust, metamorphosed and intruded during the Middle Proterozoic Grenville orogeny. Late Proterozoic to Middle Ordovician sedimentary rocks form an unconformable cover sequence, deposited during development of the ancestral North American continental margin and Taconian foreland basins. Large areas are interpreted as Taconian allochthons, including the ophiolites in the Bay of Islands (Gros

Morne National Park), and near St. Anthony, at the northern extremity of the peninsula.

Although the field trip is focussed on ore deposits and various geologic sites of interest across Newfoundland, the tectonic history of the island is key to building a better understanding of regional metallogeny. Many stops focused on the regional geology in Gros Morne National Park and Baie-Verte, two areas with large exposures of ophiolites interpreted as vestiges of oceanic crust within the Iapetus ocean.

Gros Morne National Park has incredibly diverse geology summarized below from structural bottom to top, from Stevens et al., (2003). There is a high degree of structural complexity, as many units were emplaced as allochthonous slices during the Taconic orogeny.

The structural bottom within the park also represents the oldest rocks in the area; assorted Pre-

Cambrian gneisses and plutonic rocks from the Grenville represent an extension of the Canadian Shield and form the basement throughout much of the park, but are locally thrust over Lower Paleozoic rocks. The Grenvillian basement is unconformably overlain by a sequence of basal, late Proterozoic volcanic rocks and late Proterozoic to Cambro-Ordovician shallow-water sedimentary rocks. These are followed by a series of slices of the deep-water Cambrian and Ordovician sediments of Humber Arm Supergroup, separated by mélangé.

The following tectonic slices represent distinct groups of volcanic and igneous rocks. The Skinner Cove Formation is an extremely well-preserved sequence of late Precambrian alkaline olivine basalts metamorphosed to zeolite facies. Basalts of the Skinner Cove Formation are interpreted to have erupted from a mature oceanic volcano (Baker, 1979).

The Little Port Complex is a variably deformed group of ultramafic to silicic igneous and metamorphic rocks with associated red cherts and minor shale, unrelated to the Skinner Cove Formation. It is also host to minor base metal mineralization, as observed during the field trip.

Lastly, the tectonically disrupted mafic and ultramafic massif of the Bay of Islands ophiolite shows the classic igneous, metamorphic and sedimentary stratigraphy of an ophiolitic complex. It forms the structurally highest unit in the area, and forms remarkable landscapes in the Tablelands Mountains.

## FIELD TRIP VISITS

### **Day 1 – Arrive in Newfoundland**

*May 19th, 2022*

Participants travelled to St. John's, Newfoundland from Ontario and Québec. The groups picked up the rental vehicles and drove south down the coast through Precambrian sedimentary rocks of the Avalon zone to reduce the following days' drive.



**Figure 2.** Pigeon Cove stop outside of the Mistaken Point Ecological Reserve. Photo credits - Sarah Reeseman.

### **Day 2 – Mistaken Point UNESCO Heritage Site**

*May 20th, 2022*

The SEG student participants from INRS-ULaval and Queen's University had the privilege of receiving an educational tour of the Mistaken Point Ecological Reserve and UNESCO World Heritage Site by Mark King, the Reserve Geologist. We were fortunate, as educational tours for geologists and paleontologists are brought to different sites not shared with the general public.

We first stopped at Pigeon Cove, outside of the park, in order to get an introduction to the taphonomy and sedimentology of Mistaken Point. There were large Iveshediomorph fossils as well as Rangeomorphs. The main fossil surface lies beneath a thick volcanic tuff layer which buried the organisms on the seafloor, preserving them as fossils. This scenic stop was situated along a beautiful pebble beach where the surf came crashing in.



**Figure 3.** Iveshediomorph fossil from Pigeon Cove. Photo credits - Samuel Coulombe.

We then drove into the Ecological Reserve and walked across the barrens where we examined the D, B, and E surfaces of Mistaken Point. The D surface is a narrow outcrop by the water with an overturned bed of well-preserved fossils. There are over 8 taxa at this site, including *Fractofusus*, *Bradgatia*, *Pectinifrons*, and *Charniodiscus* fossils. Following the D face stop, we continued walking to the B face where we saw turbidite sequences with large sedimentary structures. This stop provided a wide-open area for us to have lunch on an outcrop, and spot a few whales.

Our final, and most exciting stop at Mistaken Point was the E surface. We had to take off our boots prior to walking on the outcrop in order to help preserve



the fossils. During paleontology classes at Queen's, Dr. Narbonne – who completed many studies on these fossils – often says “you can't walk on the E surface without stepping on a fossil,” and the students on the trip realized how true that saying is. The E surface is the most ecologically diverse and abundant face at Mistaken Point with Charniodiscus fossils comprising over 50% of the surface. While this was a trip for SEG students, the organizers believed that Mistaken Point is an important site for any geologist to visit as it has played a key role in understanding early life and evolution.



**Figure 4.** Paleontology discussion with Mark King at Pigeon Cove. Photo credits - Sarah Reese.

**Day 3 – Travel West and Terra Nova National Park**  
May 21st, 2022

The third day of the trip was primarily a travel day across Newfoundland to Gros Morne, with a few stops along the way to explore Newfoundland's diverse ecology. The highway runs west, crossing major deformation zones between the Avalon, Gander, Dunnage and Humber zones. The group made a stop at Terra Nova National Park, a beautiful park where inland rivers run into a shallow saltwater bay bordered by pristine boreal forest. The group took advantage of the interpretation centre's resources, learning about the unique ecology



**Figure 5.** a) Fractofusus fossil from the D face at the Mistaken Point Ecological Reserve. b) Allison Howes with a Rangeomorph (Hapsidophyllas) fossil. Photo credits - Siobhán Keane.



**Figure 6.** : Hannah Brommecker with a large rip-up clast from the B face. Photo credits - Siobhán Keane.

of these coastal habitats, and the ecological challenges the boreal forest faces in Newfoundland. Students learned about anemones, sea cucumbers, anadromous trout and flounder. Figure 11 displays the many shallows bays and rocky hills of Precambrian sediments of the Avalon zone in Terra Nova National Park.





**Figure 7.** Exploring the turbidite sequences at the B face. Photo credits - Sarah Reese.



**Figure 10.** View from the Terra Nova lookout point. Photo credits - Sarah Reese.



**Figure 8.** a) and b) Frond fossils from the E face. Photo credits - Allison Howes.



**Figure 9.** Queen's and ULaval-INRS students with Reserve Geologist, Mark King at the E face.

**Day 4 – Gros Morne National Park: Green Point, Cow Head and Rocky Harbour**  
May 22nd, 2022

The geology of Gros Morne National Park is highly variable and unique, and was declared a UNESCO World Heritage Site in 1987 because it hosts “outstanding examples of major stages of the Earth’s history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features”. The material in this section was presented to the group by Dr. Greg Dunning of the Memorial University of Newfoundland, with references found in the Geological Association of Canada’s guidebook: From the Intertidal Zone to the Upper Mantle - *The Amazing Geology of Gros Morne Park, Stevens et al., (2003)*.

The day began with a short lecture from Dr. Dunning, providing an overview of the geology we would be examining over the following days, and its geologic and tectonic context. The stops throughout the day display a rare record of near-edge continental margin and of Middle Ordovician time that is represented by unconformities over most of North America.



**Figure 11.** Geologic discussion at Green Point. Photo credits - Sarah Reese.



The series of stops offered excellent outcrops of various sedimentary facies that define an upwards deepening succession on the continental margin during development of the North American continental margin, as shown in Figure 12 below, at Green Point.

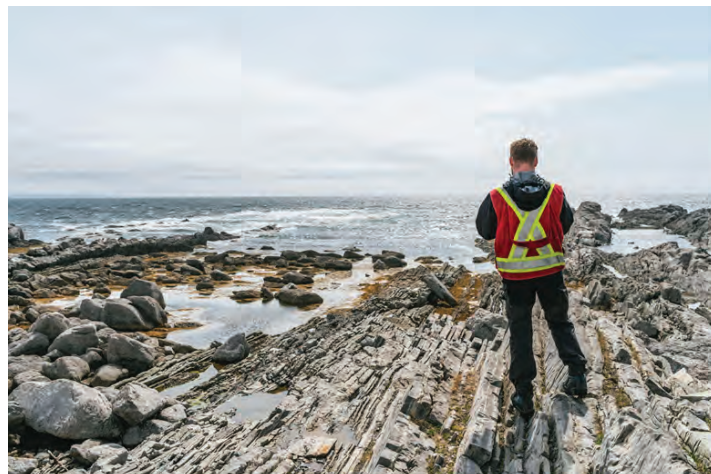


**Figure 12.** Allison Howes standing at the Cambro-Ordovician Global Stratotype. Photo credits - Sarah Reese.

At Green Point, the group visited the World Stratotype for the Cambro-Ordovician Boundary, as defined by the International Union of Geological Sciences (IUGS) International Stratigraphic Committee. This site, shown in Figure 13, offers exceptional exposure of this important boundary along a cliffside and beach at low tide. The stratigraphy is a deep marine expression of the Cow Head Group. Beautifully preserved load casts and trace fossils are visible in the succession of siltstones, shales, limestone conglomerates and rare sandstones. The limestone conglomerates were produced by the same debris flows that dominate the Cow Head Group at the following stop, and are interpreted to have run down the slope to this deep marine environment.

The Cow Head stop displays time-equivalent rocks to the previous outcrop, and is the type locality of the Cow Head Group. However, the outcrop at Cow Head contests greatly with that at Green Point. The exposures along the shore are dominated by debris flows of limestone conglomerate, with boulder-sized clasts cutting down up to 4 metres into underlying strata. Flint nodules are locally found within the succession.

The final stop of the day was back in Rocky Harbour, where outcrop along the beach is composed of *mélange*, a chaotic material with a shaley matrix. These outcrops are visually unremarkable, but significant to the comprehension of the regional tectonics. They represent an extensive zone along the base of the Humber Arm allochthon, and are interpreted as the result of near frictionless movement across zones of load-induced high hydrostatic pressure lubricated by water and bitumen from the incorporation of organic-rich black shales.



**Figure 13.** Liam Maw inspecting the sedimentary rocks at Cow Head.

**Day 5 – Gros Morne National Park: trilobites, unconformities and ultramafic rocks**  
May 23rd, 2022

The second day in Gros Morne National Park was focussed on the top and bottom of the stratigraphic column within the park, which are both dominated by allochthonous rocks including the Bay of Islands ophiolite. These rocks host typical styles of mineralization associated with submarine volcanic processes and ultramafic rocks, and also facilitated a discussion on modern fluid-rock reactions and aqueous geochemistry.



**Figure 14.** Large trilobite fossil from the Forteau Formation.

The first stop of the day featured a roadcut of sandstones and siltstone of the Lower Cambrian Hawke Bay and Forteau Formations (Labrador Group). Despite the roadcut being oblique to bedding, this site is important due to the well-preserved fossils casts of the large trilobite, *Olenellus thompsonii*, pictured below in Figure 15.

Immediately north of this stop, the road crosses the trace of a thrust fault that brings allochthonous





**Figure 15.** Road cut outcrop of Grenville gneiss and unconformity with Cambro-Ordovician stratigraphy.

Photo credits – Sarah Reese.

metamorphic rocks of the Grenville province and its Cambrian cover over younger platform carbonate rocks. This contact is exposed at the next stop in two roadcuts on either side of the highway. At this locality, green-grey gneisses of the Grenville are cut by pink pegmatite dykes and then truncated along the unconformity by a highly variable package of siliciclastic and carbonate sedimentary rocks, with minor basalt along the unconformity, as shown in Figure 16.



