The Department of Geological Sciences and Geological Engineering

Graduate Research Symposium

The schedule for the inaugural Graduate Research Symposium hosted by the Department of Geological Sciences and Geological Engineering on **December 3rd, 2025,** is shown below. A detailed program including research abstracts is included below the schedule. The speakers are split into six sessions, with a short question period at the end of each session.

Wednesday, December 3rd, 2025 – Miller Hall Rm. 105			
8:45 am	Arrive to hang posters		
9:00 am	Coffee & light snacks provided		
9:15 am	Introduction by Taylor Rae Morrell		
	Event	**Speaker**	**Title**
9:30 am	Session 1	Anaëlle Mathy	Testing the migmatite-to-granite connection in the transpressional Cadomian orogeny, Brittany, France
9:35 am		Emma Pluister	Petrogenesis of the PAK LCT Pegmatites
9:40 am		Kali Bosket	Compositional analysis of xenocryst and xenolith garnets from El Hoyazo volcanic deposits
9:45 am		Sebastian Cuervo	Marble-Hosted Long Lake Zinc Deposit in the Grenville Province, Canada: Evidence of Post-Metamorphic Mineralization
9:50 am		Emer McConnell-Radford	Reassessing the Holleford impact structure using modern techniques: Identification of shock microstructures in titanite
9:55 am		Q&A	
10:00 am	Session 2	Evan Dressel	Leveraging Machine Learning in Underground Seismic Assessments
10:05 am		Cassidy Teodoro-Neville	Rockfall Dynamics and Geological Controls at Hopewell Rocks Provincial Park
10:10 am		Émélie Gagnon	Mineral-Informed Block Models for Studying Fabric and Stress in Rocks
10:15 am		Lizzie Thiele	Comparative study of rock fracture toughness testing laboratory procedures
10:20 am		Stephanie Bringeland	Analysis of terrestrial water storage change in Canada using satellite gravimetry

10:25 am		Q&A	
10:30 am	Coffee Break		
11:00 am	Session 3	Fadhli Atarita	Evolution of thermal heterogeneity scales in long-term mantle convection models
11:05 am		Neeraj Nainwal	Optimizing Survey Planning and Automated Lithological Mapping with Supervised Machine Learning
11:10 am		Daniel Dudziak	Characterizing Geospatial Soundscapes for Urban and Environmental Resilience
11:15 am		Jack Fitzgerald	Acoustic Imaging in Moving Media
11:20 am		Monique Rivard	Centralized Integration of LEO Satellites and GNSS Networks for Robust PNT
11:25 am		Q&A	
11:30 am	Session 4	Taylor Rae Morrell	Upper Plate Expression of Reactivated Basement Faults: A Multi-Orogen Comparison
11:35 am		Michelle Pearce	Influence of inherited lithospheric scale basement faults on Himalayan seismicity: A numerical modelling approach
11:40 am		Lilly Cybulski	Upper crustal expression of a lithospheric subduction tear: the Livorno-Sillaro line, northern Apennines, Italy
11:45 am		Francesca Amabile	Progressive shearing deformation in the Variscan Fautea-Favone Metamorphic Complex (SE Corsica, France)
11:50 am		Morgan Madsen	Using SPECFEM2D to Simulate Tsunamis on a Curved Plane
11:55 am		Q&A	
12:00 pm	Lunch provided to all registrants. Poster session in Miller 102 & Miller 105		
1:00 pm	Session 5	Taewoo B. Chun	Impacts of sea level change on deltaic distributary channel morphodynamics: insights from physical experiments

1:05 pm		Aidan Peterson	Influence of Climate Change and Tectonics on Ancient River Behaviour: Insights from the Pliocene Olla Formation, Southern California
1:10 pm		George Bradley	Paragenetic evolution and implications of a mixed carbonate-evaporite system; The Givetian Dawson Bay Formation, Elk Point Basin, southern Saskatchewan, Canada
1:15 pm		Brittany Jennings	Reimagining Introductory Geoscience for Professional Learners
1:20 pm		Sarah Hatherly	Strategies for advancing equity, diversity, and inclusion in professional and educational geoscience settings
1:25 pm		Olivia Clay	Developing a radiometric chronometer for dating weathering products in mine wastes
1:30 pm		Q&A	
1:35 pm	Session 6	Meghan Boyd	Investigating the occurrence, mobility and fate of Rhenium in a Great Lakes Watershed
1:40 pm		Trevor Bond	Dissolved selenium speciation and species-specific isotopic composition derived from weathering mine wastes
1:45 pm		Sara Momenipour	From roots to ore: Biogeochemical and Isotopic Tracers of Concealed Mineral deposits: Case Studies from Saramäki VMS, Erzgebirge fertile granites and Hůrky alkaline metasomatite related REE Deposits
1:50 pm		Evelyne Leduc	Geochemistry and mineralogy of perennial spring activity in the Canadian high Arctic
1:55 pm		Nicole Johnson	Temporal Trends in High Arctic Meltwater Chemistry
2:00 pm		Natalie de Freitas	Permafrost Thaw as a Driver of Changing Water Quality in Canada's High Arctic
2:05 pm		Zahra Dorbeigi Namaghi	Development and Implementation of a UAV Monitoring System (the Black Kite) for Near-Source Assessment of Wildland Fire Smoke Composition and Emission Quantification
2:10 pm		Q&A	

After the symposium there will be an informal networking event taking place at the **Grad Club** (162 Barrie St). Attendance is **optional** for speakers & attendees!

