

# ATLAS Symposium

University of Alberta, Earth and Atmospheric Sciences Department

April 8–10, 2026

Abstract Booklet



# ATLAS Symposium 2026 – Abstract Booklet

University of Alberta

April 8–10, 2026

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# Symposium Schedule

Time	Wed 8th April	Thu 9th April	Fri 10th April
9.30-9.45	Breakfast	Breakfast	Breakfast
9.45-10.00	Opening talk		
10.00-10.15	<b>Xueqi Liang</b>	<b>Fiona Davidson</b>	<b>Lucia Vivanco</b>
10.15-10.30	<b>Mia Cowper</b>	<b>Shaun Woudstra</b>	<b>Yalda Izadi</b>
10.30-10.45	<b>Daniela Gutierrez-Rueda</b>	<b>Caio Novais</b>	<b>Hui Li</b>
10.45-11.00	Break	Break	Break
11.00-11.15	<b>Marlin Schmidt</b>	<b>Lauren Kew</b>	<b>Jiahui Gao</b>
11.15-11.30	<b>Javier González-Garcia</b>	<b>Jenifer Spence</b>	<b>William Johnston-Gramlich</b>
11.30-11.45	Break	Break	<b>Sheridan Sigstad</b>
11.45-12.00			Break
12.00-1.00	<b>Keynote Speaker: Dan Shugar</b>	<b>Keynote Speaker: Léa Ravensbergen</b>	<b>Keynote Speaker: Philip Fralick</b>
1.00-2.00	Lunch	Lunch	Lunch
2.00-2.30			
2.30-2.45	<b>Patrick O'Brien</b>	<b>Sarah Kehler</b>	<b>Ryusuke Kimitsuki</b>
2.45-3.00	<b>Keytash Moshtaghian</b>	<b>Hannah Louis</b>	<b>Zoe Risley</b>
3.00-3.15	Break	<b>Pablo Wikander</b>	<b>Baptiste Coutret</b>
3.15-3.30	<b>Anna Redanz</b>	Break	Break
3.30-3.45	<b>Menglei Duan</b>		<b>Verônica Rosa</b>
3.45-4.00	Break		<b>Jared Janzen</b>
4.00-7.00	Poster session (ESB 1-39)	Geography and Planning Year-End Student Showcase (UCOMM ATRIUM)	Break
			Banquet 5.00-10.00

<b>Quaternary/Oceanography</b>	<b>Hard Rock and Geochemistry</b>	<b>Basin research, Sedimentology and Paleontology</b>
<b>Remote Sensing/Geophysics</b>	<b>Human Geography and Urban Planning</b>	<b>Environmental Geology</b>

Talks are hosted in ESB 1-39

Keynote talks are hosted in Tory 3-16

## Hard Rock and Geochemistry

### Modern-like shallow marine redox conditions recorded by ~2.46 Ga banded iron formations

**Presenter:** Xueqi Liang

**Presentation time:** Wed 8 Apr, 10:00–10:15

**Section:** Hard Rock and Geochemistry

*Authors:* Xueqi Liang

The Great Oxidation Event (GOE) at 2.45–2.22 Ga marks the permanent rise of the atmosphere oxygen (O<sub>2</sub>), driven by enhanced O<sub>2</sub> production in surface oceans. Although the oxidation of the atmosphere is relatively well constrained, the time, tempo, and worldwide synchronicity of marine redox evolution remain poorly resolved. In this study, we present new nitrogen isotope (<sup>15</sup>N) data of 2.46 Ga billion-year-old banded iron formations (BIFs) from the Kuruman and Griquatown formations in the Griqualand West Basin, Transvaal Supergroup, South Africa. Our results reveal extensive oxygenation of shallow marine conditions immediately prior to the GOE. Moreover, stratigraphic comparison with coeval BIF successions from the Hamersley Basin demonstrates a comparable trajectory and pace of marine oxidation across these basins, despite the Griqualand West Basin recording comparatively more oxygenated conditions. Together, these findings suggest that Neoproterozoic ocean oxygenation may not be a localized phenomenon, but instead reflected a broader, potentially global reorganization of marine redox structure. Our findings indicate that, during the GOE, ocean redox structure may at times have been comparable to that of the modern ocean, underscoring the need for higher resolution, globally integrated reconstructions of early Earth's oxygenation history.

## **A Study on Tektites: Major Element Geochemistry, Identifying Sources, and Nitrogen Behaviour**

**Presenter:** Mia Cowper

**Presentation time:** Wed 8 Apr, 10:15–10:30

**Section:** Hard Rock and Geochemistry

*Authors:* M. Cowper, L. Li

Tektites form by rapid melting of the Earth's crust during large impact events which then cools to form a glass. There are four known strewn fields where tektites originate from around the world, which would include Australasia, Central Europe, North America, and West Africa, with a decreasing number of samples found respectively. Their major element geochemistry is known to be inherited from the Earth's crust at the location of impact, rather than from the impacting body. Each strewn field produces a glass with a different major element geochemistry. Trace element geochemistry is suggestive that a minor component of tektites is made up of the material from the impactor. Nitrogen isotopes ( $\delta^{15}\text{N}$ ) have very large variation between planetary bodies and meteorite types. A suite of tektites including samples from Central Europe, Australasian, and unknown localities were analyzed for major element geochemistry, as well as nitrogen isotope content. Major element analysis allowed for successful categorization of the unknown tektites to known strewn fields. Extremely low nitrogen content of the tektites makes the analysis of nitrogen isotopes very difficult, as errors are enhanced by the large blank correction factor. Samples with the least blank contribution have resulted in values expected from Earth's crust rather than any known meteorite samples. With the currently gathered data, we can conclude that nitrogen in tektites is also inherited from the Earth's crustal material, with little to no fractionation during formation.

## Tracing the Rise of Continents Through Banded Iron Formations: Experimental Insights into Germanium Partitioning

**Presenter:** Daniela Gutierrez-Rueda

**Presentation time:** Thu 9 Apr, 10:30–10:45

**Section:** Hard Rock and Geochemistry

*Authors:* Daniela Gutierrez-Rueda (1), Cedrick Ramos (1), Xueqi Liang (1), Janice PL. Kenney (2), Daniel S. Alessi (1), Kurt O. Konhauser (1)

*Affiliations:* (1) University of Alberta; (2) Laurentian University

Banded Iron Formations (BIFs) archive early Precambrian ocean chemistry, and the germanium/silicon (Ge/Si) ratio preserved in BIF silica has emerged as a promising proxy for continental weathering. A recent compilation of Archean BIF Ge/Si data reveals a stepwise decline from near-hydrothermal to continental-like values at ca. 3.5 Ga, interpreted as evidence for the rapid emergence of continental crust (Wang et al., 2025), supported by converging evidence from Si isotopes in granitoids and Hf-Nd isotope decoupling in BIFs (Greber et al., 2025; Kraye et al., 2026). However, the mechanisms governing Ge partitioning between co-precipitating silica and iron phases during BIF formation remain poorly constrained, limiting quantitative interpretation of this record.

To address this gap, we synthesised three BIF precursor analogues — silica gel, ferrihydrite, and silica-rich ferrihydrite — and conducted batch sorption experiments with dissolved Ge at 30–200 ppm across pH 4, 6, and 8. Ferrihydrite is the dominant Ge-scavenging phase, exhibiting significantly greater uptake than silica gel across all conditions, with sorption efficiency increasing systematically with pH. Silica-rich ferrihydrite displayed intermediate behaviour, suggesting silica co-precipitation suppresses Ge uptake by competing for reactive surface sites.

Since ferrihydrite preferentially sequesters Ge relative to silica, temporal changes in the iron-to-silica ratio of BIF precursor phases — driven by shifts in hydrothermal versus riverine input, or fluctuations in Fe-oxidising microbial activity — could fractionate the Ge/Si signal independently of continental weathering intensity. While multiple independent proxies support early continental emergence, the Ge/Si record specifically remains susceptible to mineralogical overprinting unresolvable using Ge/Si ratios alone. Paired stable Ge isotope measurements ( $\delta^{74}\text{Ge}$ ) will be essential for fully decoding this signal, with this work providing the experimental foundation necessary for the robust application of Ge as a proxy for early Earth surface processes.