**Figure 16.** Ophiolite with possible sulphide weathering. Photo credits - Liam Maw.

The highlight of the day was most definitely the visit to the Iherzolitic ophiolite rocks at Table Mountain. The mountain offers a spectacular view of the Iherzolite massif as it is nearly barren of any vegetation due to elevated nickel and chromium content, along with the nature of the water flowing through the rock. The mountain hosts the most alkaline seeps from spring water on Earth, with a pH of 12. In the 1960s, a massive graphite vein was intersected within a zone of serpentine while drilling an EM anomaly within the Iherzolites. These observations led to the conclusion that serpentinization of fresh Iherzolite is ongoing due to interaction of groundwater at ambient temperatures. A seep on the hillside is pictured in the bottom right of Figure 17b and

shown in the close-up of Figure 17c - the grey calcrete in the orange Iherzolite is a product of adsorption of carbon dioxide and calcite precipitation upon interaction with the atmosphere, akin to the process operating at the seafloor with the formation of white smokers.



**Figure 17.** a) Panoramic view from Table Mountain.

b) Group discussions about Iherzolites and the ophiolite, and c) Calcrete-cemented pebbles from alkaline seep from Table Mountain. Photo credits - Sarah Reese.

## Day 6 – Baie Verte: Tilt Cove, Virginite, Coachman's Cove

May 24th, 2022

The first day in the Baie Verte area was spent visiting outcrops of particular geological and economic importance under the guidance of Dr. Greg Dunning.

The geology of Baie Verte is dominated by a supracrustal assemblage of submarine volcanic rocks and ultramafic rocks within ophiolite suites along a major suture zone of the Appalachians, the Baie Verte-Brompton Line. Consequently, the Baie Verte area is an historically important area in Newfoundland's mining history; it hosts asbestos, VMS and orogenic gold deposits. The first stop of the day was to a lookout over the past-producing chrysotile pit immediately west



of Baie Verte. This deposit was first discovered in 1955, and closed in 1981 as the public became more aware of health hazards associated with asbestos fibres. The deposit itself is a large, tabular body of serpentine within a pyroxene-rich peridotite protolith, first described in the SEG's Scientific Communications by Bichan, in 1960.



**Figure 18.** a) Chrysotile pit from Baie Verte and b) virginite outcrop. Photo credits – Liam Maw.

The second stop of the day was an outcrop of mantle peridotite along Hwy 410, across from Flatwater pond. Highway 410 roughly parallels the Baie Verte-Brompton Line suture in the area. In this locality, the peridotite is pervasively altered and cut by carbonate veins, forming a rock locally termed virginite (more commonly named listwanite in other jurisdictions). This peridotite, pictured in Figure 19b above, has been completely replaced by carbonate, quartz and micas. The turquoise-green hue is due to the presence of fuchsite and mariposite (chromium-rich micas) within the rock. The chromium within the ultramafic protolith is relatively immobile, therefore it remains in the altered rock, despite the intense carbonatization and silicification. Virginite is recognized in numerous orogenic gold districts worldwide, namely in the Mother Lode district of California and in the Abitibi Greenstone Belt along the Cadillac-Larder Lake fault zone of Québec and Ontario. As many students in our group work in the Abitibi, this observation drove a discussion on the uncanny resemblance between the geology of Baie Verte and the Abitibi.

Our following stop was at Coachman's Cove, a sea-side outcrop with exceptional exposure of polydeformed mafic volcanic rocks. The outcrop is located along the same suture zone that controls the emplacement of ophiolite slices and consequently, the asbestos deposits and virginite. There is a penetrative foliation throughout the outcrop, which anastomoses around boudinaged quartz-carbonate veins within the outcrop. Small areas of epidote and manganiferous silicates reflect seafloor hydrothermal alteration, and help to distinguish two episodes of folding within the rocks. Fold interference patterns are shown within zones in Figure 20b below.

The final stop of the day brought us to the community of Tilt Cove, the smallest town in all of Canada - population five. The road into town is also featured as "Atlantic Canada's Worst Highway" - we spotted a few moose along the bumpy track that takes you past old smelter sites where mounds of slag remain as a legacy from past mineral processing in the area. Tilt Cove is an historically important site; it was the location for the first mine in Newfoundland, and eventually became the richest copper deposit in the British Empire, prior to Newfoundland joining the Dominion of Canada. Mining began in 1864 and stopped in the 1920s. Government encouraged a resurgence of mining in the community in the 1950s, but was short-lived. Today, the claims are split between a few companies; there has been intermittent production of copper and gold from small operations facilitated by the proximity of the deposits to Rambler Mining & Metals' Nugget Pond Mill. The town is largely built on crushed waste rock, with relics of the port used to ship ore to Wales remaining by the water. Acid-rock drainage continues to be produced from the waste rock, as seen running from the culvert in Figure 21b below.

The mineral deposits in Tilt Cove are copper-





**Figure 19.** : Folds from Coachman’s Cove in basalt flow (a) and silicates with epidote (b). Photo credits – Liam Maw.

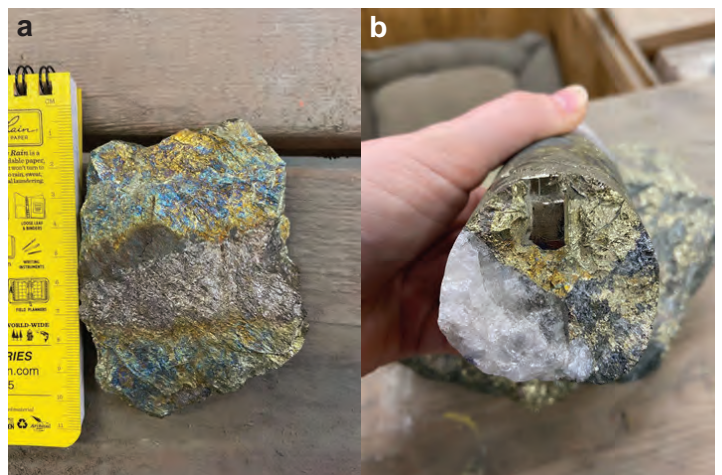
gold ± zinc VMS deposits hosted within subaqueous mafic volcanic rocks that represent a portion of the ophiolite slice. Deposits are composed of pyrite, chalcopyrite, magnetite and hematite, with minor sphalerite and covellite. The footwall rocks are strongly chloritized mafic volcanic rocks, which form large cliffs around the communities with talus slopes of waste rock and ore. Old workings and adits are visible throughout the cliffs that were once built up with an array of scaffolding to access the deposits.

**Day 7 – Baie-Verte: Rambler Mine**  
May 25th, 2022

The second half of our trip focused on mine and exploration site visits, starting with the historic Ming Mine which is owned and operated by Rambler Mining & Metals. We arrived at the site and were given a safety and corporate presentation by Mr. Peter Mercer, the Vice President of Rambler Metals & Mining. We learned



**Figure 20.** a) Tilt Cove hill leading to the ancient stopes, b) acid rock drainage from sulphides into the Atlantic Ocean. Photo credits - Sarah Reese.



**Figure 21.** a) Wall rock from the Ming Mine containing bornite, chalcopyrite, and minor chalcocite, b) euhedral pyrite in drill core. Photo credits - Siobhán Keane.



that safety is of paramount importance at the Ming Mine, and they have won the Safest Mine in Canada award from the Canadian Institute of Mining (an award that takes them 2 years to achieve due to the scale of their operations) in 2017, 2019, and 2021.

During the corporate presentation we learned about the geology of the deposit. The Ming Mine is located within the Dunnage Zone of central Newfoundland which hosts over 20 copper deposits in the Baie Verte district. The Ming Mine is a bimodal-mafic VMS deposit, and during deposition, the fluids supersaturated the footwall with copper, leaving a copper-dominant footwall stringer zone and copper-gold rich massive sulphide lens, with lesser zinc. The lack of impurities in the ore body reduces the cost of smelting, and makes it highly sought after by other operators of mines and smelters that wish to dilute the impurities in their own ore. They also incur no smelter penalties with their operations. Following the presentation, we had the opportunity to visit the core shed, and talk to the production geologists. The core

and hand samples with coarse, euhedral chalcopyrite and pyrite would catch the eye of anyone, geologist or not. One of the highlights of this visit for many students was getting to check out the ore stockpiles as we were allowed to fill our pockets with samples. The site visit gave students exposure to a working mine site, and we saw first hand how important it is to keep safety in mind when working near heavy machinery.

The most jarring part of this visit was a stop at the legacy tailings site down the road from the current mine, which was used before Rambler owned the Ming Mine. There were no environmental practices in place when this tailings facility was developed, and it has destroyed the property and local watershed. The past tailings site is now owned by the Government of Newfoundland and has an estimated remediation cost of 900 million CAD\$. Mr. Mercer brought us here to highlight that as the next generation of geologists, we have to ensure that this does not happen again. It is our responsibility to ensure that mining operations are more sustainable and proper reclamation plans are in place.



**Figure 22.** a) Acid rock drainage from the former Ming Mine tailings site. Photo credits - Sarah Reese. b) panoramic view of the area destroyed by the former tailings site. Photo credits - Richard Barrette.



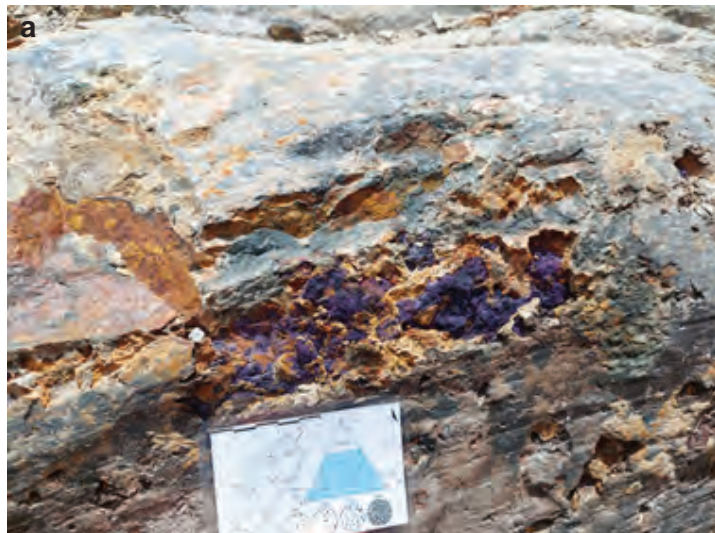
**Figure 23.** Group picture of the MUN, Queen's, and U Laval-INRS SEG students at the Rambler Metals and Mining ore stockpiles.

### **Day 8 – Springdale: Maritime Resources** May 26th, 2022

Our site visit with Maritime Resources started with a presentation at their office in Springdale, NL on the Hammerdown Deposit and the other exploration sites. Our group was impressed with the ESG focus at Hammerdown as they're focused on having a small environmental footprint during development of the site. In addition to the Hammerdown Gold Project, we also learned about the other exploration sites that Maritime Resources is focusing on, and the various mineralization styles that they have. Most of the exploration properties owned by Maritime Resources are on the eastern



edge of the Baie Verte Peninsula, which hosts VMS-style mineralization, as well as porphyry and epithermal gold associated with what is interpreted as an alkaline volcanic centre with caldera collapse features.