Detailed Program:

Title: Testing the migmatite-to-granite connection in the transpressional Cadomian orogeny, Brittany, France

Speaker: **Anaëlle Mathy**

Supervisor(s): Dr. Christopher Spencer

Abstract: The northern Armorican Massif (Brittany, France) is divided into four geological terranes that were accreted to one another during the Cadomian Orogeny (~580-540 Ma), from northwest to southeast the Trégor-la-Hague, Saint-Brieuc, Saint-Malo, and Mancellian terranes. While the Trégor-la-Hague and Saint-Brieuc terranes record a succession of calc-alkaline magmatic events that pre-date ~570 Ma, the Saint-Malo and Mancellian terranes record tectonomagmatism between 550 and 540 Ma. The Saint-Malo terrane comprises a migmatite/granite belt which was metamorphosed and experienced partial melting at ~540 Ma. The Mancellian terrane was intruded by numerous peraluminous granitoid plutons at ~540 Ma. The Saint-Malo migmatites have been hypothesized to be the mid-crustal magmatic source of the Mancellian plutons emplaced at higher crustal levels. However, this has been questioned because the partial melting temperatures of Saint-Malo migmatites are substantially lower than the melting temperatures for the source of the Mancellian plutons. As a consequence, the migmatite-to-granite connection in the Cadomian belt requires further investigations to establish the relationship between the Saint-Malo migmatites and Mancellian granitoids. This project aims to test the migmatite-to-granite hypothesis using accessory mineral and isotope composition coupled to U-Pb geochronology.

Title: Petrogenesis of the PAK LCT Pegmatites

Speaker: **Emma Pluister**

Supervisor(s): Dr. Christopher Spencer and Dr. Steve Beyer

Abstract: This study examines the petrogenesis of the PAK pegmatites using a variety of geochemical analytical techniques. The three pegmatite bodies in question are LCT-type, meaning they contain significant amounts of Lithium, Cesium, and Tantalum, which are all sought-after commodities. To determine if the pegmatites formed from the nearby granite, stable isotope analysis of the spodumene, quartz, and micas is underway. Preliminary findings suggest that the Pakegama Lake granite is likely the parent material. Determining the source rock of these pegmatites will help guide exploration to discover if there's more in the area or where other localities could exist worldwide.

Title: Compositional analysis of xenocryst and xenolith garnets from El Hoyazo volcanic deposits

Speaker: **Kali Bosket**

Supervisor(s): Dr. Christopher Spencer

Abstract: Understanding the petrogenesis of peraluminous magmas, particularly the compositional diversity within these rocks, remains a significant challenge in geology. This study investigates garnet and cordierite-bearing dacite from the El Hoyazo volcanic deposits in southern Spain, utilizing a combination of mineral chemistry and C-O-H isotopes to unravel the processes contributing to their formation. Analysis of garnet compositions show multiple generations variably ascribed to metamorphism and anatexis of the country rock. Xenocrysts as well as garnets within xenoliths exhibit similar zoning patterns, with minor exceptions that appear to represent an additional phase of magmatic growth. These results indicate garnet growth in the magma chamber is limited, with metamorphism and anatexis as the primary drivers of garnet growth. A hybrid model provides a coherent explanation for the mineralogical and isotopic characteristics observed in the El Hoyazo deposits and offers a broader understanding of peraluminous magma petrogenesis. By integrating mineral chemistry with isotopic data, this study provides a comprehensive framework for deciphering the intricate processes involved in magma formation. Our research highlights the critical role of distinguishing between xenocrystic/peritectic and phenocrystic phases in understanding the genesis of garnet- and cordierite-bearing dacites.

Title: Marble-Hosted Long Lake Zinc Deposit in the Grenville Province, Canada: Evidence of Post-Metamorphic Mineralization

Speaker: **Sebastian Cuervo**

Supervisor(s): Dr. Gema Olivo

Abstract: The marble-hosted Long Lake zinc deposit occurs along the contact zone of the marble rocks of the Proterozoic Greenville supergroup with intrusive rocks within the Greenville Central Metasedimentary Belt. Controversial genetic models have been proposed for similar marble-hosted deposits in the Grenville Province; therefore, understanding the processes that controlled the formation and transformation of zinc mineralization is essential for developing exploration strategies for zinc in the Grenville Province. In this study, historical data have been integrated with new field and drill core logging observations, lithogeochemical and petrological data into a 3D geological model to better constrain the geometry of the ore zones and delineate their spatial relationship with various intrusive rocks and marble host rocks. Zinc mineralization occurs as

lenses in two main ore zones with distinct mineralogy and geochemical signatures. Sphalerite is associated with pyrite, subordinate pyrrhotite, chalcopyrite, galena, and molybdenite, calcite, phlogopite, talc, and chlorite, being the abundance of these minerals distinct in the two ore zones. These minerals filled embayment and fractures with calc-silicate minerals such as garnet, pyroxene, and amphibole, indicating that the zinc mineralization formed after peak metamorphic conditions. Outside the mineralized zones, garnet and pyroxenes are well preserved. These findings are not consistent with historical interpretations that the Long Lake zinc deposit is a metamorphosed sediment-exhalative deposit and indicate that other processes were involved in its formation after peak metamorphism in the Grenville Province.