## **Lithium in volcano-sedimentary deposits: Contents and characterization by the Tessier method of sequential extraction**

**Presenter:** Marlin Schmidt

**Presentation time:** Wed 8 Apr, 11:00-11:15

**Section:** Hard Rock and Geochemistry

*Authors:* Marlin Schmidt (1), Maija Raudsepp (1,2), Sasha Wilson (1), Daniel S. Alessi (1,3)

*Affiliations:* (1) Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB, Canada; (2) Department of Physical Sciences, MacEwan University, Edmonton, AB, Canada; (3) Jackson School of Geosciences, University of Texas at Austin, Austin, TX, United States

Global lithium demand is projected to increase twofold by 2040, driven primarily by the rise of electric vehicles and other renewable energy technologies. Existing hard rock and brine sources are unlikely to meet all this demand, making the development of alternative sources such as lithium-rich volcano-sedimentary deposits necessary. Determining whether a site is appropriate for development depends on the financial and environmental costs of extraction, which requires a detailed understanding of the mineralogical and geochemical characteristics of the host deposit. This study compares lithium concentrations and modes of occurrence in 11 samples of volcano-sedimentary deposits from four sites in the western United States. Three sites are classified as tectonic lithium basins, and one is characterized as a caldera-hosted basin. Mineralogical analyses were conducted using scanning electron microscopy (SEM) and powder X-ray diffraction (XRD), and total lithium content was determined by  $\text{HNO}_3/\text{H}_2\text{O}_2/\text{HF}$  digestion and Li concentration measurement by ICP-MS. Lithium leachability was assessed using the Tessier sequential extraction method. Smectite crystallite size was estimated from XRD patterns using the Scherrer equation. We found that total lithium concentrations ranged from 400 to 2,600 mg/kg, with the residual (non-leachable) fraction comprising 42% to 97% of the total. While no correlation was found between total lithium content and the proportion in the residual fraction, both total lithium and residual lithium concentrations were positively correlated with smectite crystallite size, with the largest crystallites containing, and retaining, the most lithium. Our results show that a better understanding of the sample mineralogy, crystallite size, and leaching characteristics could improve the feasibility assessment of a potential volcano-sedimentary deposit and lead to cleaner, lower-cost extraction methods.

## **Integrated geophysical imaging of the hydrothermal-magmatic system beneath Nevado del Ruiz Volcano, Colombia**

**Presenter:** Javier González-García

**Presentation time:** Wed 8 Apr, 11:15–11:30

**Section:** Hard Rock and Geochemistry

*Authors:* Javier González-García (1); Martyn Unsworth (1)

*Affiliations:* (1) Department of Earth and Atmospheric Sciences, University of Alberta, Canada

Nevado del Ruiz (NRV) is an active volcano with significant geothermal energy potential, but also poses a high risk to surrounding communities. A detailed understanding of its internal structure is essential to assess available energy resources and to improve hazard management strategies. This study presents a multi-technique approach that was used to study the magmatic and hydrothermal system of NRV. It included the development of a 3D resistivity model using magnetotelluric (MT) data, a seismic hypocenter catalogue, and a 3D geological model. The MT component integrated, for the first time, multiple MT datasets collected across the volcano and in the adjacent Nereidas Valley, analyzed using a 3D MT inversion and a novel sensitivity analysis approach. In parallel, a seismic catalogue spanning 2001-2023 was analyzed using frequency-magnitude distribution (FMD) methods based on the Gutenberg-Richter law, incorporating a new technique to resolve spatio-temporal variations in b-value. A 3D geological model was constructed to provide structural context. The integrated analysis reveals a strongly heterogeneous system, characterized by a conductive domain to the east, with a continuous deep conductive layer at 2-3 km depth. This contrasted with a high resistivity western domain, where resistive bodies are flanked and underlain by conductive zones. Spatio-temporal variations in b-value delineate regions of enhanced microseismicity and dynamic stress conditions. Together, these observations define an asymmetric plumbing system with two feeding zones: a principal pathway to the southwest connected to a regional magmatic source, and a secondary northern pathway reactivated around 2010. The results indicate both structural and lithological controls on magma ascent and emplacement, supported by correlations between resistivity contrasts, geological structures, and seismicity patterns. This study provides a refined 3D representation of the structure and active processes within the volcano, with applications in geothermal exploration and volcanic hazard communication.

## Remote Sensing/Geophysics

### **Predicting Environmental DNA-derived Soil Biodiversity in Restored Forests with Orbital Hyperspectral Data**

**Presenter:** Patrick O'Brien

**Presentation time:** Wed 8 Apr, 2:30–2:45

**Section:** Remote Sensing/Geophysics

*Authors:* Patrick B. O'Brien (1), Arturo Sanchez-Azofeifa (1)

*Affiliations:* (1) Department of Earth and Atmospheric Sciences, University of Alberta, AB, Canada

Large-scale tree planting efforts globally aim to restore forests destroyed by human-made and natural causes in order to support biodiversity and other ecosystem services. However, monitoring the coincident restoration of other aspects of the ecosystem is still in its infancy; current remote sensing methods largely ignore the complex interactions between below-ground bacteria and fungi with above-ground vegetation. Using orbital hyperspectral sensors and soil-based environmental DNA (eDNA), this research aims to predict above- and below-ground biodiversity using scalable methodology. Soil eDNA was extracted from samples collected near Cochrane, AB, then sequenced, identified, and utilized to produce presence/absence metrics for bacteria and fungi. Hyperspectral data (L2) from two orbital sensors (PRISMA and EnMAP) were collected concurrently with the samples and plot-specific spectral reflectances were extracted and averaged. With the presence/absence metrics as outputs and the hyperspectral data as inputs, three different machine learning techniques were tested: Partial Least Squares Discriminant Analysis (PLSDA), Random Forest (RF), and Kolmogorov-Arnold Networks (KANs). These models were trained using a Nested Cross-Validation technique to maximize performance while reducing bias from a small data set, with feature importance derived from the best-performing models to identify and associate wavelengths with physical mechanisms in the study area. Results indicate that models predicting higher taxonomic levels of bacteria and fungi (phylum, class) perform well (accuracy  $\geq 90\%$ ), but overall performance for all models decreased when applied to lower taxonomic levels (family, genus). Permutation testing was conducted on models, and statistically significant models ( $p \leq 0.05$ ) underwent feature importance extraction. Visible and near-infrared wavelengths had the highest influence while wavelengths  $\geq 1500$  nm had little to no influence. Overall, this research indicates that remote sensing can be used to predict forest restoration above- and below-ground, offering an improved framework for monitoring forests.

## **Mapping Hidden Thaw Pathways in Discontinuous Permafrost Using the Airborne Electromagnetic Method**

**Presenter:** Keytash Moshtaghian

**Presentation time:** Wed 8 Apr, 2:45–3:00

**Section:** Remote Sensing/Geophysics

*Authors:* K Moshtaghian (1), M J Unsworth (1,2), D G Froese (2) and A Chiasson (2)

*Affiliations:* (1) Department of Physics, University of Alberta, Edmonton, AB, Canada ; (2) Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB, Canada

Permafrost in northwestern Canada is undergoing rapid warming and thaw, yet the subsurface structure that controls thaw vulnerability remains difficult to resolve using boreholes and satellite observations alone. We present results from a frequency-domain airborne electromagnetic (AEM) survey covering 1,340 line-kilometers in the central Mackenzie Valley, Northwest Territories, where warm discontinuous permafrost underlies an important northern infrastructure corridor. The survey was designed to characterize regional permafrost variability, identify terrain controls on frozen ground distribution, and assess how hydrology and wildfire influence thaw processes. Rather than relying on fixed resistivity thresholds, we interpret the 1-D AEM resistivity models using a gradient-based framework that identifies the depth and thickness of the frozen-unfrozen transition. These interpretations are evaluated using co-located electrical resistivity tomography (ERT), borehole temperature records, and surficial geology. The AEM data image resistivity to depths of about 100 m and reveal pronounced lateral heterogeneity in permafrost conditions over scales ranging from tens of meters to kilometers. Permafrost is absent beneath many rivers, lakes, and ponds, where extensive talik networks disrupt subsurface continuity, while undisturbed uplands commonly preserve permafrost to depths of about 20-35 m, and locally deeper along elevated alluvial ridges. The results further show that geology, hydrology, vegetation, slope position, and disturbance history combine to produce complex mosaics of frozen and unfrozen ground. Burned terrain exhibits reduced shallow resistivity, weaker and broader permafrost-base transition zones, and evidence of persistent post-fire warming decades after disturbance. These findings demonstrate the value of airborne geophysics for regional permafrost mapping and provide new insight into thaw vulnerability, groundwater connectivity, and infrastructure risk in the discontinuous permafrost zone. Corresponding author: [keytash@ualberta.ca](mailto:keytash@ualberta.ca)