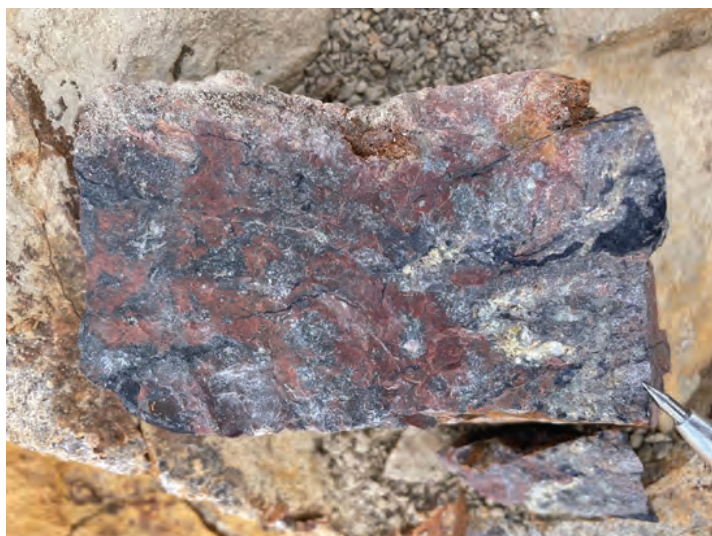
**Figure 24.** a) Purple fluorite from an REE prospective outcrop. Photo Credits – Samuel Coulombe. b) Group discussion at a Whiskey Valley outcrop. Photo credits – Larry Pilgrim (Maritime Resources).

Following the presentation, we went out to the Green Bay and Whiskey Valley prospects, testing the AWD capabilities of our rental vehicles. We visited some of the Orion and Whiskey Valley outcrops with the Maritime Resources team and had a great lunch in the field with them. One of the students' favourite trenches that we saw was in the Whiskey Valley area. This site has an REE showing with purple fluorite at the surface, associated with a jasper-style alteration of an alkaline rhyolite with honey-yellow sphalerite. There are also locally anomalous gold values from some samples in this outcrop. The visit to Maritime Resources showcased the diverse geology of Newfoundland and al-

lowed the SEG students to see atypical styles of mineralization with diverse alteration assemblages that have yet to be fully understood.



**Figure 25.** Whiskey Valley Trench. Photo credits - Larry Pilgrim (Maritime Resources).



**Figure 26.** Jasper-style alteration of an alkaline rhyolite. Photo credits – Liam Maw.

## **Day 9 – Gander: New Found Gold Corp May 27th, 2022**

Our final exploration site visit was the Queensway Project owned by New Found Gold Corp. We started the day with a presentation in their Gander office learning about the geologic and mining history in the area, as well as the general geology of the deposit. The Queensway Project is on the Dog Bay Line, which is a suture zone that formed as the Iapetus Ocean closed. New Found Gold is exploring along this structure as significant gold deposits have been found along parallel fault zones that formed at the same era in England in the southern Appalachians. The gold is hosted in large, milky white, vuggy quartz veins within Middle Ordo-





**Figure 27.** Queen's and U Laval-INRS students with the Maritime Resources geologists and field technicians.

vician shales and siltstones. Gold is generally native within the veins, and associated with minor amounts of boulangerite and ammonium-rich phengite.

The Queensway Deposit was discovered after outcrops with visible gold were found, and a comprehensive review of all data was completed. The first drillhole on the project returned 90 g/t Au over 19 metres. Compared to other orogenic gold deposits, the deposit doesn't have a strong alteration halo nor a significant contrast with surrounding host rocks making exploration with geophysical methods difficult. Because of this complexity, the company must rely solely on mapping and structural models from borehole televiewer data to understand the deposit and vector towards more veins. Oriented drilling was also attempted, but the data was not worth the effort due to the poor rock quality. Consequently, the company drills an incredibly tight grid for an exploration company (as little as 15 metre spacing on some targets) to make further discoveries. The drill collars strewn through a mulched field are an astounding sight to see, and give context to the level of detail in their drill campaign.



**Figure 28.** : Learning about the drill core from the Keats Zone with Melissa Render, the VP of Exploration at New Found Gold Corp. Photo credits - Richard Barrette.



**Figure 29.** Samples of visible gold a) drill core from the Keats Zone, b) hand sample from the discovery outcrop. Photo credits - Siobhán Keane.



Following the presentation, we had the opportunity to see core from the Lotto, Dome, and Keats targets along the Appleton Fault Zone. This was exciting for many students who hadn't seen visible gold in diamond drill-core before. One of the most exciting parts of this visit was the field portion; in addition to seeing the drill casing at the Keats target, we also visited the Dome and Discovery outcrops where many students were allowed to hammer away and collect samples with visible gold. Our visit with the New Found Gold team displayed the potential of this site and why it is currently one of the most discussed exploration projects in Canada.

**Day 10 – St John's: National Historic Sites**  
 May 28th, 2022

On the last day for the ULaval-INRS group we visited Cape Spear, a headland located in the Avalon Peninsula and the easternmost point in North America. Originally constructed in 1836, the Cape Spear lighthouse is the oldest surviving lighthouse in Newfoundland and was kept by the Cantwell family for 150 years, with two intermissions. The original lighthouse and lighthouse keepers living quarters have been restored and are designated a National Historic Site of Parks Canada.

**Day 11 – St John's: INRS-ULaval departure and Signal Hill (Queen's)**  
 May 29th, 2022

On the last day for the Queen's students, we went to Signal Hill which overlooks St. John's, with its summit reaching roughly 167 metres above sea level. There are commanding views of the Narrows, a channel through which all ships must pass when entering St. John's Harbour from the Atlantic Ocean. This site was important for communications and defence. Its fortifications defended St. John's harbour for centuries and in 1901 Guglielmo Marconi received the first transatlantic wireless transmission at Signal Hill.

As the French and British battled for Canada, Signal Hill became an important military post and after the departure of the British in 1870 it remained an active flag signalling and communication post that supported the rise of St. John's as a commercial centre. During the second world war, it was an important port for departing merchant marine vessels and the allied forces that protected them. Consequently, German U-boats would roam the rocky seafloor in order to ambush ships leaving the Narrows. The Narrows receive plenty of traffic today, as St John's remains an active port city.

**ACKNOWLEDGEMENTS**

First and foremost, we would like to thank all of our sponsors for their financial contributions, and the in-kind contributions that helped make this trip a suc-



**Figure 30.** a) Cape Spear light house, b) Hannah Brommecker checking out some cross-bedding in sedimentary rocks of the Avalon Zone.



cess. Without them, we would not have been able to bring as many students to Newfoundland and run an affordable trip for undergraduate and graduate students alike. A special thanks goes to our platinum sponsor New Found Gold Corp, and to our other supporters, the Society of Economic Geologists - Stewart R. Wallace fund, the Geological Association of Canada – Mineral Deposits Division, Barrick Gold, SRK Consulting, and E4m - Centre de recherche sur la géologie et l'ingénierie des ressources minérales.

Secondly, this trip would not have been the success that it was without the contribution of time and knowledge we received from Dr. Greg Dunning of the Earth Sciences Department of the Memorial University of Newfoundland. The three days spent with Greg in Gros Morne and Baie-Verte were paramount to build the group's understanding of the regional geology and tectonics of the Northern Canadian Appalachians. This left the group better prepared to understand the regional context of the following mineral properties we visited. Greg was also invaluable when it came to sharing his knowledge of the local area, economy and history – an excellent addition as many students had never been to Newfoundland, or were foreign students unaccustomed to Canada's East Coast.

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**Figure 31.** Views from Signal Hill on a sunny afternoon and at sunset. Photo credits - Siobhán Keane and Sarah Reese.

## CONTRIBUTE TO THE GANGUE

The Gangue newsletter is available to MDD members and other professionals to voice new ideas, describe interesting mineral occurrences or expound on deposit models. Articles on ore deposits, deposit models, news events, field trips, book reviews, conferences, reprints of presentations to companies, mining groups or conferences, or other material which may be of interest to the economic geology community are welcome. Contributions should be submitted by email in WORD format or similar, and illustrations and photos should be of good quality. Short items dealing with news events or meetings are also welcome. Contributions may be edited for clarity or brevity.

For Information & Submissions:  
[info@mddgac.org](mailto:info@mddgac.org)





## MDD AWARDS NOMINATIONS



APPLICATION DUE DATE:  
DECEMBER 31ST, 2022



It is time to start thinking about those geoscientists who would make worthy candidates for one or the other of this year's (2023), MDD awards (presented at the GAC-MAC Annual meeting in 2023). These awards are:

- 1) The Duncan R. Derry Medal presented to an outstanding economic geologist who has made significant contributions to the science of economic geology in Canada.
- 2) The William Harvey Gross Award, presented to an MDD geoscientist less than 40 years of age who has made a significant contribution to the field of economic geology in a Canadian context, and

The nomination form can be downloaded directly from our MDD website ([www.mddgac.org](http://www.mddgac.org)). A summary of the nomination procedure is given below. Please give serious thought to nominating a worthy colleague for one of these awards.

Nominations are to be made by three members of the Mineral Deposits Division, either jointly or by independent submission, and can be submitted at any time during the calendar year using the prescribed Awards Nomination Form. Supporting information is required, which may be submitted after December 31<sup>st</sup> but before the end of January. A completed nomination is valid for three years and must include the following supporting documents:

- Cover Letter (maximum 2 pages)
- Citation (30 words or less; on Awards Nomination Form)
- Citation expanded (maximum 400 words; separate document)
- Curriculum vitae of nominee
- Supporting letter from First Co-Sponsor (maximum 1 page)
- Supporting letter from Second Co-Sponsor (maximum 1 page)

It is the responsibility of the Primary Sponsor to complete the attached Awards Nomination Form and to gather the supporting information. Nomination forms shall be submitted to the MDD Awards Committee by December 31<sup>st</sup> at the email addresses below:

Medals Committee:  
Daniel Gregory: [daniel.gregory@utoronto.ca](mailto:daniel.gregory@utoronto.ca) (Derry)  
Jim Walker: [jim.walker@gnb.ca](mailto:jim.walker@gnb.ca) (Gross)

## Tom Lane Student Field Trip Award

Application due date: December 31<sup>st</sup>, 2022  
Awards up to \$1500\*

The Mineral Deposits Division of the Geological Association of Canada supports students interested in the study of mineral deposits and exploration with an annual field trip funding competition. These competitive awards are allocated to successful student groups who demonstrate a need for financial support to offset expenses for a field trip focused on economic geology.

### Eligibility:

- 1) Field trips must have a mineral deposits/economic geology focus (N.B., field trip itineraries should not include conferences such as PDAC);
- 2) The group must be affiliated with a Canadian University/Institution;
- 3) Preference will be given to field trips involving student members of the MDD;
- 4) Preference will be given to student-led field trips who can demonstrate significant student involvement in field trip planning (e.g., through their letter of support);
- 5) Preference will be given to Canadian field localities;
- 6) Preference will be given to students groups who most clearly demonstrate financial need.

### Application requirements:

- I) Proposal outlining or demonstrating:
  - i. Purpose of trip
  - ii. Itinerary
  - iii. Application of the trip to mineral deposits/ economic geology
  - iv. Trip leaders
  - v. List of participants and their affiliations (students, industry etc.)
  - vi. Amount requested from the MDD and why (e.g., \$300 for van rental)
- II) Budget:
  - i. Detailed budget of projected expenses
  - ii. Cost to participants
  - iii. Sources of funding
- III) Letter of support from faculty sponsor

Submit to: [patrick.sack@gov.yk.ca](mailto:patrick.sack@gov.yk.ca) and [info@md-dgac.org](mailto:info@md-dgac.org)

\*A maximum of three student groups can split the \$1500 award with a minimum award of \$500.

The Tom Lane Student Field Trip Award is presented in honour of the late Dr. Thomas E. Lane.