Title: Reassessing the Holleford impact structure using modern techniques: Identification of shock microstructures in titanite

Speaker: **Emer McConnell-Radford**

Supervisor(s): Dr. Christopher Spencer

Abstract: Impact cratering is a fundamental geologic process affecting all planetary bodies with a solid surface. Despite advances in impact crater identification, many known structures lack modern re-evaluation using contemporary criteria for confirming an impact site, including the Holleford structure in Ontario, Canada. This study revisits the ~2 km buried simple crater, employing modern techniques to reassess microstructures in accessory minerals in an attempt to further confirm an impact origin. Here, we present the first detailed microstructural analysis for Holleford, focusing on accessory minerals using electron backscatter diffraction (EBSD). We report the first identification of {-111} shock twins in titanite in Holleford samples, which previous studies have hypothesized are diagnostic of shock deformation at pressures between 12 and 17 GPa. Cataclastic textures consistent with high-strain deformation are also present; however, the absence of shock indicators in zircon from across all lithologies constrains formation conditions to pressures below 20 GPa. These findings not only reinforce an impact origin for Holleford but also highlight the significance of titanite as an accessory phase capable of recording impact-related microstructures. Furthermore, this study helps bridge the gap in the quality and type of impact evidence between sites studied several decades ago and sites currently being studied.

Title: Leveraging Machine Learning in Underground Seismic Assessments

Speaker: **Evan Dressel**

Supervisor(s): Mark Diederichs, Kathy Kalenchuk

Abstract: As deep hard-rock mining advances, predicting seismogenic rockmass response is critical. This study presents a data-driven framework that infers stress:strain domains from standard seismic source parameters, reducing reliance on continuous numerical-model calibration. Seismic records from a deep mine, paired with a calibrated FLAC3D geomechanical model to label event locations as ground truth. Manual vs. K-means clustering revealed two pre-peak mechanistic domains: stress-riser zones (increasing energy) and stress-shadowed zones (decreasing energy). A comparison of PCA reduced parameter intercorrelation and other preprocessors for shifting logarithmic data. A Gradient Boosting Machine classifier achieved 82% accuracy on unseen test data. Stress-riser events exhibit larger stress drops and greater energy release, while stress-shadowed events show lower stress and higher Es:Ep ratios, consistent with shear-dominated failure. The approach demonstrates that mechanistic seismogenic domains can be robustly identified from routine seismic monitoring, offering a practical, low-overhead tool for continuous assessment of stress evolution and seismic hazard in deep mining environments.

Title: Rockfall Dynamics and Geological Controls at Hopewell Rocks Provincial Park

Speaker: **Cassidy Teodoro-Neville**

Supervisor(s): Jennifer Day and Elisabeth Steel

Abstract: The rocky coastline of Hopewell Rocks Provincial Park showcases mesmerizing erosional features that attract over 250,000 visitors annually, making it one of the primary tourist attractions within New Brunswick. While visually striking, these features present a substantial rockfall hazard capable of causing injury or death. Mitigating this risk involves developing a more detailed understanding of the geology of the cliff face and the frequency, magnitude, and mechanics behind previous rockfalls within the park. Generally, the park hosts a succession belonging to the Hopewell Rocks Member, consisting primarily of massive poorly sorted conglomerate with discontinuous lenses of sand. A 350m discontinuous stratigraphic section of the park was used to interpret the paleo-depositional environment. Additionally, petrographic analysis of 18 samples was used to characterize mineralogical differences of the cliff face above and below the high tide line that influence the observed changes in rock competence and strength. Finally, 3D structure-from-motion photogrammetry models generated using input data from remotely piloted aircraft system surveys conducted in May 2021 and August 2024 were used for change detection analysis, allowing for the quantification of magnitude and frequency of these rockfall events within the park for the first time.

Title: Mineral-Informed Block Models for Studying Fabric and Stress in Rocks

Speaker: **Émélie Gagnon**

Supervisor(s): Jennifer Day

Abstract: In underground engineering, rock behaviour must be understood across two very different scales. Engineers test small core specimens, a few centimeters in size, to measure mechanical properties, then apply these results to models of excavations or rock masses spanning tens to thousands of meters. The most challenging geological environments are heterogeneous at intermediate scales: too large to be fully captured in lab tests, leading to high variability, and too small and numerous to characterize at the excavation scale. Examples of these features include veins, stockwork, and foliation, which are common in deep, massive rockmasses and often pose major engineering challenges. To investigate these processes, I use a "virtual laboratory", building Lego-like bonded-block models (BBMs) in which each block represents a mineral grain with realistic, mineral-informed stiffness. This approach allows me to construct different fabrics and study how they control stress localization and drive microcracking in rocks. These models can address diverse research questions and help link small-scale findings to practical excavation-scale engineering applications.

Title: Analysis of terrestrial water storage change in Canada using satellite gravimetry

Speaker: **Stephanie Bringeland**

Supervisor(s): Georgia Fotopoulos

Abstract: As the impacts of climate change influence hydrological dynamics globally, it is critical to understand regional impacts of mean temperature rise on water resources. Canada, with complex hydrology including glaciers, permafrost, large lakes, and arid prairie regions, is impacted by data sparsity which limits interpretation of climate impacts in remote regions. Satellite-derived data can complement in-situ data with consistent spatial coverage of observations. The Gravity Recovery and Climate Experiment (GRACE) and its follow-on mission (GRACE-FO), with over two decades of time-variable gravity observations, enables estimates of mass change within Canada. Isolating hydrological change from GRACE/GRACE-FO-derived data requires removal of background geophysical signals and other mass change processes such as glacial isostatic adjustment (GIA), which is significant in Canada. This research explores the possibilities of applying GRACE/GRACE-FO-derived terrestrial water storage anomaly (TWSA) data within Canada. Canada is vulnerable to the hydrological impacts of a warming climate, and this research explores methodologies and limitations for examining long-term surface mass change.