### **3-D Magnetotelluric images of the hydrothermal system beneath Montserrat**

**Presenter:** Anna Redanz

**Presentation time:** Wed 8 Apr, 3:15-3:30

**Section:** Remote Sensing/Geophysics

*Authors:* Anna Redanz (1), Martyn Unsworth (1), Andrew Williamson (1), Graham A. Ryan (2,3), Barry Williams (2), Jon Blundy (4), J. Michael Kendall (4), Siobhan Killingbeck (5)

*Affiliations:* (1) Department of Physics, University of Alberta, Edmonton, Alberta, Canada; (2) Montserrat Volcano Observatory, Brades, Montserrat; (3) The University of the West Indies Seismic Research Centre, St. Augustine, Trinidad and Tobago, West Indies; (4) University of Oxford, Oxfordshire, England; (5) University of Swansea, Swansea, Wales.

The volcanic island of Montserrat in the Caribbean continues to suffer from the economic challenges caused by the eruption of Soufrière Hills Volcano that lasted from 1995 to 2010. Geothermal energy coupled with the extraction of metals from geothermal brines is being investigated by the Martin School at the University of Oxford through the ReSET project as one of the avenues to strengthen the post eruption economy of Montserrat.

Magnetotelluric (MT) data were initially collected at 28 stations in 2009 to investigate the geothermal system beneath Montserrat. These data were combined with time domain electromagnetic, geochemical, and structural geology investigations to select the best locations for drilling. Three geothermal wells were then drilled between 2013 and 2016. The two successful wells reached depths of 2298 m and 2870 m and yielded bottom hole temperatures of 230 °C and 265°C. To expand cross-island coverage, 21 additional MT stations were collected in 2025. The combined 2009 and 2025 datasets were inverted using a both 1-D and 3-D approaches. The inversion models showed that a spatially extensive low resistivity layer was present in the depth range 200 to 1300 m. The resistivity of this layer is being interpreted quantitatively using well log information that provides the concentration of clay minerals such as smectite and illite, temperature, salinity, and porosity. This approach is being extended away from the wells to determine if drilling should take place in other areas of Montserrat. Details of this analysis will be presented, and the implications for geothermal development on Montserrat will be discussed.

## **Aboveground Carbon Estimation in a Mangrove Ecosystem Using UAV-Based Remote Sensing and Machine Learning**

**Presenter:** Menglei Duan

**Presentation time:** Wed 8 Apr, 3:30–3:45

**Section:** Remote Sensing/Geophysics

*Authors:* Menglei Duan (1), Arturo Sanchez-Azofeifa (1), Muhammad Abdulmajeed (2), David Turner (2), Kathleen Buckingham (2), Agatha Odari (3), Josphat Mtwana (3), Solomon Kipkoech (3), Neda Kasraee

*Affiliations:* (1) Centre for Earth Observation Sciences (CEOS), Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB T6G 2E3, Canada; (2) Veritree Technology Inc. 230-1275 Venables St, Vancouver, BC V6A 2E4, Canada; (3) EarthLungs Reforestation Foundation, Palm Court, Waiyaki Way, Westlands, Nairobi, Kenya.

Mangroves are an important part of coastal blue carbon ecosystems, efficiently absorbing atmospheric carbon dioxide (CO<sub>2</sub>). Accurate quantification of mangrove carbon stocks aids climate change mitigation and adaptation strategies. This study uses UAV-based remote sensing datasets to model Aboveground Carbon (AGC) in a juvenile mangrove ecosystem in Kenya, characterized by relatively open canopies. We developed an Ensemble regression model to estimate AGC, achieving a Mean Absolute Error (MAE) of 1.79 kg when validated against ground truth data. Instead of plot-level metrics, which lack detailed spatial information about individual trees or areas smaller than the mapping unit, our model was developed based on tree-level metrics, using data on hundreds of trees from fewer forest inventory plots. This methodology enabled the extraction of detailed spatial information on AGC at the tree level. We also explored the potential of two different datasets (LiDAR vs high overlap images) for estimating mangrove AGC. Furthermore, a pixel-level comparison (“AGCLiDAR - AGCHigh overlap”) was conducted to quantify the estimated AGC differences (R<sup>2</sup> = 0.71, RMSE = 0.97 kg/m<sup>2</sup>). The results suggest that both LiDAR data and superior high overlap images have the potential to accurately predict mangrove carbon stocks. The tree-level-based modeling methodology presented in this work offers a different insight into carbon stock modeling.

## Quaternary/Oceanography

### **Ocean Memory: Interactions between Atmospheric Modes and Ocean Dynamics**

**Presenter:** Fiona Davidson

**Presentation time:** Thu 9 Apr, 10:00–10:15

**Section:** Quaternary/Oceanography

*Authors:* Fiona Davidson (1), Paul G. Myers (1), Hemant Khatri (2), Richard G. Williams (3)

*Affiliations:* (1) Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta, Canada; (2) Met Office, Exeter, UK; (3) Department of Earth, Ocean and Ecological Sciences, School of Environmental Sciences, University of Liverpool, Liverpool, UK

Increasing greenhouse gas emissions are reducing the efficiency with which heat radiates from Earth's surface into the atmosphere, leading to an accumulation of excess energy in the climate system. The global oceans absorb approximately 91% of this excess heat, making ocean heat content a key indicator of climate change. Increases in ocean heat content contribute to sea level rise, marine heatwaves, coral bleaching, and the melting of ocean-terminating glaciers and ice sheets. However, ocean heat uptake is not spatially uniform in the North Atlantic Ocean. While subtropical and tropical regions have experienced significant warming, the subpolar North Atlantic has experienced relative cooling. This presentation introduces an ocean memory framework to understand how ocean heat storage is modulated by large-scale atmospheric variability, specifically the North Atlantic Oscillation and the Arctic Oscillation. We will show how anomalous atmospheric forcing alters the ocean state through two mechanisms: short-term, local effects involving air-sea heat fluxes and Ekman circulation, and long-term, far-field effects involving changes from overturning and gyre circulations.

## **Holocene volcanism in northwestern British Columbia**

**Presenter:** Shaun Woudstra

**Presentation time:** Thu 9 Apr, 10:15–10:30

**Section:** Quaternary/Oceanography

*Authors:* Shaun H. Woudstra (1), Britta J.L. Jensen (1)

*Affiliations:* (1) Department of Earth and Atmospheric Sciences, University of Alberta, Canada

The Northern Cordilleran Volcanic Province encompasses northwestern British Columbia, southeast Alaska, and central Yukon, and has been active for the past ~20 million years. Despite being home to the largest volcanic complexes and most recent volcanic eruptions in Canada, as well as the only event with documented fatalities, the Holocene eruptive record of this region is poorly understood. In British Columbia, communities and infrastructure are concentrated in valleys, vulnerable to even smaller, less explosive, mafic eruptions. With revitalised mining activity in the “Golden Triangle”, exposure to these volcanic centers is increasing. We require a better understanding of eruption frequency, size, distribution, and sources in order to properly inform hazard models. Even with limited existing information, Kelman and Wilson (2024) use USGS methodologies and guidelines to evaluate 28 Canadian volcanic fields, and determine Mount Edziza to be High Threat. As only one Canadian volcano is actively monitored (Mt Meager), we are very far behind contemporary countries in volcano monitoring and hazard assessment. To contribute to this problem and overcome the challenge and expenses caused by the remoteness of the volcanoes, work by Lakeman et al. (2008) and Woudstra and Jensen (2026) used more accessible distal volcanic ash (tephra) in lake cores to identify at least 9-13 explosive eruptions in this region across the Holocene. These tephra show a wide variety of compositions and are thought to mainly originate from Mount Edziza and the Iskut Volcanic Field. Our next steps are to visit these target volcanoes to collect proximal material and better characterise them. Using both distal phenocryst-rich tephra and proximal rock samples, I intend to explore magma linkages, evolution, and discriminations between eruptive events with further petrological tools like Pearce Element Ratios and Raman spectroscopy of melt inclusions. Corresponding author: woudstra@ualberta.ca

## **Exploring Lagrangian Simulation Strategies for Oil Spill Tracking in the Arctic Ocean**

**Presenter:** Caio Novais

**Presentation time:** Thu 9 Apr, 10:30–10:45

**Section:** Quaternary/Oceanography

*Authors:* Caio Novais Fernandes da Silva (1), Paul Myers (1)

*Affiliations:* (1) University of Alberta

With the increase of anthropogenic activities in the Arctic Ocean, environmental impacts such as oil spills are likely to become more frequent. Understanding the fate of the oil in the marine environment is crucial to identify areas at risk and avoid potential chemical hazards. This study employs Lagrangian trajectory modeling to track particles from their point of release, simulating the complex dynamics of the ocean. In this project, 5,000 particles of generic diesel were simulated across 10 key locations in the Arctic Ocean. The spatial distribution was evaluated analyzing trajectory, density and depth of the oil. Back-ground marine fields were provided using the high resolution numerical model NEMO.