## Discovering Ancient to Modern Earth *Découvrir la Terre Ancienne à Moderne*



### *First Circular*

## Sudbury 2023 GAC-MAC-SGA Joint Annual Meeting

### 24-27 May 2023

The geoscience community is invited to attend the **Geological Association of Canada – Mineralogical Association of Canada – Society for Geology Applied to Mineral Deposits Joint Annual Meeting** to be held in Sudbury, Ontario, Canada, **May 24-27, 2023**, with pre- and post-meeting workshops and field trips.

Sudbury is one of the world's oldest (~1.8 Ga), largest, and best-exposed meteorite impact sites on Earth, hosts one of the world's premiere Ni-Cu-PGE mining districts, and is surrounded by a wide range of superbly exposed Archean, Proterozoic, Paleozoic and Quaternary rocks.

The City of Greater Sudbury, the largest city in northeastern Ontario, lies amidst glacially-shaped ridges, green boreal forests, and contains 330 lakes > 10 hectares and 110 lakes > 100 hectares. The success of more than 40 continuous years of environmental reclamation efforts has led to numerous national and international awards, including a Government of Canada, *Environmental Achievement Award*, a United States, *Chevron Conservation Award*, and a United Nations, *Local Government Honours Award*.

### Meeting Theme

The theme of the meeting is **Discovering Ancient to Modern Earth**, reflecting the location of Sudbury at the intersection of the Archean Superior Province, Proterozoic Southern and Grenville Provinces, and Paleozoic-Quaternary cover sequences. The conference will include an exceptionally diverse program of **Symposia, Special Sessions, General Sessions, Field trips, Workshops, and Short Courses** covering the complete spectrum of geoscience disciplines.

The meeting will be delivered in hybrid format with both in-person and virtual components. Abstracts, talks, and posters can be given in English or French.

### Hosts and Sponsors

The meeting is being hosted by the *Harquail School of Earth Sciences and Mineral Exploration Research Centre* at Laurentian University, and is being sponsored by the *Geological Association of Canada*, the *Mineralogical Association of Canada*, and the *Society for Geology Applied to Mineral Deposits*.

### Meeting Venue

The meeting will be held on the Laurentian University campus. Technical sessions will be in the **Fraser Auditorium** and **Classroom Buildings**. Posters and exhibit booths will be held in the **Parker Atrium**. Workshops and Short Courses will be held in the Harquail School of Earth Sciences in the **Willet Green Miller Centre**, which is across the road from the Fraser Complex, and which also houses the *Ontario Geological Survey*, the *Ontario Geoscience Laboratories*, and several other mineral and mining research centers.



## Meeting Format

There will be three days of technical sessions, including plenary, invited, and volunteered oral presentations, dedicated times for posters, pre- and post-meeting field trips, and workshops.

<b>21-24 May 2023</b>	Pre-meeting field trips, workshops, and short courses
<b>24 May 2023</b>	Late afternoon registration, evening Icebreaker
<b>25-27 May 2023</b>	Morning and early afternoon oral sessions, late afternoon poster sessions
<b>28 May – 01 June 2023</b>	Post-meeting field trips, workshops, and short courses

## Provisional Registration Fees

Registration fees will be finalized in December when the budget is approved, but are expected to be similar to previous meeting and will include lunches (see **Meals** below). Field trip, workshop and short course fees will also be finalized in December.

Registration category	Early on-site	Late on-site	Virtual
Professional (member)	\$500	\$600	\$400
Professional (non-member)	\$600	\$700	\$500
Student or Retired (member)	\$150	\$200	\$100
Student or Retired (non-member)	\$250	\$300	\$200
Day (member)	\$250		N/A
Day (non-member)	\$300		N/A
Guest	\$50		N/A

plus 13% HST

## Abstracts

On-line abstract submission details will be provided in the *Second Circular*. The early (**\$40**) abstract deadline will be **01 February 2023**. The late (**\$60**) abstract deadline will be **01 March 2023**.

*Abstracts will be accepted only from authors who register for the conference and present their work in person or virtually in either poster or oral form. Submission of an abstract implies a commitment to attend the meeting and the abstracts of authors who do not subsequently register will not be included in the abstract volume.*

## Technical Program

### Association/Division Lectures

- A01 - **GAC Presidential Address** (Alwynne Beaudoin)
- A02 - **GAC Logan Medalist** (TBA)
- A03 - **GAC-CSR Middleton Medalist** (Brian Pratt)
- A04 - **GAC-MDD Derry Medalist** (TBA)
- A05 - **GAC-MDD Gross Medalist** (TBA)
- A06 - **MAC Peacock Medalist** (TBA)
- A07 - **MAC Young Scientist Award** (TBA)

### Symposia

- SY01 - **Critical Minerals in Canada**, Chairs: Evan Hastie (OGS), Eric Potter (GSC), Rob Cundari (OGS), Marcus Burnham (OGS)
- SY02 - **Crustal Architecture and Metal Endowment**, Chairs: Ross Sherlock (MERC-HES/LU), Bruno Lafrance (MERC-HES/LU), Stéphane Perrouy (MERC-HES/LU)
- SY03 - **Magmatic Ore Deposits Associated with Mafic - Ultramafic Systems: A Symposium Honouring Dr. Sarah-Jane Barnes**, Chairs: Michel Houlié (GSC), Sarah Dare (UQAC)



- SY04 - Orogenic Gold Deposit Metallogeny: A Symposium Honouring Dr Benoît Dubé**, Chairs: Jochen Kolb (KIT), Georges Beaudoin (U Laval), Iain Pitcairn (Stockholm U), Nicolas Thébaud (UWA)
- SY05 - Sudbury Impact Structure**, Chairs: Gordon Osinski (Western U), Michael Leshner (MERC-HES/LU)

### **Special Sessions**

- SS01 - Advancements in Canadian Deep-Water Research**, Chairs: Lilian Navarro (Cape Breton U), Vittorio Maselli (Dalhousie U), Elisabeth Steel (Queen's U)
- SS02 - Advances in Isotope Sciences**, Chairs: Dan Layton-Matthews (Queen's U), Matt Leybourne (Queen's U), James Kidder (GSC)
- SS03 - Advances in Marine Geology and Geodynamics and their Application to Understanding Ancient Metallogenic Terranes**, Chairs: Erin Bethell (U Ottawa), Chris Galley (U Ottawa), Alan Baxter (U Ottawa), Mark Hannington (U Ottawa)
- SS04 - Advances in the Study of Accretionary Tectonics in the Paleozoic: From the Appalachians to Zagros**, Chairs: Deanne van Rooyen (Acadia University) et al.
- SS05 - Advances in VMS Deposits: Genetic Models and Approaches to Mineral Exploration**, Chairs: Frank Santaguida (Glencore), Harold Gibson (MERC-HES/LU)
- SS06 - All that Glitters is Cold: Advances in Quaternary Glacial Investigations**, Chairs: Jessey Rice (GSC), Tyler Hodder (MGS), Riley Mulligan (OGS)
- SS07 - Anything but Boring: the Grenville Orogeny a Key into Mesoproterozoic Geodynamics**, Chairs: Aphrodite Indares (Memorial U), Caroline Lotout (Memorial U / CNRS)
- SS08 - Archean Craton Assembly**, Chairs: Antoine Godet (Laval U), Carl Guilmette (Laval U), Doug Tinkham (MERC-HES/LU)
- SS09 - Canadian Journal of Earth Sciences at 60: Celebrating Canadian Geoscience and Geoscientists**, Chairs: Sally Pehrsson (GSC), Brendan Murphy (SFX)
- SS10 - Cratons, Kimberlites, and Diamonds**, Chairs: Thomas Stachel (U Alberta), Yana Fedortchouk (Dalhousie U), Maya Kopylova (UBC), Graham Pearson (U Alberta)
- SS11 - Environmental Aspects of Mine Waste**, Chairs: Ian Power (Trent U), Sasha Wilson (U Alberta), Matthew Lindsay (U Sask)
- SS12 - Environmental Restoration: Lessons from Sudbury's Recovery and Beyond** Chairs: Nadia Mykytczuk (GSM/LU), Graeme Spiers (GSM/LU)
- SS13 - Geobiology of the Late Archean to Early Paleoproterozoic Surface World and its Impacts on Proterozoic Evolution**, Chairs: Kurt Konhauser (U Alberta), Jamie Robbins (U Regina), Mike Babechuk (Memorial U)
- SS14 - Geophysics of Mineral Systems**, Chairs: Richard Smith (MERC-HES/LU), Callum Walter (Queen's U), Hema Sharma (Western U), Rajesh Vayavur (MERC-HES/LU)
- SS15 - Geoscience Education and Communication**, Chairs: Lesley Hymers (Mining Matters), Deana Schwarz and Veronica Klassen (APGO Education Foundation), Beth McLarty Halfkenny (Carleton U / Canadian Federation of Earth Sciences)
- SS16 - Impact Processes on Solar System Bodies: A Special Session in Memory of Erin Walton**, Chairs: Gordon Osinski (Western U), Christy Caudill (Western U)
- SS17 - Integrated Studies in Paleozoic Basins: Life, Environments, Resources**, Chairs: Nikole Bingham-Koslowski (GSC), Michelle Coyne (GSC)
- SS18 - Iron-rich Au, Ag, Bi, Co, Cu, F, Mo, Nb, P, Pb, REE, U, Zn, PGE Mineralization: Genetic Processes and Feedback Mechanisms between Magmatism and Metasomatism**, Chairs: Wyatt Bain (Lakehead U), Louise Corriveau (GSC), Jean-Francois Montreuil (MacDonald Mines / Red Pine Expl)
- SS19 - Isotopes in Ore Deposits and their Utilization in Exploration**, Chairs: Bertrand Rottier (U Laval), Crystal Laflamme (U Laval), Guillaume Barré (U Laval), Georges Beaudoin (U Laval)
- SS20 - Lithium in Pegmatites: Mineralogy, Petrogenesis and Classic to Innovative Exploration Techniques**, Chairs: Tania Martins (Manitoba Geological Survey), Axel Muller (Natural History Museum, Oslo), Joana Cardoso-Fernandes (U of Porto / ICT), Encarnacion Roda-Robles (U Basque Country), Lee Groat (UBC)
- SS21 - Mineral Exploration Footprints**, Chairs: Stéphane Perrouy (MERC-HES/LU), Kevin Ansdell (U Sask), Robert Lee (MDRU/UBC)
- SS22 - New Insights on Cordilleran Magmatism and Tectonics: from Rifted Margin to Continental Arc Systems**, Chairs: Rosie Cobbett (Memorial U / YGS), Luke Beranek (Memorial U), Justin Strauss (Dartmouth U), David Moynihan (YGS)
- SS23 - On the Beam: Advances and Applications in In-Situ Microanalysis and Geochronology**, Chairs: Jeff Marsh (MERC-HES/LU)
- SS24 - Optimizing Geological, Environmental, and Social Criteria for Exploration in the Arctic**, Chairs: Anna Bidgood (iCrag/UCD), Brendan Dyck (UBC-Okanagan), Philip Rieger (iCrag/UCD), John Thompson (PetraScience Consultants)



- SS25 - Precambrian Depositional and Environmental Systems**, Chairs: Maxwell Lechte (McGill U), Nabil Shawwa (Carleton U), Mollie Patzke (MERC-HES/LU)
- SS26 - Rare Metals in Igneous Systems**, Chairs: Zsuzsanna Magyarosi (GSNL), Nadia Mohammadi (GSC), Zeinab Azadbakht (OGS), Tarryn Cawood (GSC), Anne-Aurélien Sappin (GSC)
- SS27 - Spectroscopic Mineral Analysis**, Chairs: Philip Lypaczewski (CNA), Derek Wilton (CNA / Memorial U), Gary Thompson (CNA)
- SS28 - Subsurface Energy Storage in Geologic Media: Hydrogen, CAES, and CO<sub>2</sub>-Sequestration: Preparing for New Energy Economy**, Chairs: Frank Brunton (OGS), James Brydie (NRCan Canmet-Devon), Nick Utting (NRCan Canmet-Devon), Nirmal Gnanapragasam (Canadian Nuclear Labs)