Title: Evolution of thermal heterogeneity scales in long-term mantle convection models

Speaker: **Fadhli Atarita**

Supervisor(s): Alexander Braun

Abstract: Thermal heterogeneity within the Earth exhibits multi-scale characteristics shaped by mantle convection, lithospheric structure, and core-mantle coupling over billions of years following the Moon-forming giant impact. To evaluate the long-term consequences of the impact, we analyse the scale dependence of mantle convection models, with a focus on thermal structure, using a systematic modelling scheme and comprehensive statistical analyses. We developed a reference model constrained by the mantle's cooling history and present-day estimates. Building on this framework, we examined three-dimensional mantle convection models over a 4.5 Gyr timespan. Initial thermal perturbation fields were generated using controlled randomness and scale-specific thresholds, all subjected to a plate-like surface boundary condition. Our results show that heterogeneity in the lower mantle gradually becomes more homogeneous and less variable over time. Moreover, all simulations display a consistent long-term evolutionary pattern, indicating that mantle convection tends to converge to a similar pattern regardless of the initial distribution of temperature perturbations. These findings offer new insights into the extent to which the Moon-forming impact may have influenced Earth's long-term thermal evolution. However, mantle heterogeneity is governed by complex thermo-chemical interactions, underscoring the need for further analyses.

Title: Optimizing Survey Planning and Automated Lithological Mapping with Supervised Machine Learning

Speaker: **Neeraj Nainwal**

Supervisor(s): Alexander Braun

Abstract: Geological maps are essential for successful mineral resource discovery. In this study, supervised machine learning was applied to automate lithological mapping using multi-source remote sensing and geophysical data. XGBoost and Random Forest algorithms were utilized to predict geological units, and performance was validated by withholding a subset of the training data to simulate unmapped zones. Following the prediction phase, SHAP (SHapley Additive exPlanations) was employed to interpret the models and identify the most reliable variables for characterizing the study area. This provides actionable intelligence to transform survey design from guesswork into data-driven decision-making. The results highlighted elevation (18%) and magnetics (17%) as the dominant datasets. This suggests that future campaigns should prioritize

dense collection for these fields. While radiometrics also proved important (18%), the results suggest that adaptive flight lines could be used for this dataset to optimize efficiency.

Title: Characterizing Geospatial Soundscapes for Urban and Environmental Resilience

Speaker: **Daniel Dudziak**

Supervisor(s): Alexander Braun, Georgia Fotopoulos

Abstract: Sound, or acoustic noise, is often considered a source of pollution that affects human health. However, sound also carries valuable information about its sources and the environment. Listening to acoustic wavefields allows us not only to interpret the sources around us, but also allows us to image the environment, similar to radar, sonar or seismic imaging. Having the ability to assess and image the state of various environments from multiple perspectives is crucial for making informed decisions regarding responsible human development, and for environmental conservation. Soundscapes are defined by the standard ISO 12913-1, as "the acoustic environment as perceived or experienced and/or understood by people, in context." The focus of this research is geospatial soundscapes, a form of geospatial data sensing that provides high-resolution models of complex environments through mapping sound. This project aims to develop an integrated framework for characterizing geospatial soundscapes, while also considering the subjective element of human sound perception. It will integrate acoustic observations from multiple sources, make use of high-performance computing to produce real (and simulated) noise maps, and combine models and data within the ArcGIS platform to support evidence-based decision making for soundscape management.

Title: Acoustic Imaging in Moving Media

Speaker: **Jack Fitzgerald**

Supervisor(s): Hom Nath Gharti, Alexander Braun

Abstract: Acoustic imaging is a foundational approach to geophysical exploration and modeling. It has long been understood to be a useful approximation in seismic contexts, where acoustic signals (P-waves) are considered exclusively for simplicity of migration, modeling, and inversion. However, this interest is primarily focused on imaging in purely solid earth contexts, and does not tend to include liquid or gaseous contexts. Such models do not consider the media nor the source to be moving in time. Capturing this motion in numerical simulations is critical to expanding the knowledge, understanding, and applications of acoustic imaging techniques to other domains, such as infrastructure monitoring, submarine media flow, aerial media flow, and dynamic source localization.

Title: Centralized Integration of LEO Satellites and GNSS Networks for Robust PNT

Speaker: **Monique Rivard**

Supervisor(s): Georgia Fotopoulos

Abstract: Global Navigation Satellite System (GNSS) receivers are utilized by many platforms to achieve local Positioning, Navigation, and Timing (PNT) for a variety of purposes including mining, vehicle navigation, surveying, agricultural monitoring, and national security. A novel approach to traditional satellite-based PNT is the inclusion of Low Earth Orbit (LEO) satellites in addition to GNSS satellites and Inertial Measurement Units (IMUs). Operating closer to Earth, LEO-based PNT systems promise to deliver higher signal strength and reduced latency, supporting more precise PNT capabilities, in addition to increased resilience to jamming and spoofing threats. Furthermore, the rapid movement of LEO satellites introduces temporal diversity, improving accuracy in dynamic environments and urban canyons where GNSS signals often degrade. The scope of this research is to develop a centralized PNT system that simultaneously supports measurements from GNSS satellites, LEO satellites, and IMUs, while utilizing machine learning (ML) algorithms in LEO pseudo-range prediction. This research will help Canada maintain its leadership in state-of-the-art communication and positioning technologies by further contributing to the emerging field of LEO satellite PNT technology. The adoption of LEO-based PNT enhances robustness in autonomous navigation, and provides critical backup for GNSS-reliant infrastructure, contributing to more resilient and adaptable positioning capabilities across diverse domains.