## **Reconstructing Changes in the Northwest Atlantic $^{14}\text{C}$ Depth Gradient using Deep-Water Gorgonian Corals**

**Presenter:** Lauren Kew

**Presentation time:** Thu 9 Apr, 11:00–11:15

**Section:** Quaternary/Oceanography

*Authors:* Lauren Kew (1,2), Wilder Greenman (2), Liam Jasperese (3), Aislinn Fox (4), Brett Walker (4), Owen Sherwood (2)

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Radiocarbon ( $^{14}\text{C}$ ) analysis is an important tool in chemical oceanography. Nuclear bomb testing in the early 1950s–1960s added artificial  $^{14}\text{C}$  (“bomb- $^{14}\text{C}$ ”) to the surface ocean, which is useful for tracking the movement and mixing of water masses. Bomb- $^{14}\text{C}$  records are also useful for generating reference chronologies that can be used to date materials such as fish otoliths, clams, and sediments. However, few available bomb- $^{14}\text{C}$  chronologies extend into the early 21st century, so proxy records of seawater  $^{14}\text{C}$  are needed to better constrain changing water mass influence off eastern Canada, one of the fastest warming regions globally. Gorgonian corals (*Primnoa resedaeformis* and *Keratoisis grayii*) can be used as proxies for seawater  $^{14}\text{C}$  since they are long-lived and have annual growth rings. Further, *K. grayii* secretes a two-part skeleton of gorgonin and calcite. The gorgonin fraction encodes the  $^{14}\text{C}$  signatures of freshly exported organic matter from the marine mixed layer while the calcite fraction is derived from dissolved inorganic carbon (DIC) at the intermediate depths where the corals live. Here, we combine time-resolved  $^{14}\text{C}$  data from coral specimens collected at the Stone Fence and Northeast Channel to create an updated bomb- $^{14}\text{C}$  reference chronology for the northwest Atlantic mixed- and intermediate- layers. The chronology spans the early 1920s–2022 and tracks the known pulse and subsequent decrease in mixed layer bomb- $^{14}\text{C}$  activities as well as the attenuated and diluted signal in the intermediate layer. Our record reveals a reversal in F $^{14}\text{C}$  concentration from the air to surface ocean since the early 2010s. We also generate decadal-scale depth gradients from both skeletal fractions and compare to in situ data to validate the use of gorgonian corals to resolve accurate  $^{14}\text{C}$  depth gradients. This new record is valuable for marine age calibration and offers insight into recent changes in circulation and air-sea carbon exchange.

## **Influence of Tidewater Glaciers on Marine Nitrogen Cycling**

**Presenter:** Jenifer Spence

**Presentation time:** Thu 9 Apr, 11:15-11:30

**Section:** Quaternary/Oceanography

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In modern oceans, nitrification - the oxidation of ammonia to nitrate - occurs predominantly in low light conditions and proceeds via a two-step pathway mediated largely by ammonia-oxidizing archaea and nitrite-oxidizing bacteria. Competition for nutrients and photoinhibition generally restrict these taxa to deeper waters making vertical mixing an important mechanism for delivering nitrate to the surface ocean in coastal regions. Recent reports, however, suggest that surface nitrification may be more important than previously considered in the modern ocean, with observations of nitrification genes (ammonia monooxygenase (amoA), nitrite oxidoreductase (nxr)) and measurable rates of nitrification in the upper 50 m. However, the lack of paired functional data with isotope measurements leaves uncertainty about whether these nitrifying taxa are transiently transported to the surface ocean or actively mediating nitrification in situ. Here, we integrate analyses of the natural abundance of nitrate isotopes (d15N and d18O), metanomics, and targeted gene quantification to explore whether nitrifiers detected in surface waters were metabolically active. To achieve this, we undertook sampling campaigns in August 2021 and 2022 in the Canadian High Arctic (Nunavut), where we collected marine water samples from Sverdrup Glacier, a site suspected to be influenced by glacially-driven upwelling. We evaluated surface waters for: (1) isotopic signatures consistent with in situ nitrate regeneration; (2) expression of key nitrification proteins (i.e., ammonia monooxygenase and nitrite oxidoreductase); and (3) elevated abundances of amoA and nxrB genes encoding these enzymes. Together, these converging signals provide preliminary evidence for active in-situ surface-ocean nitrification at Sverdrup Glacier. In modern nitrate-depleted systems, including the Canadian Arctic, local nitrate regeneration coupled with rapid phytoplankton uptake can decouple production rates from standing concentrations, potentially obscuring evidence of active cycling.

# Human Geography and Urban Planning

## **Building Resilient Places: The Promise and Paradox of Place-based Adaptation**

**Presenter:** Sarah Kehler

**Presentation time:** Thu 9 Apr, 2:30–2:45

**Section:** Human Geography

*Authors:* Sarah Kehler (1), Jeff Birchall (1)

*Affiliations:* (1) Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta, Canada

Place-based adaptation is often proposed as a pathway to building resilience in the face of climate change - but what exactly is “place,” and why would it matter for resilience? Drawing on findings from my recent systematic literature review, through this talk I weave the many perspectives of place into an interdisciplinary understanding of what makes humans resilient to change. Peer-reviewed literature published up to 2024 was retrieved through Web of Science, Scopus and ProQuest. Screening of 835 unique publications resulted in a final set of 163 articles meeting inclusion and exclusion criteria that spanned 35 years, 112 journals and 45 distinct disciplines. Database and thematic narrative analysis found that, across landscapes and cultures, place relationships are reciprocal and resilient: Change forces interdependent social and ecological systems to reorganize, and place drives processes of adaptation and transformation. Within social-ecological systems, place co-evolves alongside our perception through sensory perception, lived experience, language, knowledge, values, and worldview. I argue that place is a species-level biocultural adaptation that grounds our knowledge and values in unique, spatially-oriented ontologies. Through this lens, I explore what this means for climate change adaptation and those that plan for it.

## **Âhkamêymok: An Interdisciplinary Student's Journey to Wicked Problems in a Wicked World**

**Presenter:** Hannah Louis

**Presentation time:** Thu 9 Apr, 2:45–3:00

**Section:** Human Geography

*Authors:* Hannah L. Louis (1,2), Paulina R. Johnson (2), Paul G. Myers (1)

*Affiliations:* (1) Department of Earth and Atmospheric Sciences, University of Alberta; (2) Department of Sociology, University of Alberta

Definition 1: hkamêymok is a Plains Cree word used to address a group of people meaning “Don’t Give Up/Keep Trying.” Definition 2: Wicked problems are ones that are complex and involve many contradictions, often described as difficult or impossible to fully solve. Since starting my journey as an interdisciplinary student, I’ve begun to see multiple wicked problems arise within different areas of not only research, but in my life in general. There is no guidebook to doing a PhD, there is seemingly less of an understanding to finding a path that fits in between two seemingly disparate disciplines. With this presentation, I ask a simple question: What does it mean to do interdisciplinary research in a good way? Though extremely unorthodox and highly criticized, I take an autoethnographic approach bringing the context, histories and stories that in which taking into all of this into consideration helps navigate this position in between two worlds.