## General Sessions

- GS01 - Economic Geology**, Chair: Daniel Gregory (U Toronto), Merilie Reynolds (NWTGS)
- GS02 - Environmental Geology**, Chair: TBA
- GS03 - Geochemistry, Geochronology**, Chair: Steve Piercey (Memorial U)
- GS04 - Geophysics**, Chair: Richard Smith (MERC-HES/LU), Hema Sharma (Western U), Rajesh Vayavur (MERC-HES/LU), Callum Walter (Queen's U)
- GS05 - Geoscience Education**, Chair: Tobias Roth (MERC-HES/LU)
- GS06 - Hydrogeology**, Chair: TBA
- GS07 - Igneous and Metamorphic Geology, Volcanology**, Chair: Doug Tinkham (MERC-HES/LU)
- GS08 - Indigenous Engagement**, Chair: TBA
- GS09 - Mathematical Geology**, Chair: Cliff Stanley (Acadia U)
- GS10 - Mineralogy, Crystallography**, Chair: Andrew Conly (Lakehead U), Shannon Zurveniski (Lakehead U)
- GS11 - Paleontology**, Chair: Nikole Bingham-Koslowski (GSC), Katie Maloney (McGill U)
- GS12 - Planetary Geology**, Chair: Gordon Osinski (Western U)
- GS13 - Sedimentology, Stratigraphy**, Chair: Max Lechte (McGill U), Nabil Shawwa (Carleton U)
- GS14 - Structural Geology, Tectonics**, Chairs: Deanne van Rooyen (Acadia U)

## Field Trips

- FT01 - Base, Critical, and Precious Metals Mineralization in the Metasomatic Iron and Alkali-Calcic Systems of the Southern Province in the Sudbury Area**, Leaders: Jean-Francois Montreuil (MacDonald Mines / Red Pine Expl), Louise Corriveau (GSC), Wyatt Bain (Lakehead U), Sponsor: MacDonald Mines, Duration: **2 days**
- FT02 - Discovering the Abitibi Gold Belt**, Leaders: Stéphane Perrouty (MERC-HES/LU), Ross Sherlock (MERC-HES/LU), Sponsor: MERC, Duration: **4 days**
- FT03 - Geological Traverse of the Sudbury Impact Structure and Evolution of the Impact Melt**, Leaders: Dustin Peters (MERC-HES/LU), Sandra Baurier-Aymat (MERC-HES/LU), Shirley Peloquin (OGS), Caroline Gordon (OGS), Sponsor: MERC, Duration: **1 day**
- FT04 - Geology of Manitoulin Island**, Leaders: Frank Brunton (OGS), Catherine Béland Otis (OGS), Katherine Hahn (OGS), Sponsor: OGS, Duration: **2 day**
- FT05 - Ice on the Rocks: Quaternary Geology of the Sudbury Region**, Leaders: Andrea Marich (OGS), Riley Mulligan (OGS), Abigail Burt (OGS), Grant Hagedorn (OGS), Sponsor: OGS, Duration: **1 day**
- FT06 - Multiscale and Polyphase Deformation Structures in the Grenville Front Tectonic Zone near Sudbury**, Leaders: Dazhi Jiang (Western U), Changcheng Li (U Waterloo), Sponsor: Western U, Duration: **1 day**
- FT07 - Noranda and Swayze Volcanology and Hydrothermal Ore Deposits**, Leaders: Harold Gibson (MERC-HES/LU), Thomas Gemmel (OGS / MERC-HES/LU), Taus Jørgensen (MERC-HES/LU), Evan Hastie (OGS), Sponsor: MERC, Duration: **4 days**
- FT08 - Paleoproterozoic Glacial, Microbially Induced, Tidal, and Seismic Deposits of the Huronian Supergroup, Elliot Lake Region, Canada**, Leaders: Patricia Corcoran (Western U), Carolyn M. Hill-Svehla (Western U), Sponsor: Western U, Duration: **3 days**
- FT09 - Sudbury Offset Dikes and Associated Ni-Cu-PGE Mineralization**, Leaders: Henning Seibel (MERC-HES/LU), Michael Leshner (MERC-HES/LU), Sponsor: MERC, Duration: **3 days**
- FT10 - Orogenic and Intrusion-Related Gold Deposits of the Michipicoten and Mishibishu Greenstone Belts in the Wawa Region, with an Emphasis on the Structural Framework**, Leaders: Chong Ma (MERC-HES/LU), Lianna Vice (OGS / MERC-HES/LU), Sponsor: MERC, Duration: **3 days**

## Workshops

- W01 - Curriculum Connections, Educator Professional Learning (K-12)**, Leaders: Lesley Hymers (Mining Matters), Deana Schwarz (APGO Ed Foundation), Veronica Klassen (APGO Ed Foundation), Sponsor: Mining Matters/APGO/EdGEO/CGED, Duration: **1 day**

- W02 - Environmental Remediation: Sudbury's Award-Winning Reclamation and Remediation Story**, Leaders: Nadia Mykytczuk (GSM/LU), Graeme Spiers (GSM/LU), Sponsor: Goodman School of Mines, Duration: **2 days** (*workshop and field trip*)
- W03 - Iolite 4: Advances in LA-ICPMS Data Processing and Visualization**, Leaders: Jeff Marsh (MERC-HES/LU), Joe Petrus (MERC-HES/LU), Sponsor: MERC, Duration: **1 day**
- W04 - Ore Microscopy**, Leaders: Simon Kocher (CSM), Tobias Fusswinkel (RWTH Aachen), Sponsor: SGA, Duration: **2 days**
- W05 - Orogenic Gold Deposits**, Leaders: Jochen Kolb (KIT), Georges Beaudoin (U Laval), Iain Pitcairn (U Stockholm), Nicolas Th  baud (UWA), Sponsor: SGA, Duration: **1 day**
- W06 - Reflectance Spectroscopy for Mineral Exploration**, Leaders: Philip Lypaczewski (CNA), Derek Wilton (CNA / Memorial U), Gary Thompson (CNA), Sponsor: CNA, Duration: **1 day**

### Short Courses

- SC01 - Fundamentals and Applications of Hydrogeochemistry**, Leaders: Matt Leybourne (Queen's U), Rob Bowell (SRK), James Kidder (GSC), Sponsor: MAC, Duration: **2 days**
- SC02 - Mineral Prospectivity Mapping**, Leader: Jeff Harris (MERC-HES/LU), Sponsor: MERC, Duration: **1 day**

### Social Program

There will be an *Icebreaker* in the **Vale Cavern at Science North** on the evening of May 24, a public outreach event will be organized on May 25 at **Dynamic Earth**, and late-afternoon *Poster Sessions* on May 25-27. Details will be provided in the *Second Circular*.

### Accompanying Guest Program

Depending on weather and interest, a variety of activities are planned for accompanying guests. Transportation costs will be nominal. Entrance/rental fees and lunches in restaurants will not be included.

**Ramsey Lake Waterfront** (winner of a 1992 international *Excellence on the Waterfront* award): A visit to the **Sudbury Art Gallery**, a walk along the waterfront through **Bell Park** and along the **Boardwalk**, a visit to the multiple award-winning **Science North** museum and **3D Imax** theatre complex, and a tour of **Lake Ramsey** on a 70-passenger **Cruise Boat** will be proposed.

**Kayaking on Lake Ramsey**: If there is sufficient interest, we can also arrange kayaking on Lake Ramsey, which used to be listed by the *Guinness Book of World Records* as the largest lake (~8 km<sup>2</sup>) located entirely within the boundaries of a single city. However, when the Regional Municipality of Sudbury was amalgamated into the current City of Greater Sudbury in 2001, this status was transferred to Lake Wanapitei, which fills an 8.4 km diameter, 37 Ma-old, meteorite crater located near the Sudbury Airport. Kayaks will be rented from the **Northern Watersports Centre**.

**Killarney Provincial Park**: The park contains numerous crystal-clear (deep blue on clear days) lakes set amongst white quartzite ridges and glacially-sculpted pink granites and syenites. It is widely regarded as one of the most beautiful parks in Canada and was the subject of several paintings by the *Group of Seven* Canadian landscape artists in the 1920s. There are several options for hikes ranging from short (1 hour) and easy (requiring only sturdy walking shoes) to long (3-4 hours) and moderate-strenuous (requiring sturdy hiking boots), but none will be technically difficult. There may also be time for a refreshing dip in Killarney Lake (cool) or Georgian Bay (very cool). The hike will be followed by late-afternoon fish and chips at the world-renowned *Herbert Fisheries* in the waterfront village of Killarney.

**AY Jackson Lookout**: Hiking and lunch (*brown bag*) at AY Jackson Lookout in Onaping Falls, 45 km WNW of Sudbury on the rugged North Range of the Sudbury Basin. The 50 m water cascade facing the lookout is the site of the painting "*Spring on the Onaping River*" by Jackson, who was a member of the *Group of Seven*. There are several hiking trails of various lengths, an information center, and a self-guided geological tour through a collection of very large samples of Sudbury rocks and ores.

**Lake Laurentian Conservation Area**: There are many hiking trails in the 950-hectare Lake Laurentian Conservation Area, which surrounds Laurentian University and extends around the south of Lake Ramsey, ranging from short to long, and flat to rugged.

**Dynamic Earth**: Science North's sister attraction contains an underground mine, a wide range of Earth Science exhibits, a giant high-definition movie theatre, and – a must-see for anyone visiting Sudbury – the 9 m diameter "Big Nickel" (listed in the *Guinness Book of World Records* as the world's largest coin). A public mineral identification event will be held here during the conference, where mineral kits put together by MAC will be distributed.



## Transport

Sudbury is ~400 km north of Toronto and ~450 km northwest of Ottawa. Depending on your budget and the amount of time you have, there are four travel options: **air** (Air Canada, Bearskin, Porter), **train** (VIArail – *once per week*), **bus** (Ontario Northland), and **car** (~4.5 hrs from Toronto, ~5.5 hrs from Ottawa).

A **Shuttle Service** will be operated between South End hotels (e.g., Hampton Inn/Homewood Suites, Comfort Inn, Super 8, Holiday Inn, Travelodge, Travelway Inn), downtown hotels (e.g., Radisson, Northbury), and the Laurentian University campus during the meeting. Details will be provided in the *Second Circular*.

## Accommodation

Laurentian University is located ~4 km southeast of downtown Sudbury. Blocks of rooms have been reserved at several local hotels, some of which are located fairly near the university, some of which are a bit further but closer to the “Four Corners” commercial area, and some of which are located in downtown Sudbury. All of the listed hotels have private bathrooms, most serve continental or hot breakfasts and/or have adjacent coffee shops/restaurants, and some have indoor swimming pools. The rooms will be held until March/April 2023.

Accommodation will also be available in the Residences at Laurentian University.

Additional information is provided on the meeting website: <https://event.fourwaves.com/Sudbury2023/>.

**NOTE:** Sudbury hosts many large sporting events during the summer, so participants should make sure that they book their accommodation as early as possible.

## Meals

Attendees will be responsible for their own breakfasts and dinners. Because the Laurentian University campus is not close to restaurants, registration fees include catered box and/or BBQ lunches. Provisions will be made for those with dietary restrictions.