Title: Upper Plate Expression of Reactivated Basement Faults: A Multi-Orogen Comparison

Speaker: **Taylor Rae Morrell**

Supervisor(s): Laurent Godin

Abstract: Pre-existing structures, such as ancient sutures and fault zones, within tectonic plates involved in collision are predicted to influence the evolution of the overlying orogenic system during orogenesis. The pre-existing structures in the underthrusted plate can reactivate, altering the geometry of the overlying basal detachment, causing along strike changes in metamorphism, rock unit and shear zone distribution, and age in deformation. My Ph.D. research explores the expression of reactivated basement faults within the overlying orogenic system, with study localities in the Himalayan orogen and the North American Cordilleran orogen. Both orogenic systems have previously documented basement faults extending beneath the orogen in the underthrusted plate. I have used multiple methodologies to characterize the varying tectonic history of the overlying orogen, including extensive structural field mapping and cross section development, microstructural analysis, metamorphic modelling, monazite and xenotime U-Th/Pb petrochronology, and Rb/Sr geochronology on biotite and muscovite. The goal of this research is

to develop a tectonic model applicable to multiple orogenic systems of different sizes and age, to track the expression of basement fault reactivation during orogenesis. The recognition of multiple reactivation events through time will have direct influence on the modern tectonic architecture and provide targets for basement fluid-related mineralization.

Title: Influence of inherited lithospheric scale basement faults on Himalayan seismicity: A numerical modelling approach

Speaker: **Michelle Pearce**

Supervisor(s): Hom Nath Gharti, Laurent Godin

Abstract: The seismically active Himalayan orogen is the product of the Cenozoic collision between the Indian and Eurasian plates. Prior to this collision, the Precambrian Indian craton experienced a protracted geological history that led to the development of lithospheric-scale faults. These inherited basement faults coincide with slab tears in the Indian lithosphere under Tibet, suggesting deep lithospheric control on fault reactivation. We seek to understand if and how inherited structures in the underthrusted plate influence the distribution of seismicity in orogenic settings. Coulomb stresses are implemented into the open-source 3D coseismic and postseismic deformation software SPECFEMX. Using the hexahedral meshing software Coreform Cubit, various scenarios pertaining to the basement faults' influence on seismicity are explored. For instance, how does megathrust seismicity influence the Coulomb stress state of these basement faults, and can they influence the direction of rupture and aftershocks? Can the basement faults act as stress barriers, concentrators, or refractors? How do fault properties such as fault strength and pore fluid pressure influence the reactivation potential of these basement faults? Through analyzing changes in Coulomb stress, we aim to resolve dynamic linkages between these inherited basement faults, the Himalayan basal detachment, and earthquake distribution and frequency along the Himalayan Orogen.

Title: Upper crustal expression of a lithospheric subduction tear: the Livorno-Sillaro line, northern Apennines, Italy

Speaker: **Lilly Cybulski**

Supervisor(s): Laurent Godin

Abstract: The Apennines in Italy are the product of Cenozoic convergence between the Adriatic microplate and the European plate. The Northern Apennines display complex lateral variations in surface geology, some of which could be associated with a postulated yet controversial tear in the subducting Adriatic lithosphere, known as the Livorno-Sillaro Line (LSL). To characterize the LSL and potential peak temperature and timing of deformation variation across the postulated

tear, I collected 48 samples across two orogen-parallel transects in Tuscany. Microstructural analysis, quartz crystallographic preferred orientation analysis and Raman spectroscopy of carbonaceous material will quantify peak temperature, while 87Rb/87Sr and 40Ar/39Ar dating of white micas will be used in to constrain timing of deformation. A complementary geophysical investigation suggests gravity disturbance data analysis of lineament patterns is a powerful tool to detect lithospheric-scale structures such as slab tears and may provide insight into the tectonic evolution of a complex area.

Title: Progressive shearing deformation in the Variscan Fautea-Favone Metamorphic Complex (SE Corsica, France)

Speaker: **Francesca Amabile**

Supervisor(s): Laurent Godin

Abstract: The high metamorphic grade Variscan rocks cropping out in the Fautea-Favone Complex (SE Corsica, France) record progressive deformation mainly related to two distinct shear events (referred as D2 and D3 phases) that occurred at different crustal levels. The first event (D2) generated a first S2 pervasive mylonitic foliation exhibiting both dextral and sinistral sense of shear and associated with partial melting. Lately D3 shearing event produced a network of 10 to 50 cm thick anastomosing and localized E-W striking dextral and sinistral shear zone developed from ductile to brittle conditions.

Title: Using SPECFEM2D to Simulate Tsunamis on a Curved Plane

Speaker: **Morgan Madsen**

Supervisor(s): Hom Nath Gharti

Abstract: Tsunamis pose a major hazard for many coastal areas around the world. Large seismic events such as earthquakes and landslides can produce large waves by displacing a great amount of water. Modeling using the SPECFEM2D package has been done to track the waves of tsunamis from seismic sources assuming the wave would travel along a flat plane. However, this isn't a perfect estimation, as it doesn't take into account the curvature of the Earth. While a 3D simulation would be ideal, the computing power needed to do it is much greater than running a 2D program. By adding in a curved surface, we hope to increase the accuracy of the simulation while maintaining the efficiency at which it is able to run.