## **Who is to blame for the housing crisis in Canada: a conjunctural analysis of housing and immigration since WWII**

**Presenter:** Pablo Wikander

**Presentation time:** Thu 9 Apr, 3:00–3:15

**Section:** Human Geography

*Authors:* Pablo Wikander (1), Joshua Evans (1), Damian Collins (1)

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This presentation examines the conjunction between housing and immigration regimes in Canada as interconnected mechanisms shaped by contemporary capitalism. We challenge conventional supply-and-demand explanations that treat housing and immigration as separate domains—or attribute housing pressures to immigration inflows—to argue that these regimes are part of a broader configuration of contemporary capitalism. We draw on social reproduction theory, political economy, and conjunctural analysis to reconstruct how these domains have historically functioned as coordinated or uncoordinated spheres, producing different outcomes over time. The conjunctural analysis compares three key periods: a Fordist–Keynesian conjuncture (1945–mid-1980s), neoliberal restructuring (mid-1980s–2000s), and deepening the neoliberal–financialized conjuncture (2000–present). During the postwar period, immigration, labour, and housing were relatively synchronized through state-led coordination, including permanent immigration, stable employment, and large-scale housing provision, thereby enabling national stabilization. Since the mid-1980s to the 2000s, this relative coordination has progressively unravelled. Immigration policy has shifted toward employer-driven temporary migration, labour markets have become increasingly precarious, and housing provision has been marketized. Since the 2000s to the present, these domains have come to be governed primarily through market mechanisms, and their articulation has become unstable. Housing has been financialized, labour incorporation is increasingly decoupled from the conditions required for social reproduction, and working-class immigrants are constantly replaced, facing increasingly precarious labour, housing and legal status. Based on this conjunctural analysis, we argue that recent policy adjustments in both housing and immigration are unlikely to resolve the crisis. As long as these domains remain subordinated to market logics, such interventions risk having limited effects or even intensifying existing contradictions, reproducing instability in the conditions of labour, housing, and social reproduction.

## Basin Research, Sedimentology and Paleontology

### **Subsidence in Magma-Rich vs. Magma-Poor Margins: Controls on Scotian Basin Architecture**

**Presenter:** Lucia Vivanco

**Presentation time:** Fri 10 Apr, 10:00–10:15

**Section:** Basin/Sedimentology/Paleo

*Authors:* Lucia Vivanco (1); Nicholas Harris (1); Octavian Catuneanu (1); Didier Granjeon (2); Stephen Johnston (1)

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Magma-rich passive margins dominate many of the world's continental margins and are characterized by extensive magmatism during rifting, producing thick volcanic sequences, seaward-dipping reflectors (SDRs), and magmatic underplating (Hinz, 1981). In contrast, magma-poor margins exhibit limited magmatism, extreme crustal thinning, and mantle exhumation (Gillard et al., 2019). Understanding how these contrasting tectono-magmatic settings influence subsidence and sedimentary architecture remains a key challenge in basin analysis. The Scotian Basin, offshore eastern Canada, provides an ideal area to investigate along-strike variability between magma-rich and magma-poor margins. The southwestern segment is interpreted as magma-rich, based on the presence of SDRs and its association with the East Coast Magnetic Anomaly (Keen & Potter, 1995), whereas the northeastern segment is magma-poor, characterized by the absence of SDRs and the presence of serpentinitized mantle (Lau et al., 2018). This study investigates how differences in subsidence histories between these margin types control post-rift accommodation and basin-scale sedimentary architecture. Subsidence is quantified through thermal subsidence. Forward stratigraphic modeling using DionisosFlow™ is then applied to simulate sedimentary architecture and compare model outputs with observed seismic stratigraphy. Results indicate that thermal subsidence after ~175 Myr of post-breakup evolution at the shelf edge is significantly greater in the northern magma-poor segment, reaching up to ~7.3 km, compared to ~1.7 km in the southern magma-rich segment. Forward stratigraphic models further demonstrate that reproducing the observed sedimentary architecture in the northern basin requires higher subsidence to generate sufficient accommodation for sediment deposition, as well as greater sediment inflow. These findings highlight the fundamental role of subsidence in controlling sediment distribution and depocenter development, providing new insights into the contrasting evolution of magma-rich and magma-poor margins, and further suggest that possible uplift in the northern drainage area may have contributed to increased sediment supply.

## **Overpressure Development in Organic-Rich Shales: Insights from the Bakken Formation, Williston Basin**

**Presenter:** Yalda Izadi

**Presentation time:** Fri 10 Apr, 10:15–10:30

**Section:** Basin/Sedimentology/Paleo

*Authors:* Yalda Izadi (1), Nicholas B. Harris (2), Rick Chalaturnyk (1)

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Overpressure is common in organic-rich shale systems but is less well understood than in mudstone-dominated successions such as the Cenozoic section of the Gulf of Mexico Basin. Proposed mechanisms include compaction disequilibrium, fluid expansion (e.g. hydrocarbon generation and cracking), buoyancy-driven pressure and tectonic uplift. In organic-rich shales, reactions associated with kerogen maturation and hydrocarbon cracking may be particularly important because they generate additional fluid volume in very low-permeability rocks. The organic-rich Bakken Formation of the Williston Basin provides an example where overpressure strongly influences drilling safety, reservoir behavior, and hydraulic stimulation performance. This study integrates petrophysical analysis, basin modeling, and thermodynamic calculations to quantify the timing, magnitude, and mechanisms of overpressure generation in the Bakken shale. Sonic and density logs from wells in the central Williston Basin were analyzed to identify overpressure indicators such as velocity reversals and velocity–density anomalies. Drill stem test (DST) and mud-weight data were used to estimate pore pressure and effective stress and were compared with normal compaction trends. A calibrated one-dimensional basin model was developed to reconstruct burial history, thermal maturity, and pore-pressure evolution. Thermodynamic pressure was estimated using the Peng–Robinson equation of state combined with pore-volume constraints derived from formation properties. Results indicate that compaction disequilibrium contributes only a minor fraction (~4%) of the present-day overpressure (~7.6 MPa), while uplift has negligible effect. Overpressure development coincides with the main phase of hydrocarbon generation, indicating that fluid expansion associated with hydrocarbon generation and retention is the primary mechanism driving overpressure in the Bakken shale.

## **Microbially catalyzed illitization of smectite clay in organic-rich mudstones from the Upper Devonian Duvernay and Muskwa Formations, Western Canada Sedimentary Basin**

**Presenter:** Hui Li

**Presentation time:** Fri 10 Apr, 10:30-10:45

**Section:** Basin/Sedimentology/Paleo

*Authors:* Hui Li (1), Nicholas B. Harris (1), Sasha Wilson (1), Nina Zeyen (1,2), Maija Raudsepp (1,3), Dipo Omotoso (4)

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The smectite-to-illite (S-I) transformation is widely used as a paleogeothermometer in mudstones and strongly influences overpressure development, rock geophysical properties, and reservoir quality. The primary models, derived from Gulf of Mexico Cenozoic mudstones, interpret illitization as a temperature-driven process initiated after a relatively high thermal threshold. However, emerging evidence suggests that microbial processes may catalyze this reaction. In organic-rich mudstones, microbial reduction of structural Fe(III) in smectite to Fe(II) can increase layer charge, facilitate K<sup>+</sup> fixation and accelerate illitization, potentially enabling illitization at lower temperatures and shallower burial depths than predicted by purely thermal models. This model has been applied to young sediments in the Nankai Trough, offshore Japan, where illitization of smectite has been observed at relatively low temperatures. Mudstones from the Duvernay and Muskwa Formations in the Western Canada Sedimentary Basin were analyzed using clay mineralogical and petrographic methods, including XRD and SEM. Clay assemblages are dominated by illite and R3 illite-rich mixed-layer illite-smectite, with 1M, 1Md, and 2M1 polytypes indicating mixed detrital and diagenetic origins. Diagenetic illite occurs in thermally immature samples that experienced maximum temperatures of only ~75 °C and burial depths of 1116-1169 m, conditions under which temperature-driven models would predict smectite-dominated clays. Illite in the shallow buried samples is associated with K-feldspar dissolution, Fe enrichment at dolomite rims, and precipitation of microcrystalline quartz and authigenic albite, indicating active early diagenesis reactions. Mass-balance estimates indicate that Duvernay mudstones contain a Fe budget comparable to or exceeding that of Gulf of Mexico sediments. However, Fe preserved in illite is lower, implying greater Fe consumption during illitization and subsequent expulsion into secondary mineral sinks. Together, these observations indicate that microbial processes can catalyze the S-I transformation at abnormally low temperatures and shallow burial depths in organic-rich shales, challenging traditional thermally driven models of clay diagenesis.