## Internet and E-Mail Access

Wireless access to internet is available for free everywhere on the LU campus. Most hotels also provide wired and/or wireless access to the internet, but visitors should verify this with their hotel before booking.

## Medical

Sudbury Regional Hospital is a major medical and emergency service center with an emergency room within 5 minutes of Laurentian University. Visitors should assume that they will have to pay all medical costs immediately and should be properly insured. Temporary medical insurance can normally be arranged through your airline company at a reasonable cost. Most pharmacies are open 7 days a week, but only between 09:00 am and 11:00 pm.

## Weather

The days in Northern Ontario in late May are moderately long with the sun rising at 05:40 am and setting at 09:00 pm. Temperatures range between 9 °C and 18 °C and are rarely below 3 °C or above 25 °C. Sudbury is one of the sunniest cities in Canada, but afternoon thunderstorms are common in the summer. A rain parka and hat are recommended for those attending field trips or hikes, and a light umbrella is recommended for those staying on campus or in town. Attendees should also bring sunscreen (SPF 30 or greater) and reapply it often if they plan to spend more than very short periods outdoors.

## Travel Visas

A list of countries and territories whose citizens require visas in order to enter Canada as visitors can be found on <http://www.cic.gc.ca/english/visit/visas.asp> and additional information regarding visas can be found on <http://www.cic.gc.ca/english/visit/index.asp>. Visitors are required to make their own visa arrangements.

## Electrical System

Canada operates on the same 120V 60 Hz AC electrical system as the United States. Grounded outlets require a plug with two parallel flat blades and a cylindrical pin, and ungrounded outlets require a plug with two parallel flat blades. Many laptop computers operate with only an adapter, some hotels provide dual-voltage outlets for shavers, and some hotels provide hair dryers, but visitors should check with their hotels before arrival to determine which appliances will need adapters and/or transformers.

## Child Care

Younger guests (<12 years old) may stay at the *Laurentian Child and Family Centre*. Details will be provided in the *Second Circular*, but if you wish to make use of this service, please let us know as soon as possible so that we can make appropriate arrangements.

## Important Dates

- 01 February 2023**     Deadline for **early submission** of abstracts (\$40)
- 01 March 2023**         Deadline for **late submission** of abstracts (\$60)
- 31 March 2023**         Deadline for **early registration**  
Deadline for **field trip, workshops, and short course registrations**
- 24 April 2023**         Deadline for **hotel “block” bookings**

## Additional Information

The **Second Circular** will be distributed in **January 2023**. Both circulars and additional information will be posted on the meeting website (<https://event.fourwaves.com/Sudbury2023/>). Questions may be directed to [Sudbury2023@laurentian.ca](mailto:Sudbury2023@laurentian.ca).

We are looking forward to seeing you in Sudbury!

*Sudbury 2023 GAC-MAC-SGA Local Organizing Committee*



*The Laurentian University Campus with Lake Ramsey and Bethel Lake in the background, the Idylwyld Golf Club and Lake Nepahwin in the left foreground, Bennett Lake and the Lake Laurentian Conservation Area to the right.*



# A new comprehensive volume on mineral systems with IOCG and affiliated critical metal deposits

[https://gac.ca/product-category/new\\_releases/](https://gac.ca/product-category/new_releases/)

**DISCOVER** the power of alteration facies mapping in exploration for:

- iron oxide copper gold (IOCG)
- iron oxide-oxide-apatite-REE (IOA)
- iron-rich Au-Co-Bi-Cu
- albitite-hosted U and Au-Co
- skarn
- affiliated critical metal deposits

**DIVE DEEP INTO** the identification, mapping, exploration, and interpretation of metasomatic iron and alkali-calcic mineral systems and their IOCG and affiliated critical metal deposits.

**LEARN ABOUT** new exploration and mapping tools, descriptive lexicons, alteration facies, discriminant diagrams and molar barcodes. Frame metal endowment and metal associations to deposit types and prognosticate mineralization types as you map, explore and mine these mineral systems.

**EXPLORE** the many avenues for using new geoscience knowledge while you are mapping, exploring, making land-use decisions, conducting environmental assessment, planning investments.

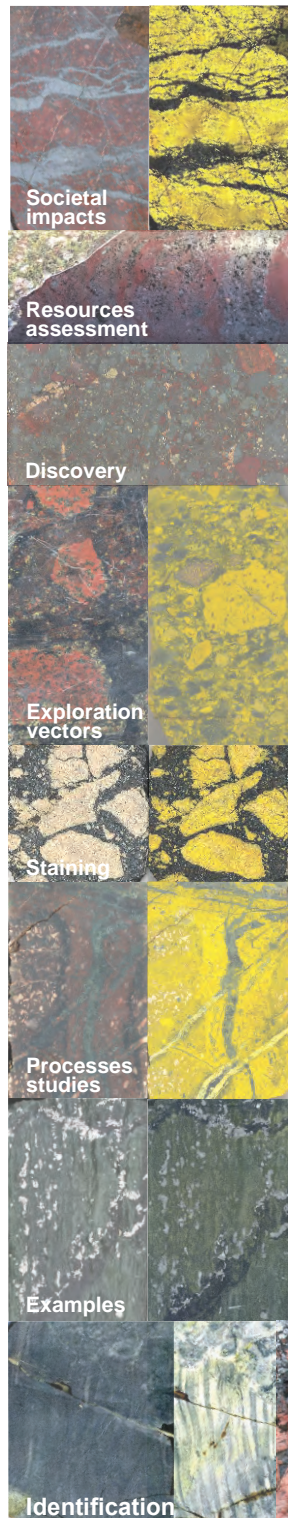
**UNCOVER** case examples from Australia, Canada, China, India, Iran, and US, and see them as if you were in the field or logging cores through the 70 full pages of photos and figures.

**SEE FOR YOURSELF** the Olympic Dam deposit geological and geochemical evolution and critical metal endowment.

**COMPARE** your sample with the examples provided.

**ENJOY** our new GAC Special Paper 52, soon to be published by the Geological Association of Canada.

**ACKNOWLEDGMENTS:** MDD, the GAC-MAC-IAH 2019 meeting and DEMCo sponsorship of its short course publication for extensive financial support, and the GAC and the Geological Survey of Canada and its Targeted Geoscience Initiative Program for in-kind support.



## GAC Special Paper 52

### Mineral Systems with Iron Oxide Copper-gold (IOCG) and Affiliated Deposits

Guest Editors  
 Louise Corriveau  
 Eric G. Potter and A. Hamid Mumin





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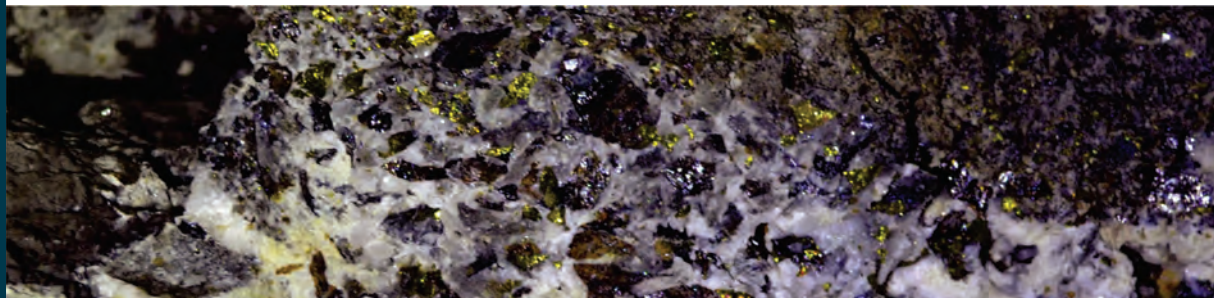
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Ore Deposits Hub provides an accessible platform for communication and discussion between industry and academia at all levels with free, weekly, online seminars on the latest ore deposit geoscience.

With more than 1,700 subscribers signed up in the first month, and audiences of up to 300 participants, we are rapidly achieving our goal of open scientific communication at a global scale.

We want to sincerely thank everyone for their support and engagement so far, especially the SEG & SGA, and we invite all geologists to join us for future Ore Deposits Hub talks!

*Ore Deposits Hub Team*







PROSPECTORS &  
DEVELOPERS  
ASSOCIATION  
OF CANADA



## PDAC-SEG Student Minerals Colloquium

Toronto • Canada • March 5-8, 2023

The Student Minerals Colloquium (SMC) committee is pleased to announce the call for registration and abstract submissions for the 2023 PDAC-SEG Student Minerals Colloquium (SMC). The Colloquium will take place as an in-person event at the PDAC 2023 Convention in Toronto, Canada, from March 5-8, 2023.

The SMC attracts hundreds of industry participants who attend the PDAC Convention, providing the widest possible exposure for student research. Presenters will have the opportunity to share their research with an audience of academics, students, and industry professionals in a poster format located within the Investors Exchange exhibit.

All students (BSc, MSc, PhD) working on projects related to mineral deposits (e.g. mapping, mineralogy, geochemistry, geophysics, environmental, hydrogeology, etc.) are encouraged to participate!

Posters are judged by a panel of academics and industry professionals, and thanks to our sponsors, cash prizes are awarded to winners in multiple categories. Judges will select three winners for the best poster presentations from each of the BSc, MSc, and PhD categories. All participating posters must be on display for the duration of the Convention.

Participation in the Student Minerals Colloquium has two mandatory components:

### 1. Registration:

In order to reserve a spot in the event, you must complete the **Online Registration Form** before **December 16, 2022**. Spaces are limited.

Information required to register includes: student name, institution name, degree level (currently enrolled), and research category.

### 2. Abstract Submission:

Abstracts must be submitted using the **Abstract Submission Form** and will be accepted through **January 13, 2023**.

Questions regarding registration or submission requirements may be directed to the SMC Organizing Committee at [smc@laurentian.ca](mailto:smc@laurentian.ca).

We look forward to seeing you at SMC 2023!

SMC Convention  
Schedule

#### Sunday March 5:

Poster set up before  
10:00 am

#### Tuesday March 7:

Judging followed by the  
SMC Awards  
Ceremony & Reception  
from 3:30 — 5:00 pm

**Register here!**



<https://merc.laurentian.ca/seg-smc>



## M.Sc. Project: Characterizing mineralization styles in orogenic gold systems of Newfoundland

The island of Newfoundland is experiencing a rush of new prospecting and exploration for orogenic gold deposits related to Appalachian mountain building. There are many open questions related to the mineralization styles and processes, such as: (1) What are the mineral assemblages and textures of unmineralized/mineralized rocks, and what do they imply with respect to mineralization histories?; (2) What were the hydrothermal fluid/metamorphic conditions (T, pH,  $fO_2$ ) that formed sulfide minerals and associated gold mineralization?; (3) What were the source(s) of sulfur, gold, and other metals?; (4) Is there evidence for remobilization of gold and other elements associated with alteration processes?; and (5) Is the style of mineralization at different gold prospects similar and explained by a holistic deposit model, or do differences occur that warrant different deposit models?

These types of questions will be addressed in an **M.Sc. project** focused on gold prospects along fault structures in northeast-central Newfoundland. The study will combine field work in Newfoundland and micro-analytical methods. Field work will involve regional geology, core logging, and sample collection for micro-analytical work. Micro-analytical methods may include polarized and reflected light microscopy, micro-X-ray fluorescence ( $\mu$ XRF), scanned electron microscopy (SEM), electron probe microanalysis (EPMA), laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS), electron back scattered diffraction (EBSD), and/or secondary ion mass spectrometry (SIMS). Results will be compared and integrated with existing geological and geochemical datasets from different gold prospects.