Title: Impacts of sea level change on deltaic distributary channel morphodynamics: insights from physical experiments

Speaker: **Taewoo B. Chun**

Supervisor(s): Elisabeth Steel

Abstract: Deltas evolve and build land through their distributary channel networks, which transport water, sediment, and nutrients to coastlines. Distributary channels can move across their floodplains through gradual lateral migration or through avulsion. This mobility is affected by sediment flux, discharge variability, and by creation or destruction of accommodation. Distributary channel mobility influences the distribution of arable land, marshes, and bays, and impacts communities living on delta plains. Once distributary channels are buried and preserved in the subsurface, their coarse-grained channel deposits serve as pathways for subsurface fluids such as water, oil, or gas, making them excellent reservoirs and aquifers. However, the many factors that influence river mobility are complex and remain incompletely understood. Here, we investigate distributary channel behavior in response to a steady sea-level rise using overhead imagery from the QDB24-1 laboratory experiment. The QDB24-1 experiment was conducted in a 3.77 x 3.77 m basin equipped with an ocean-control system that includes a computer-operated river influx and a motorized weir to control ocean level with sub-millimeter accuracy. The sediment mixture consists of quartz sand, glass beads, ceramic microspheres, and bentonite. To create a cohesive sediment mixture, a polymer was added, which increases sediment cohesiveness with the clay. The QDB24-1 experiment was designed to create accommodation through a steady sea-level rise rate of 0.5 mm/hour over a 300-hour run time, while maintaining constant sediment (0.00022 L/s) and water flux (0.22 L/s). We will present results using a modified Particle Image Velocimetry-based method that allows detailed quantification of channel mobility. These results allow for comparisons between base level rise, channel migration rates, avulsion frequency, and avulsion node migration over the course of the experiment.

Title: Influence of Climate Change and Tectonics on Ancient River Behaviour: Insights from the Pliocene Olla Formation, Southern California

Speaker: **Aidan Peterson**

Supervisor(s): Elisabeth Steel

Abstract: Ancient river systems can act as an archive for understanding fluvial responses to climate change because clues to their behaviour are preserved in the rock record. However, internal and external processes such as river avulsion or tectonically forced sediment storage act to obscure or shred climate signals, especially in large river systems. Therefore, we hypothesize that locally derived river systems with a shorter source-to-sink distance preserve clearer climate signals than large-scale rivers. This study will focus on the late Pliocene to early Pleistocene Fish

Creek-Vallecito basin in Southern California, with an emphasis on the Olla Formation, which was deposited by local river systems draining uplift along the West Salton Detachment Fault. The Olla Formation exhibits both locally derived channel deposits along with Colorado river derived channel deposits. The arrangement of these deposits provides a unique opportunity to test our hypothesis and compare the clarity of climate signals in local rivers to those in larger river systems. Fieldwork will include stratigraphic logging and mapping of larger scale architecture along with provenance analysis to characterize fluvial changes. These methods will reveal how fluvial systems responded to the complex and variable climate that was present during the Pliocene–Pleistocene Epochs.

Title: Paragenetic evolution and implications of a mixed carbonate-evaporite system; The Givetian Dawson Bay Formation, Elk Point Basin, southern Saskatchewan, Canada

Speaker: **George Bradley**

Supervisor(s): Peir Pufahl, Ted Matheson

Abstract: This study re-evaluates the depositional setting and diagenetic history of the Middle Devonian (Givetian) Dawson Bay Formation in the Elk Point Basin of southern Saskatchewan. The Dawson Bay Formation is a halite-cemented carbonate unit that is part of the second sequence in a cyclic carbonate–evaporite sequence that repeats multiple times in the Middle to Late Devonian. Despite being buried to depths of up to 2,500 m in the study area, it exhibits minimal deep compactional features, highlighting the role that evaporite cementation plays in suppressing burial-related deformation. This study uses the Dawson Bay Formation as a natural archive to explore how evaporite diagenesis influences the preservation of primary sedimentary facies, paragenesis, and geochemical markers in similar carbonate systems. The data suggest that carbonate deposition was followed by reflux dolomitization and porosity generation. Halite brines subsequently permeated the formation, with some early compactional features preserved, implying some compaction occurred prior to halite cementation. These rocks demonstrate the importance of understanding carbonate diagenesis in the context of how evaporite cementation can hinder or halt the normal evolution of diagenesis in a mixed carbonate-evaporite system.

Title: Reimagining Introductory Geoscience for Professional Learners

Speaker: **Brittany Jennings**

Supervisor(s): Rob Harrap, Christopher Spencer

Abstract: This project examines how to teach foundational geoscience concepts to non-geoscientists, focusing on mid-career professionals who need geological literacy for their professions but have limited time. Through literature review, classroom and field observations,

interviews, and iterative design, the study identifies the core concepts most essential for this audience and evaluates which teaching formats, such as field experiences, visual tools, or digital modules, best support their learning. The findings will guide a redesign of the Geology Bootcamp resource within the MEERL program, creating clearer, more accessible introductory materials. Ultimately, this work aims to strengthen geoscience understanding for interdisciplinary professionals who rely on it for informed decision making.

Title: Strategies for advancing equity, diversity, and inclusion in professional and educational geoscience settings

Speaker: **Sarah Hatherly**

Supervisor(s): Christopher Spencer, Alex Pederson

Abstract: Geoscience remains one of the least diverse STEM disciplines, shaped by histories of racial, gender-based, and other forms of discrimination. To address these barriers, this research examines how equity-deserving groups experience the field and identifies strategies that can improve participation, support, and success. The three studies consider both global-scale professional and local-scale educational settings. They explore how external pressures, such as the COVID-19 pandemic, influence perceptions of productivity, particularly among women and early-career professionals who often judge themselves more harshly despite similar outputs. They also examine the impact of stereotype threat on students in geological sciences and engineering, revealing how it can undermine confidence, sense of belonging, and performance. Finally, the work evaluates inclusive teaching strategies, such as competency-based assessment, which show promise in improving student motivation, attitudes, and achievement. Together, these findings demonstrate how inequities shape experiences across the geosciences and provide practical, evidence-based recommendations for fostering more equitable pedagogy, institutional policy, and professional culture. The overarching goal is to help transform the discipline into one that welcomes and supports a more diverse community of students and practitioners.