## **Architectural elements of the Cadomin Formation in the Crowsnest Pass: insights from 3D photogrammetric outcrop models**

**Presenter:** Jiahui Gao

**Presentation time:** Fri 10 Apr, 11:00–11:15

**Section:** Basin/Sedimentology/Paleo

*Authors:* Jiahui Gao (1), Stephen T. Johnston (1), Murray K. Gingras (1), Michael J. Ranger (2), Jennifer J. Scott (3)

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The Early Cretaceous (Aptian) Cadomin Formation, deposited along the western margin of the Western Canada Sedimentary Basin, is dominated by pebble conglomerates composed primarily of well-rounded chert clasts. The Cadomin Formation unconformably overlies Jurassic flysch and molasse sequences of the Fernie and Kootenay groups, and is interpreted as a classic example of a terrigenous braided river system. This study employs architectural element analysis to better characterize the internal architectural elements and depositional dynamics of these gravel-bed braided systems. Focusing on well-exposed sections in Crowsnest Pass, Alberta, this study integrates lithological data from three outcrops with drone-based photogrammetry from two key sites. High-resolution three-dimensional digital outcrop models were generated to extract precise bedding orientations and analyze sedimentary accretionary patterns. These data collectively facilitate architectural element analysis to reconstruct the braided-river depositional environment of the Cadomin Formation. Within the studied sections, trough cross-stratification, formed by the migration of large-scale sinuous-crested dunes under high-energy, lower-flow-regime unidirectional currents, is the predominant sedimentary structure. The transition from these dune deposits to overlying sub-horizontal beds indicates an upward shift to upper-flow-regime plane-bed conditions, likely driven by increased flow velocities or reduced water depths. These architectural patterns suggest that the Cadomin Formation aggraded during episodic flood events, which caused rapid transitions between dune migration and upper-stage plane-bed deposition.

## **Kingdoms of ecology: how Linnaean ranks shape the living world**

**Presenter:** William Johnston-Gramlich

**Presentation time:** Fri 10 Apr, 11:15–11:30

**Section:** Basin/Sedimentology/Paleo

*Authors:* William Johnston-Gramlich (1), Chris L. Schneider (1), Amelinda E. Webb (2), Lindsey R. Leighton (1)

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Linnaeus produced the first concept of classifying species in a ranked system in the early to mid 18th century, which has since evolved into modern cladistics. However, Linnaean ranks are still heavily employed; this is particularly true in the field of palaeontology. Biodiversity curves utilizing the fossil record often rely upon ranks above the species level, often invoking genus or family, but how comparable are clades sharing arbitrarily defined ranks? Species level data collected over multiple years near Bamfield Marine Science Center provide a means to address this question. The data set is exhaustive, containing a complete survey of all life greater than 1 millimeter in size found attached to rocky outcrops within the study area. The data set allows an exploration of data at all Linnaean ranks, which permits comparison of biodiversity pattern construction for coarse-grained ranks to the high-resolution data of the species level across time and space. Analyses such as NMDS ordinations may reveal patterns that are weakened or lost as our data set becomes taxonomically coarse, or potentially show new patterns emerging at a coarser grain; results can then be confirmed by conducting procrustean randomization tests. Initial results suggest that Linnaean ranks, regardless of how coarse, contain the same signals seen in the finest grain level of species. This implies that palaeontological studies do not suffer from a lack of specificity in identification, but rather that any Linnaean rank can capture the signal of a dataset. Thus, palaeontological questions examining biodiversity patterns are not negatively impacted from the often-used coarser data categories of genus and family.

## **Ichnological Analysis of the Paleocene Eocene Thermal Maximum**

**Presenter:** Sheridan Sigstad

**Presentation time:** Fri 10 Apr, 11:30–11:45

**Section:** Basin/Sedimentology/Paleo

*Authors:* Sheridan Sigstad (1), Kurt O. Konhauser (1), Jens O. Herrle (2), Paul Myers (1), Alina Shchepetkina (3), Murray Gingras (1)

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This study investigates the ichnological characteristics of deep-sea cores recovered from site U1580 on the southern Central Agulhas Plateau during International Ocean Discovery Program (IODP) Exp. 392, with a focus on the Paleocene-Eocene Thermal Maximum (PETM) event. By comparing pre-, syn-, and post-PETM intervals, this research applies trace fossil diversity, maximum trace diameter, and bioturbation patterns to assess benthic community responses to extreme climate changes including temperature changes, fluctuating bottom water oxygenation, nutrient availability, as well as changing deep sea circulation patterns. Trace fossil records such as ichnogenera diversity and maximum trace fossil diameters across 10 cm intervals (bins), were extracted from high-resolution photographs of cores U1580A and U1580B. Results reveal a reduction in maximum trace fossil diameters during the PETM, reflecting potential environmental stressors like elevated temperatures and lower oxygen (O<sub>2</sub>) levels, followed by a post-PETM recovery. Trace fossil diversity increased from the syn- to post-PETM interval, ecological reorganization and potential recolonization of newly available niches. A comparative analysis of the two cores highlights subtle differences, with core U1580B exhibiting larger average maximum trace fossil diameters possibly due to localized variations in seafloor topography, food availability and/or biological factors. The deep-tier trace fossil Zoophycos is both included and excluded from the analysis to explore how its burrow depth – which likely exceeds the 10 cm bin intervals used – impacts ichnological trends. Overall, the ichnological patterns presented here provide new insights into how deep-sea macrobenthic communities responded to PETM environmental stressors, complementing existing paleoenvironmental interpretations based primarily on microfossil data. Continued research on other Atlantic Ocean sites is currently underway.

## **A glimpse into the palaeoecology of a Cretaceous floodplain pond**

**Presenter:** Ryusuke Kimitsuki

**Presentation time:** Fri 10 Apr, 2:30–2:45

**Section:** Basin/Sedimentology/Paleo

*Authors:* Ryusuke Kimitsuki (1), Corwin Sullivan (2), John-Paul Zonneveld (1), Murray Gingras (1)

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The Wapiti Formation is an Upper Cretaceous fully nonmarine system deposited in west-central Alberta. The rock unit is famous for exceptionally preserved vertebrate body fossils, whereas co-occurring invertebrate trace fossils are less well studied. Recently, however, carbonaceous mudstones bearing various invertebrate trace fossils were found at a riverbank along the Wapiti River. These trace fossils include arthropod trackways (*Octopodichnus*), invertebrate coprolites deposited into small mounds or rings (*Cumulusichnus*), and radiating burrows. The arthropod trackways consist of sets of four imprints in a bilateral series, suggesting an arthropod trackmaker with four pairs of legs. They morphologically resemble trackways produced by modern crayfish, and thus, a decapod trackmaker is posited. The fossil invertebrate fecal deposits consist of small (usually  $\leq 0.5$  mm in diameter), rod-shaped or string-like coprolites, which are organized into a conical mound or an incomplete ring. The morphology of the coprolites and inferred mode of defecation resemble those seen in modern aquatic worms. Finally, the radiating burrows occur at the bases of vertical shafts, suggesting middle- to deep-tier deposit feeding behaviour. While a variety of continental invertebrates may be able to construct similar structures, the burrows are similar in architecture to those made by modern earthworms. The exceptional preservation of the surficial trace fossils was probably made possible by a volcanic event: the ash layer deposited right above the bedding surface buried the biogenic structures instantaneously, without major disruption. The middle- to deep-tier radial burrows likely came after ash fallout was completed, to exploit the organic-rich deposit. These trace fossils give us crucial insights into the palaeoecology of invertebrates whose body fossils are not known from the Wapiti Formation. Furthermore, the fossil fecal mounds are direct evidence that vertical sediment mixing was occurring in nonmarine settings by the Late Cretaceous.