The research will be carried out under Natural Resources Canada's Targeted Geoscience Initiative 6 program, as part of Dr. Ian Honsberger's research activities at the Geological Survey of Canada. The M.Sc. student will be based in Dr. Stefanie Brueckner's laboratory in the Department of Earth Sciences at the University of Manitoba. Dr. Honsberger and Dr. Brueckner will serve as co-academic advisers of the M.Sc. student. The study will take place over two years from Summer 2023 to Spring 2025 and is fully funded. An anticipated start date is July 1, 2023.

Interests in **bedrock geology, mineralogy and petrography, petrology, and ore systems** are desired. Knowledge of mineral chemistry, litho-geochemistry, economic geology, and/or structural geology is an asset.

For more information or to express interest, please email Dr. Ian Honsberger ([ian.honsberger@nrcan-rncan.gc.ca](mailto:ian.honsberger@nrcan-rncan.gc.ca)), Research Scientist, Geological Survey of Canada and Dr. Stefanie Brueckner ([stefanie.brueckner@umanitoba.ca](mailto:stefanie.brueckner@umanitoba.ca)), Assistant Professor, University of Manitoba. If expressing interest, please include a cover letter, CV, (un)official academic transcript, and contact information for up to three references in your email. The application period will remain open until the position is filled.





## Economic Geologist

The University of Texas at Austin: Jackson School of Geosciences: Bureau of Economic Geology

**Location:** Austin, Texas, J.J. Pickle Research Campus in North Austin

To initiate and conduct basic scientific research in economic geology and to assess nonfuel mineral resources, including critical and industrial mineral resources, primarily in the State of Texas.

### Responsibilities

- To initiate and conduct basic scientific research and resource assessment in economic geology across the State of Texas, assessing critical mineral resources and non-fuel minerals (including sand and aggregate) that can be used for economic or industrial purposes.
- Obtain research funding and serve as PI or co-PI on projects.
- Participate in and support other researchers in field work.
- Present project results at sponsor review meetings, regional and national conferences. Publish results in contract reports, peer-reviewed journal articles, books, and other papers.
- Supervise and mentor junior research staff and students.

**Required Qualifications:** Ph.D. degree in geological sciences or related field with a concentration in economic deposits of geological material and two years of related experience. Excellent data management skills. Mechanical aptitude with field equipment. Able to travel for and conduct field work, sometimes in remote and uncontrolled environments. Demonstrated report writing and publication skills. Demonstrated production of independent geologic mapping. Excellent interpersonal and communication skills, and professional demeanor. *Relevant education and experience may be substituted as appropriate.*

**Preferred Qualifications:** Demonstrated ability to meet deadlines and deliverables. Experience in subcontract management. Experience conducting publishable research. Ability and desire to work in diverse, multi-disciplinary, integrated research teams. Interest in life cycle analysis.

**Salary Range** \$80,000 + depending on qualifications

**Apply to the position here:**

[https://utaustin.wd1.myworkdayjobs.com/en-US/UTstaff/details/Economic-Geologist\\_R\\_00021601](https://utaustin.wd1.myworkdayjobs.com/en-US/UTstaff/details/Economic-Geologist_R_00021601)

*The University of Texas at Austin, as an equal opportunity/affirmative action employer, complies with all applicable federal and state laws regarding nondiscrimination and affirmative action. The University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, national origin, age, marital status, sex, sexual orientation, gender identity, gender expression, disability, religion, or veteran status in employment, educational programs and activities, and admissions.*



## Tenure Track Faculty Position Announcement

Department of Geological Sciences  
College of Natural Sciences and Mathematics  
Assistant Professor  
Fall 2023

The Department of Geological Sciences at California State University, Fullerton, invites applications for a tenure-track Assistant Professor position in **Economic Geology** with appointment to begin Fall 2023.

We seek an outstanding scholar and committed teacher who will establish an innovative and inclusive research and teaching program in **Economic Geology**, complementing existing departmental strengths. The successful candidate examines geological processes that generate mineral resources, and explores their magmatic, metamorphic, fluid-related, and/or structural controls. Applicants who explore mineral and metal extraction from secondary sources and apply traditional and novel methods (e.g., remote sensing) in search of critical minerals are encouraged to apply. We expect candidates to show evidence of an existing or developing active, externally funded, student-centered research program, and the ability and enthusiasm to teach introductory-level courses and upper-division/graduate courses in Economic Geology, and Earth Materials or Igneous and Metamorphic Petrology, emphasizing field and laboratory skills. The successful candidate will be expected to contribute to and participate in the life and development of the department, advise students from diverse ethnic, cultural and socioeconomic backgrounds, serve on committees, and participate in the broader university and disciplinary communities.

California State University, Fullerton (CSUF) is a minority-serving institution and an affirmative action and equal opportunity employer. CSUF is strongly committed to increasing the diversity of the campus community and the curriculum, and to fostering an inclusive environment within which students, staff, administrators and faculty thrive. Candidates who can contribute to this goal through their teaching, research, advising, and other activities are encouraged to identify their strengths and experiences in this area. Individuals advancing the University's strategic diversity goals and those from groups whose underrepresentation in the American professoriate has been severe and longstanding are particularly encouraged to apply.

To learn more about the position and CSUF, required application materials, and to apply, please visit <https://careers.pageuppeople.com/873/fl/en-us/job/519002/assistant-professor-of-economic-geology>. For full consideration, all application materials must be received by November 28, 2022.

Please direct all questions about the position to Dr. Vali Memeti at [vmemeti@fullerton.edu](mailto:vmemeti@fullerton.edu) or call 657-278-2036.



Call for candidates for research projects on

## The metallogeny of orogenic gold deposits

The Agnico Eagle – Eldorado - MRNF Alliance Team

The Agnico Eagle – Eldorado - MRNF Alliance Team is a 5-year major research initiative funded by NSERC and partners Agnico Eagle, Eldorado Gold and Ministère des Ressources Naturelles et des Forêts (MRNF) to study the metallogeny of orogenic gold deposits. The team comprises researchers from Université Laval (Profs G. Beaudoin, C. Guilmette, C. LaFlamme, and B. Rottier), and INRS-ETE (Prof. R. Soucy La Roche). The Alliance Team offers a dynamic and collaborative training environment comprising more than thirty graduate students and research associates. Université Laval is amongst the top-ranked universities in Canada. Recognized for its leadership and high achievements in education and research, it offers a welcoming and diverse environment in the heart of Quebec City, a UNESCO World Heritage City (<http://www.quebecregion.com/en/>). The university community comprises over 50,000 students and offers an engaging work environment in an outstanding quality of life setting.

We are calling for applications to undertake **seven** PhD projects and **one** 2.5 years post-doctoral fellowship (PDF). The projects comprise **1)** regional scale studies of orogenic gold districts, **2)** studies to date and determine the origin of auriferous fluid events in important orogenic gold deposits, **3)** development of new indicator mineral methodologies to fingerprint the origin, vector towards ore and assess metal endowment of orogenic gold deposits, **4)** investigation of geomechanical modeling of fluid flow and deformation in relationship to gold deposition, and **5)** development of exploration methodologies for orogenic gold deposits using portable instruments. The project titles are listed below, and detailed descriptions are appended.

- 1. Regional scale studies** – Understanding the regional geological setting of gold deposits is a critical component for targeting of regions with higher potential to host orogenic gold deposits.
  - a. Bonnefond corridor (PhD1)** – The Bonnefond corridor is a sector of the Val-d'Or orogenic gold vein field, in the Neoproterozoic Abitibi sub-province (Québec), south and southwest of the Bourlamaque batholith.
  - b. Hope Bay (PhD2)** – Hope Bay is a strongly deformed, 100 km long greenstone belt in the Neoproterozoic Slave Province (Nunavut), that contains several gold deposits.
- 2. Dating gold mineralization events and source of fluids** – deposit scale studies to date fluid flow events and to understand the source and flow of hydrothermal fluids forming gold deposits.
  - a. Meliadine (PhD3):** Meliadine (Nunavut) hosts a series of orogenic gold deposits located along the Pyke Fault, with a complex history.
- 3. Indicator minerals** – The projects will continue to develop fingerprinting provenance, vectoring and fertility exploration tools.
  - a. Arsenopyrite (PhD4):** arsenopyrite is a common gold associated mineral for which trace element data are scarce.



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- b. **Ormaque (PhD5):** a case-study at Ormaque (Val-d'Or) quartz-tourmaline-carbonate veins to devise innovative indicator mineral vectoring and fertility assessment tools to target gold oreshoots.
- c. **Nunavik (PhD6):** this case study will integrate the indicator mineral fingerprinting methodologies in a large regional survey in Nunavik (northern Québec) carried by the MRNF.
- 4. **Geomechanical modeling of deformation/fluid flow (PDF)** – a common feature in orogenic gold deposits is strain partitioning within and/or between competent intrusive rocks and less competent volcanic country rocks. The study will investigate variations in shear and dilatational strain localization between the intrusive bodies and their host rocks, which are a major control on the distribution of gold mineralization.
- 5. **Field-Based Methodologies** – develop application of portable instruments for in-field results enabling fast decision making in exploration workflows.
  - a. **pSWIR Bonfond corridor (PhD7):** this study will field test application of portable Short Wave InfraRed (pSWIR) for detection of gold fertile alteration in both granodioritic rocks of the Bourlamaque batholith and in mafic to felsic volcanic rocks of the Bonfond corridor, which also host volcanogenic massive sulfide (VMS) deposits and related alteration zones.

The **PhD projects** are supported with a scholarship of 27 500\$ per year for 3 years. PhD candidates can receive up to \$8,500 from the University for achieving milestones in their training program in addition to their scholarship. Foreign PhD students receive a waiver of international tuition fees to the level of students residing in Québec. This scholarship can be cumulated with another excellence award. The **PDF** will receive a salary commensurate with qualifications. The candidates will have the opportunity to conduct original research and to present it at national and international conferences. Projects will start in January or May 2023. Positions are open until filled. Fluency in spoken and written English is mandatory whereas proficiency in French is beneficial, but not required. The team will supervise students in their preferred language (English or French).

Valuing equity, diversity and excellence, Université Laval is strongly committed to provide an inclusive work and living environment for all its members. **We subscribe to equal access and encourage qualified individuals** of all origins, sexes, sexual orientations, gender identities or expressions, as well as persons with disabilities, to apply.