Title: Investigating the occurrence, mobility and fate of Rhenium in a Great Lakes Watershed

Speaker: **Meghan Boyd**

Supervisor(s): Bas Vriens

Abstract: Rhenium (Re), one of the rarest elements in the Earths crust, is a critical element used in jet engine turbine alloys and and little is known about its geochemistry or behaviour in varying aqueous environments. Previous work has investigated trace metal concentrations in wastewater and has found abnormally high levels (up to 5 µg/L in effluent and 1300 µg/kg in sludge) of Rhenium (Re) in a wastewater treatment plant (WWTP) in the Great Lakes Basin- likely due to an industrial source. This unique site has presented the opportunity to investigate the behaviour of Re once emitted via effluent pathways to the surrounding watersheds in order to elucidate its mobility and fate. Field campaigns were carried out in spring/summer of 2024 and 2025- surface waters and sediment samples were collected across a 5km transect and were analyzed for total trace and major element concentrations. General water quality parameters were measured in-situ during sampling. Collected data was analyzed for spatial and temporal trends, as well as any relationships between measured parameters. Preliminary results indicate an enrichment of Re nearby and downstream of the WWTP discharge point, with higher partitioning to the sediment than the aqueous phase.

Title: Developing a radiometric chronometer for dating weathering products in mine wastes

Speaker: **Olivia Clay**

Supervisor(s): Bas Vriens

Abstract: Remediating abandoned mine sites and re-processing potentially valuable elements from mine wastes to support critical mineral supply remain priorities for environmental sustainability and economic security. A major challenge in designing effective long-term management strategies is the complexity of mineral weathering reactions in mine wastes. Secondary minerals precipitated during weathering reflect the fluid composition, pH, temperature, redox conditions, and other environmental factors under which they formed. If the formation ages of these secondary minerals could be determined, it would become possible to reconstruct past geochemical conditions and quantify in-situ mineral reactivity over practice-relevant (decadal) timescales. However, dating secondary minerals in mine wastes has not been attempted before, since conventional geochemical dating techniques use stable isotope ratios or long-lived radiometric elements that cannot be resolved on decadal timescales. This study examines possible chronometers suited to both the composition and timeframe of mine site secondary minerals with the goal of obtaining the relative ages of the precipitates. If successful, this chronometer will enable reconstruction of temporal changes in secondary mineral formation, providing a powerful new tool for predicting long-term reactivity and informing sustainable closure and remediation strategies.

Title: Dissolved selenium speciation and species-specific isotopic composition derived from weathering mine wastes

Speaker: **Trevor Bond**

Supervisor(s): Bas Vriens

Abstract: Methodologies to quantify dissolved Se solutes are available for various sample matrices, but tools to assess their species-specific isotopic signatures and therefore aqueous fractionation dynamics remain scarce. Here, we present an HPLC-QQQ-ICP-MS-based methodology to quantify inorganic (selenite, selenate) and methylated (methane seleninic and -selenonic acid) Se oxyanions at the ppb level and semi-quantify their species-specific isotopic signatures. On-column fractionation of individual Se species during separation was significant for all investigated species and increased with retention time. On-column fractionation was effectively accounted for by quantitative species separation and fraction collection prior to isotope detection. Selenium isotopic signatures were quantified for the lab standard chemical compounds used for method optimization followed by application to aqueous samples from mine waste rock piles seeps with ~1 ppb Se. This work presents a practical tool to screen for species-specific Se isotopic fractionation patterns that can help elucidate the biogeochemical cycling of Se in a variety of industrial and environmental systems.

Title: From roots to ore: Biogeochemical and Isotopic Tracers of Concealed Mineral deposits: Case Studies from Saramäki VMS, Erzgebirge fertile granites and Hůrky alkaline metasomatite related REE Deposits

Speaker: **Sara Momenipour**

Supervisor(s): Matthew Leybourne

Abstract: My research project aims to advance biogeochemical and isotopic methods for detecting deeply concealed mineral deposits as part of the EU-funded DeepBEAT project. The research focuses on improving the sensitivity, precision, and interpretive power of geochemical signals preserved in vegetation, soils, rock and other surface media, enabling the recognition of distal footprints associated with buried ore systems. Ultra-trace and isotopic analyses will be conducted using Triple Quadrupole ICP-MS (TQ-ICP-MS) to characterize elements such as Sr, Pb, Li, and Cu in vegetation materials (canopy tissues, needles, twigs, bark, cones) and soils (B and C horizons) collected from the Saramäki VMS, Hůrky alkaline metasomatite, and stream sediment and vegetation samples from Erzgebirge granite test sites. Laboratory protocols developed at QFIR will enhance data quality by reducing matrix effects and supporting more robust geochemical modelling of concealed mineralization. The project contributes analytical innovations and interpretative frameworks that integrate directly into 3D mineral prospectivity models, linking laboratory geochemistry with field-based mineral systems exploration. This

work addresses a major challenge in the search for critical raw materials: geophysical-only approaches often lead to costly, high-risk drilling in areas of complex cover. By strengthening geochemical signal detection and advancing understanding of element mobility and isotopic behaviour within the geosphere–biosphere interface, the research supports sustainable, low-impact exploration strategies aligned with the European Green Deal and Critical Raw Materials Act.