## **Novel trace of successful crushing predation on gastropods**

**Presenter:** Zoe Risley

**Presentation time:** Fri 10 Apr, 2:45–3:00

**Section:** Basin/Sedimentology/Paleo

*Authors:* Zoe Risley (1), Janet Alexander (1), Alexander G. Baxter (1), Nathaniel E. D. Morley (1), William Johnston-Gramlich (1), Lindsey R. Leighton (1)

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Marine crushing predation studies commonly use repair scars to investigate predation intensity; however, because repair scars represent failed attacks, they do not provide information on successful attacks (kills). The current paradigm is that kills from crushing attacks are lost from the fossil record because crushing shatters the shells of the prey. However, experimental predator-prey studies using red rock crabs (*Cancer productus*) and black turban snails (*Tegula funebris*) found that the kills created a distinctive fragment. This disk-shaped fragment is from the apex (top) of the snail shell and is formed when a crab peels the shell. To identify if this kill fragment could be found in nature, and if the distribution of these fragments is consistent with a previously determined crab-snail predation pattern, we sampled six well-studied intertidal locations around Bamfield, Vancouver Island, Canada. The results found that the disk-shaped kill fragments were present in the natural settings and followed the previously established predation pattern, where the *Tegula* kill fragments were more common at localities known to have larger and more abundant crabs (greater predation). The discovery of this distinctive kill fragment provides the opportunity to analyze this and potentially other crab-snail predator-prey relationships more completely by utilizing evidence of both failed and successful attacks. Future work should investigate this distinctive kill fragment in the fossil record to better understand predation systems in palaeoecology.

## Early Animal Evolution and Microbialite Ecosystems

**Presenter:** Baptiste Coutret

**Presentation time:** Fri 10 Apr, 3:00–3:15

**Section:** Basin/Sedimentology/Paleo

*Authors:* Baptiste Coutret (1), Sanaa Mughal (1), Gavin Rishworth (2), Murray K. Gingras (1), Cody N. Lazowski (1), Kelly J. Rozanitis (1) & Kurt O. Konhauser (1)

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Microbialites are key components of carbonate deposits and the most abundant fossilized life form in Precambrian rocks. Microbialites are regarded as fossilized relics of microbial communities and occupied various subaqueous and shallow water environments. The Late Ediacaran Byng Formation, stratigraphically positioned at the top of the Neoproterozoic Miette Group in the Canadian Rockies, contains carbonate outcrops that host both exceptionally preserved microbialites, ranging from stratiform to columnar forms and some of the earliest calcified macrofossils of the *Cloudina*–*Namacalathus* assemblage in shallow-marine settings. However, the role of microbial reefs in the lives of early animals during the Late Ediacaran remains poorly understood, raising the question of whether this association reflects only preservation potential or if microbialites provided environments where biomineralization conferred an advantage. Ecological interpretations gleaned from the fossil record can be further understood through analogous modern microbialite-metazoan interactions. However, in present day, well-developed microbial communities are rare because most are consumed by animals. In supratidal pools along the South African coast (SSLiME), microbialites host diverse benthic communities such as arthropods, annelids, and molluscs, that occupy their surfaces and internal cavities offers a unique opportunity to explore how microbial communities and animals can co-exist, providing a valuable modern analog in which microbialites offer sheltered habitats, structural support, dissolved oxygen, and organic carbon.

## Environmental Geology

### Considering Felsic, Intermediate and Mafic Feedstocks for Biotic and Abiotic CO<sub>2</sub> Removal

**Presenter:** Verônica Rosa

**Presentation time:** Fri 10 Apr, 3:30–3:45

**Section:** Environmental Geology

*Authors:* Verônica Rosa (1), Sasha Wilson (1), Maija Raudsepp (1,2), Connor Turvey (1), Arif Hussain (1), Ian Power (3), Benjamin Bates (3), Victoria Hatten (3), Liam Ng (1)

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Carbon dioxide removal (CDR) is a necessary strategy to achieve net-negative emissions and stabilize Earth's climate. Storing CO<sub>2</sub> as alkalinity through silicate weathering is one of the most efficient forms of inorganic carbon storage. In this study, the CO<sub>2</sub> removal potential of six diverse mine tailings and ores, with felsic to ultramafic lithologies and diverse mineralogical compositions, were investigated (1) using HCl-leaching tests and (2) biotic and abiotic mineral dissolution experiments.

HCl leaching experiments were performed at a nominal pH of 5.60, 4.41, and 3.89 — corresponding to aqueous CO<sub>2</sub> concentrations of 0.04%, 10%, and 100%, respectively — and sampled at 1 week, 1 month and 3 months. Prior to leaching experiments, the feedstocks were characterized by quantitative X-ray diffraction (QXRD) to determine modal abundances of Mg- and Ca-bearing silicates. Modal mineralogy and dissolution rate constants were used to calculate the upper limits of H<sup>+</sup> neutralization associated with mineral dissolution, as well as Mg and Ca release at pH 5.60, 4.41, and 3.89. Mafic and ultramafic feedstocks released more Mg and Ca and approached calculated values, which reflect far-from-equilibrium upper limits of silicate dissolution, more closely than what was observed for felsic feedstocks. Cation release occurred on the same order of magnitude as CO<sub>2</sub>-based experiments (Figure 1), indicating that simple HCl-dissolution experiments may be used as a proxy for more labour intensive H<sub>2</sub>CO<sub>3</sub>-leaching experiments.

In a second set of experiments, cyanobacteria were added to selected feedstocks in a modified BG-11 growth medium. Cyanobacterial mats were incubated for 6 months with either phlogopite (a mica), forsterite (olivine), or tailings from two mines containing up to 32 wt.% phlogopite and 22 wt.% forsterite, respectively. Each substrate was tested under biotic and abiotic conditions. In the biological experiments, cyanobacterial growth increased pH and nutrient cycling, and in some cases reduced silicate dissolution rates.

## **Geometallurgy and Critical Metal Department in Listwanite-Hosted Ultramafic Systems: Atlin, British Columbia**

**Presenter:** Jared Janzen

**Presentation time:** Fri 10 Apr, 3:45–4:00

**Section:** Environmental Geology

*Authors:* Jared Janzen (1), Sasha Wilson (1), Annah Moyo (1), Maija Raudsepp (1), Matthew Steele-MacInnis (1)

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Listwanites are carbonate-silica altered ultramafic rocks formed through CO<sub>2</sub>-rich hydrothermal metasomatism and are commonly associated with critical metal enrichment, but the mechanisms governing metal department during progressive alteration are poorly constrained. The Atlin ophiolite complex in northwestern British Columbia, Canada provides an excellent opportunity to investigate metal enrichment during listwanitization, as it preserves a well-developed alteration sequence of dunite, serpentinite, soapstone and listwanite rocks and is spatially associated with historical gold mineralization. This study investigates (1) the mineralogical hosts and department of critical metals across the dunite-serpentinite-soapstone-listwanite alteration sequence, (2) the composition and evolution of mineralizing fluids responsible for ultramafic rock alteration and metal redistribution, and (3) whether these natural processes provide insight into the potential mobilization and extraction of critical metals during engineered in situ carbon sequestration of ultramafic rocks. Multiple representative samples from the historical Pictou and Anna mine sites will be analyzed using integrated whole-rock geochemistry [X-ray Fluorescence (XRF), Inductively Coupled Plasma Mass Spectrometry (ICP-MS), fire assay], mineralogical and microanalytical techniques [X-ray Diffraction (XRD), transmitted light petrography, Scanning Electron Microscopy (SEM), Electron Microprobe Analysis (EMPA), and micro-X-ray fluorescence ( $\mu$ XRF)], and multivariate statistical methods to quantify metal mobility and pathfinder relationships. In addition, analysis of fluid inclusions using Raman spectroscopy, microthermometry and Laser Ablation ICP-MS will be used to constrain the physicochemical composition of mineralizing fluids. This research will result in an integrated model for critical metal enrichment in listwanite-hosted systems by linking the department of valuable metals within minerals with fluid characteristics and alteration intensity. The results will improve exploration strategies for ultramafic-hosted mineralization, inform geometallurgical considerations, and enhance understanding of fluid–rock interactions during carbonation of ultramafic environments.