Candidates should send their curriculum vitae, a letter of motivation indicating which project(s) are of interest, and the names of 3 references to:

Professor Georges Beaudoin  
NSERC-Agnico Eagle Industrial Research Chair in Mineral Exploration  
Université Laval  
[explomin@ggl.ulaval.ca](mailto:explomin@ggl.ulaval.ca)

Call for candidates for research projects on  
**The metallogeny of orogenic gold deposits**





## Appendix – Detailed description of projects

1. **Regional scale studies** – Understanding the regional geological setting of gold deposits is a critical component for targeting of regions with higher potential to host orogenic gold deposits.
  - a. **Bonnefond corridor (PhD1)** – The Bonnefond corridor is a sector of the Val-d’Or orogenic gold vein field, in the Neoarchean Abitibi sub-province (Québec), south and southwest of the Bourlamaque batholith. The volcanic country rocks are intruded by several intrusive bodies, both syn- and post-volcanic, including the Bonnefond South tonalitic to dioritic complex and the New Louvre tonalite sill. The intrusions and their immediate host rocks are cut by second- and third-order shallow-dipping (15 and 45°) shear zones that host gold-bearing quartz-carbonate-tourmaline veins. Efficient exploration requires a better understanding of the relations between the intrusion age, petrology and geochemistry, and that of the volcanic host rocks and the overlapping VMS (e.g., Louvicourt) and orogenic gold mineralized systems. **Objectives:** i) characterize the petrological and geochemical evolution of the volcanic and intrusive rocks; ii) constrain the chronology of intrusive activity; iii) establish the paragenetic sequence of mineralization and alteration; iv) define the structural framework of the shear zones and veins; v) compare with other gold deposits hosted in tonalitic and dioritic intrusions. **Activities:** detailed field mapping and core logging, followed by petrography, microstructural analysis, litho-geochemistry, mineral chemistry and geochronology of intrusions. **Anticipated results:** i) a framework explaining the petrochronologic evolution of the intrusions, their geochemical affinity and conditions during emplacement; ii) the structural evolution of the vein-hosting shear zones; iii) the paragenetic evolution on mineralization and alteration; iv) constraints on the timing and role of the intrusions for gold mineralization; v) improved map of the Bonnefond corridor and new exploration guides.
  - b. **Hope Bay (PhD2)** – Hope Bay is a strongly deformed, 100 km long greenstone belt in the Neoarchean Slave Province (Nunavut), that contains several gold deposits formed during the main D<sub>2</sub> deformation event (Sherlock et al. 2012). It is metamorphosed to lower greenschist facies, with higher metamorphic grade (lower amphibolite) at the contact with surrounding granite/gneiss. Several smaller zones of higher metamorphic grade are recognized proximal to gold mineralization suggesting localized higher thermal regime or carbonic fluid flux as in Timmins/Kirkland Lake (Thompson 2005). This relationship need to be documented in detail to assess its control on localization of gold mineralization and to develop innovative exploration guides. **Objectives:** i) map the structural patterns and distribution of metamorphic facies with emphasis on metamorphic “hot spots”; ii) estimate rock/fluid thermobarometric conditions; iii) establish the geodynamic setting of volcanism, metamorphism/deformation, and gold mineralization; iv) constrain the chronology of deformation, metamorphism, and gold mineralization.



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**Activities:** detailed field mapping of metamorphic facies, petrography, microstructural analysis and litho-geochemistry, thermobarometric phase diagrams for rock and fluid phase equilibrium, dating of tectonometamorphism.

**Anticipated results:** i) improved tectono-metamorphic map of the Hope Bay greenstone belt; ii) metamorphic and deformation history of the belt; iii) relation between tectono-metamorphic evolution and mineralization; iv) new exploration guides.

**2. Dating gold events and source of fluids** – deposit scale studies to date fluid flow events and to understand the source and flow of hydrothermal fluids forming gold deposits.

**a. Meliadine (PhD3):** Meliadine hosts a series of Banded-Iron Formation (BIF) associated orogenic gold deposits located along the Pyke Fault, in Nunavut. Dating of arsenopyrite by Re/Os yields a range of model ages from 2.3 to 1.8 Ga (Lawley et al. 2015). Late xenotime in quartz veins and altered host rocks yielded SHRIMP ages of  $1858 \pm 10$  Ma (Lawley et al. 2015) similar to monazite  $1854 \pm 6$  Ma (Carpenter et al. 2005), but the relationship of the dated phosphate grains with gold mineralization is equivocal. Thus, the age of gold mineralization is uncertain, and the source of fluids has not been investigated, such that the origin of the gold mineralization hosted in Archean rocks, overprinted by Paleoproterozoic events, remains mysterious, thus hampering efficient exploration in similar terranes. **Objectives:** i) date auriferous hydrothermal fluid flow events using phosphate U/Pb geochronology on grains related to gold deposition; ii) establish the source of fluids, gold ligands, and metals; iii) present a framework relating the auriferous fluid events to the tectonometamorphic evolution of the country rocks. **Activities:** detailed paragenetic sequence of gold mineralization and deformation, geochronology of phosphate minerals, stable isotope geochemistry of sulfides and vein minerals (bulk and in situ). **Anticipated results:** i) age of gold mineralization and other hydrothermal events; ii) source and evolution of hydrothermal fluids, gold ligands and metals; iii) improved understanding of potentially polyphased orogenic gold deposits; iv) implications and new guides for gold exploration.

**3. Indicator minerals** – The NSERC-Agnico Eagle Industrial Research Chair in Mineral Exploration as established itself as the international leader in indicator mineral research. The proposed research will continue to develop our leadership in fingerprinting the provenance of indicator minerals, on indicator mineral vectoring and fertility exploration tools.

**a. Arsenopyrite (PhD4):** arsenopyrite is a common gold associated mineral for which trace element data are scarce. This hampers application of indicator minerals for deposits where arsenopyrite is abundant, such as orogenic gold deposits in Nunavut. **Objectives:** i) measure the major and trace element composition of arsenopyrite from a range of geological settings; ii) define chemical criteria to fingerprint arsenopyrite sourced from orogenic gold deposits; iii) carry case studies to test application of arsenopyrite for provenance surveys. **Activities:** acquire a set of representative samples from orogenic gold and other settings, measure the major and trace element composition of arsenopyrite, statistical analysis of chemical composition using





multivariate and machine learning methods. **Anticipated results:** i) a database of arsenopyrite major and trace element composition; ii) chemical criteria to discriminate the source of arsenopyrite; iii) methodology to use arsenopyrite in exploration for orogenic gold deposits.

- b. Ormaque (PhD5):** this orogenic gold deposit (Val-d'Or) is mostly formed by a set of extensive sub-horizontal quartz-tourmaline-carbonate veins principally hosted in a porphyry intruded in volcanic rocks, but with a geometry different from the Triangle deposit currently mined by Eldorado Gold Quebec.

**Objectives:** i) define the paragenetic sequence of successive gold mineralization events; ii) measure the chemical and isotope composition of minerals associated with gold deposition; iii) identify textural, chemical, isotopic features associated with gold; iv) define vectoring criteria to target gold oreshoots. **Activities:** field, underground mapping and core logging, mineral (ore and gangue) chemical and stable isotope composition (bulk and in situ), petrography of gold mineralization, statistical data analysis.

**Anticipated results:** i) characteristic textures, chemical and isotopic composition of minerals intimately associated with gold; ii) discriminating criteria between ore and gangue minerals associated with gold or not; iii) indicator mineral vectoring methodologies to vector towards ore shoots in a deposit.

- c. Nunavik (PhD6):** this case study will integrate the indicator mineral fingerprinting methodologies developed by the previous and proposed research programs in a large regional survey in Nunavik (northern Québec) carried by the MERN. **Objectives:** i) measure the abundance of indicator minerals (scheelite, tourmaline, gold, chalcopyrite, arsenopyrite) in till; ii) measure the major and trace element composition of indicator minerals; iii) assess the provenance of indicator minerals using previous studies fingerprinting criteria; iv) identify deposit types eroded and dispersed in glacial sediments. **Activities:** measure the abundance of indicator minerals in heavy mineral concentrate, measure the major and trace element composition, and mineral association of indicator minerals, apply fingerprinting criteria to assess provenance. **Anticipated results:** i) relative abundance of indicator minerals; ii) database of chemical composition of indicator minerals; iii) classification of potential sources for each indicator mineral, based on chemical criteria.
- 4. Geomechanical modeling of deformation/fluid flow (PDF):** a common feature in orogenic gold deposits is strain partitioning within and/or between competent intrusive rocks and less competent volcanic country rocks. Variations in shear and dilatational strain localization between the intrusive bodies and their host rocks is a major control on the distribution of gold mineralization, like in Triangle and several other deposits in the Val-d'Or vein field. A better understanding of the relationships between deforming intrusions, weaker host rocks and fluid flow is crucial. **Objectives:** i) measure rock properties for various lithologies and their alteration products; ii) model rock deformation and fluid flow; iii) establish parameters favorable for localized strain and dilation; iv) compare modeling results to Triangle and other intrusion hosted gold deposits in the Val-d'Or vein field. **Activities:** measure rock



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properties, 2D (UDEC) and 3D (FLAC3D) numerical modeling of coupled deformation and fluid flow, compare results to 3D shear and vein, and alteration distribution at Triangle and other deposits. **Anticipated results:** i) relationships between deformation, rock rheology and shear and vein formation; ii) predictive model of gold mineralization localization; iii) key geological features that need to be documented during core logging to predict mechanical behavior; iv) new exploration guides.

**5. Field-Based Methodologies:** field-based methodology projects are designed to develop application of portable instruments for in-field results enabling fast decision making in exploration workflows.

**a. pSWIR Bonnefond corridor (PhD7):** this study will field test application of portable Short Wave InfraRed (pSWIR) for detection of gold fertile alteration in both granodioritic rocks of the Bourlamaque batholith and in mafic to felsic volcanic rocks of the Bonnefond corridor, which also host volcanogenic massive sulfide (VMS) deposits and related alteration zones, building on the alteration facies SWIR spectra database of Eldorado Gold (Québec) Inc. The pSWIR instrument has seen wide adoption for mapping alteration in epithermal and porphyry systems, but less so in exploration for orogenic gold despite promising results obtained by the CMIC-Footprint team at Canadian Malartic (Lypaczewski et al. 2019). **Objectives:** i) measure SWIR absorption spectra in alteration zones related to gold mineralization, in areas devoid of gold, and in VMS alteration zones, in the field and in drill core samples; ii) compare the chemical composition of micas and other alteration mineral to their absorption spectra to identify gold-related alteration; iii) relate the SWIR spectra to geological context (metamorphic, versus hydrothermal VMS or orogenic gold); iv) carry out case studies on outcrops and drill core. **Activities:** acquire SWIR spectra on outcrops and on drill cores, measure in situ the chemical composition of alteration minerals, analyse the relationship between spectral features, chemical composition, and fertility for gold mineralization. **Anticipated results:** i) library of characteristic SWIR absorption spectra of orogenic gold-related, unrelated, and VMS alteration minerals; ii) discriminant criteria for gold-related and unrelated hydrothermal alteration; iii) field-based methodology to integrate pSWIR to exploration survey workflow.



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# WEBINARS AND THE GANGUE

## MDD-VIP WEBINARS AND YOUTUBE CHANNEL

In collaboration with the Geological Association of Canada's Volcanology and Igneous Petrology (VIP) Division, the MDD will continue to make an effort to bring regular webinars to its members.

Recent uploads include talks by the 2022 Keating-Boyle Award Winners and an introduction to several chapters in the newly published Geological Association of Canada Special Paper 52 on mineral systems with IOCG and affiliated critical metal deposits that contains contributions from experts across the world.

Future webinars will be announced through the email list - stay tuned!



MDD:

<https://www.youtube.com/channel/UCOhxzskR5CBBKecD4MY7mQg>

VIP:

[https://www.youtube.com/channel/UCErZFwdDwz86qy\\_gwzKUiA](https://www.youtube.com/channel/UCErZFwdDwz86qy_gwzKUiA)



**Fracture coatings as a tool for mineral exploration**

Collette Pilsworth

Keating-Boyle Webinar  
Friday 23<sup>rd</sup> September 2022

PhD Supervisors: Dr. Daniel Layton-Matthews & Dr. Matthew Leybourne

The slide features logos for MDD, a stylized 'Q' logo, and Queen's University. It also includes a small image of a person in a red safety vest working in a field.



**Mg-carbonate mineral formation potential of sulfate-reducing bacteria**

University of Waterloo Faculty of Science

The slide features the University of Waterloo Faculty of Science logo.

Title slides from the webinars by the 2022 Keating-Boyle winners Collette Pilsworth and Decla McParland. Both talks can be viewed on demand by visiting the MDD Youtube channel.

## MISSED A PREVIOUS ISSUE OF THE GANGUE?

Visit the The Gangue archive and browse all the old newsletters at:

[www.mddgac.org/mdd-the-gangue-archive](http://www.mddgac.org/mdd-the-gangue-archive)