Title: Geochemistry and mineralogy of perennial spring activity in the Canadian high Arctic

Speaker: **Evelyne Leduc**

Supervisor(s): Christopher Omelon, Matthew Leybourne

Abstract: My PhD research aims to investigate the origin of the brines associated with perennial spring systems in high Arctic environments (Axel Heiberg Island), from a geochemical perspective. Specifically, I am trying to determine the source and flow paths of the spring waters, and plan to characterize their associated mineral precipitates, culminating in the integration of these findings into a functional hydrogeological model for the occurrence of these unusual systems. Comprehensive geochemical and isotopic analyses will be performed on the brines coming up to the surface to test whether basinal brines, subglacial melt, seawater incursion, permafrost thaw, precipitation, and/or proglacial lake discharge (or a combination of these) can explain their provenance. Major and trace element concentrations as well as H, O, Sr and Pb isotope ratios will be measured, and with salinity, pH, alkalinity and noble gas data, should allow me to constrain any mixing relationships, water–rock interactions, and subsurface residence times. Insights into environmental conditions, both at depth and at the surface, will be sought using a variety of techniques (petrography, SEM-EDS, MLA, XRD, XRF, and isotopic analyses of carbonate, sulfate, sulfide, and silicate phases) applied to the mineral precipitates found in association with the springs.

Title: Temporal Trends in High Arctic Meltwater Chemistry

Speaker: **Nicole Johnson**

Supervisor(s): Christopher Omelon, Laura Thomson

Abstract: The geochemistry of glacier-fed watersheds in the Canadian High Arctic remains largely understudied, particularly during the brief snowmelt season. The understanding of water quality is important to downstream ecosystems and is becoming increasingly relevant as the melt season lengthens due to a warming climate. This research aims to address a gap in quantifying the temporal differences in geochemistry of stream water over this two-month period on Axel Heiberg Island, Nunavut. Preliminary results show acidic, sulfur-dominant waters, potentially originating from the sulfur oxidation of shales. From water isotope data, the contribution of glacier meltwater to this watershed appears minimal, suggesting a smaller geochemical influence than predicted. Seasonal trends are observed, with suspended sediment loads going from high to low as the season progresses, and dissolved ion concentrations going from low to high. These results reflect the bedrock erosion and depletion of the snow cover during the early melt season, transitioning to a groundwater dominant system with the deepening of the active layer as the season progresses. These findings enhance understanding of High Arctic watershed processes during the melt season and offer insight into the quantity and composition of solutes being discharged into the Arctic Ocean.

Title: Permafrost Thaw as a Driver of Changing Water Quality in Canada's High Arctic

Speaker: **Natalie de Freitas**

Supervisor(s): Melissa Lafrenière

Abstract: Permafrost, ground that remains frozen for two or more consecutive years, plays a fundamental role in controlling landscape stability, groundwater movement, and interactions between surface and subsurface waters. As the Arctic warms four times faster than the global average, thawing permafrost has become one of the most consequential climate driven changes in Canada, where 32–46% of the landmass is underlain by permafrost. Continued warming deepens the active layer into the transient layer, a zone with distinct ice, mineral, and solute compositions, including elevated sulfate and trace metals derived largely from sulfide minerals. Increased thaw enhances subsurface hydrologic connectivity and solute transport, altering downstream water chemistry with cascading impacts on community water resources, freshwater fish habitat, and overall ecosystem function. However, the role of thaw-mediated subsurface flow in mobilizing sulfate and trace metals in High Arctic watersheds remains poorly understood. This research investigates how transient layer thaw influences sulfate and trace metal mobility at the Cape Bounty Arctic Watershed Observatory (CBAWO), Nunavut. Using high-frequency water sampling, sulfur and water isotope analyses, permafrost coring, and frost probing, this project will quantify solute concentrations, fingerprint their hydrological sources, and evaluate their continued responses to warming. Integrating new field data with multi-decadal CBAWO records will improve predictions of how continued permafrost thaw will reshape hydrology, water quality, and ecosystem health in the Canadian High Arctic.

Title: Development and Implementation of a UAV Monitoring System (the Black Kite) for Near-Source Assessment of Wildland Fire Smoke Composition and Emission Quantification

Speaker: **Zahra Dorbeigi Namaghi**

Supervisor(s): David McLagan

Abstract: The increasing impacts of climate change, the application of non-adaptive wildfire management and existing forestry practices have led to a rise in the size and intensity of wildfires. In addition to causing permanent land-cover changes and altering weather and climate patterns, large and intense wildfires release vast amounts of toxic trace gases and aerosols, posing significant health risks to communities. Near-source measurements of smoke composition, which is critical for the development of wildfire emission estimates and air-quality prediction tools, remain limited due to the constraints of current monitoring platforms, including satellites, fixed ground stations and costly aircraft campaigns. The Black Kite project proposes the development and implementation of a lightweight UAV-based smoke monitoring system designed to collect high-resolution, near-source data across diverse fire environments. The system is equipped with optical and electrochemical sensors to quantify key trace gases and particulate matters while offering flexible sampling in space and time. The first round of system implementation has been completed in Grasslands National Park during a prescribed burn and in Alkali Lake during a pile-burn in collaboration with project partners. Preliminary data show strong correlations across sensors, which confirms the practicality and reliability of the system for wildfire smoke detection and measurement.