## Poster Section

### **Does the Architecture-Based Metabolic Scaling Exponent Change With American Elm Age as Estimated From SLAM LiDAR and 3D Modelling?**

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The West, Brown, and Enquist (WBE) model predicts a universal metabolic scaling exponent across plant species and sizes, yet empirical studies report conflicting evidence, particularly across plant life stages. While respiration-based scaling has been examined extensively, architecture-based scaling has not been systematically tested across tree age classes. This project evaluates whether the architecture-based metabolic scaling exponent varies with age in American Elm trees using mobile SLAM LiDAR and 3D modelling. SLAM LiDAR data was collected from young and mature trees to generate 3D point clouds. Individual trees were reconstructed with TreeQSM to extract branch-level metrics, which were used to compute scaling parameters and derive architecture-based metabolic scaling exponents. We observed differences in scaling exponents between young and mature trees and confirmed that SLAM-derived measurements were consistent with TLS. Patterns were evaluated against the WBE framework to assess the assumption of invariant scaling across life stages. This study demonstrated the potential of mobile SLAM LiDAR as a rapid, cost-effective tool for quantifying forest structure and testing ecological theory. Results provided insight into how tree architecture influences metabolic scaling across ontogeny, with implications for forest modeling and ecosystem ecology.

## **Examining The Change In Structure Of The Peace River Arch From The Devonian To Lower Cretaceous**

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The Peace River Arch (PRA) has undergone various phases of uplift and subsidence that has caused its structure to change during different periods of time. We therefore examine how this structure evolved over time, specifically during the Lower Cretaceous and Upper Devonian to Lower Carboniferous.

We use regional cross sections that were flattened on datums in the Banff formation (Upper Devonian to Lower Carboniferous) and Bluesky formation (Lower Cretaceous). Based on structural depths gotten from these cross sections, we create an isopach map. In this map, we observe areas of increased thickening, indicating high rate of block subsidence in the region that contributed to collapse of the PRA structure. Additionally, we find numerous faults. We deduce that these faults are likely reactivated from pre-Devonian times and were a major contributor to subsidence in the region.

This study is important as it aids in understanding the Peace River Arch structure and the factors causing subsidence. It could also help to enhance resource exploration in the region. However, more stratigraphic studies are needed to better understand subsidence in the Peace River Arch.

## **Befriending A Bryozoan - Bryozoan-Hosted Epibiotic Interactions in the Silica Shale (Devonian)**

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Epibiosis, the relationship between an animal that is encrusting (the epibiont) and a host animal (the basibiont), is a commonly studied ecological phenomenon in the fossil record. Almost all studies on Paleozoic epibionts concern brachiopod hosts. This study examines the epibionts that encrusted trepostome bryozoan hosts from the Middle Devonian Silica Shale Formation in Ohio, USA. An examination of the bryozoan hosts revealed that of the 62 bryozoan colonies collected, 44 showcased the encrustation of the epibiont directly onto the host bryozoan. Of the epibionts present, *Microconchus* sp., a coiled, encrusting “worm” tube, was the most common epibiont, appearing on 80% of the host bryozoans. Other epibionts include ascodictyons, auloporid corals, sheet-like bryozoans, cornulitid “worm” tubes, crinoid holdfasts, and colonial hederellids. The number of epibionts encrusting a bryozoan specimen is strongly associated with the bryozoan’s volume (Pearson’s Correlation,  $r=0.715$ ,  $p \ll 0.001$ ), as determined by displacement by the bryozoan by water in a beaker. This study opens a rare window on epibiont relationships with non-brachiopod hosts in the Paleozoic.

## **Geochemical Characterization of the Potential Source Vents for Major Holocene Volcanic Eruptions at Mono-Inyo Craters, California**

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The Mono-Inyo Craters are an active volcanic chain comprised of coulees, lava domes, and craters located in eastern California. Most of the Mono-Inyo Craters are comprised of high-silica ( $\text{SiO}_2$ ) rhyolites that formed through an initial Plinian to sub-Plinian eruption forming a crater and tephra-ring followed by effusive flows that fill the crater with a dome; if the flows exit the crater they form a coulee. There are numerous volcanic ash deposits in the area from these events that represent a regional hazard, but few have been linked to their source crater/dome. This research focuses on samples from the Mono Craters domes and coulees thought to be associated with the last two major eruptions and seeks to geochemically characterize and link them to their ash deposits. Samples were crushed, sieved, and processed to separate out the Fe-Ti oxides and glass. Glass and Fe-Ti oxide major element geochemistry was characterized by an Electron Probe Microanalyzer (EPMA), and glass trace element compositions were obtained by Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS). These data are then compared to ash deposit geochemistry to test hypotheses about the eruption sequences of the last two eruptive events. These data will also help to understand if there are compositional changes post-(sub) Plinian eruptions that may complicate geochemical linkages between the ash deposits and their presumed sources. Overall, this research will help determine the source magma's geochemical evolution during eruptive sequences, building a better understanding of the processes building these unique volcanoes and the hazards they represent.

## **The Thermal Impact of Kimberlite Magmatism on the Sask Craton - Xenocrysts from the Fort à La Corne Kimberlite Field, Saskatchewan**

**Authors:** Kalen Vamvakakis, Thomas Stachel, Luísa de Carvalho

Located centrally within the Canadian Shield, the Sask Craton is an Archean to Paleoproterozoic crustal fragment enclosed within the Trans-Hudson Orogen (THO). Inside the craton sits the Cretaceous (~106 to ~95 Ma) Fort à la Corne (FaC) kimberlite field, which hosts major diamond deposits. This study looks at the major elements of clinopyroxene (n = 367), and garnet (n=194) mantle xenocrysts picked from heavy media concentrate from the Star and Orion South kimberlites, to constrain the thermal regime and paragenesis of the subcontinental lithosphere. Samples were recovered from three stratigraphic intervals (Early Joli Fou, Pense, Cantuar) to get analysis from the whole extent. Clinopyroxenes are dominantly from the peridotitic suite (n = 309), with the remaining (n = 57) being assigned to the eclogitic suite. Single grain clinopyroxene thermobarometry defines a cool model paleogeotherm at 38mW/m<sup>2</sup> (T38) indicating the base of the lithosphere at approximately 220 km depth. Clinopyroxene temperatures reveal two peaks in temperatures, revealing sampling at discrete depths by the kimberlite. Similarly, Mn-in-garnet thermometry applied to lherzolitic garnets (n = 78) further defines the thermal structure of the subcontinental lithosphere with projection of temperatures on T38. Garnet temperatures primarily fall within one peak, revealing kimberlite sampling from a single depth region ~20 – 40km deeper (100 – 200°C on T38) than the main clinopyroxene peak.

## **Microscopic volcanic ash deposits in Kluachon Lake, Northwestern British Columbia**

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The Northern Cordilleran Volcanic Province (NCVP) is the most active volcanic region in Canada. These volcanoes are under-monitored and understudied compared to other volcanoes globally due to their remote location and inaccessibility. However, volcanic ash (also known as tephra) deposited in lake sediments in this region are proving to be fundamental for reconstructing NCVP eruption histories. When a volcanic eruption produces tephra, it can travel many kilometres from the source, and each tephra can have a unique geochemical signature that ties it to its source. The challenge is that lake sediments in this region are very difficult to radiocarbon date, and visible ash are hard to locate, complicating local eruption reconstructions. To overcome this challenge, we took a “cryptotephra” approach to find microscopic ash deposits in this core. Cryptotephra are found by sieving and density-separating sediment samples, which are then mounted on microscope slides where any glass shards (the main component of tephra) are counted. A peak in glass shard concentration represents an eruption, which is then geochemically analysed. This provides a method to identify local eruptions that are not obvious in the lake sediments and locate more distantly sourced Alaskan cryptotephra that are more likely to originate from well-known and dated eruptions. This approach has resulted in the identification of at least two distal Alaskan tephra that help constrain our age model and the timing of more local eruptions. This study demonstrates that we can use cryptotephra to help date our sediment records in this region. It also builds our understanding of the eruption frequency and hazards presented by the local volcanoes of the NCVP.

## **Drought Variability in Tropical Dry Forests Over 70 Years**

**Authors:** Paula Moreno-Pina (1) & Arturo Sanchez-Azofeifa (1)

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Tropical dry forests (TDFs) are among the most threatened ecosystems in the Americas, facing compounding pressures from climatic variations and human disturbance. Yet continental-scale assessments of ecological drought dynamics across their geographic range remain scarce. To address this gap, we quantified spatial and temporal drought patterns across Neotropical TDFs using the Standardized Precipitation Evapotranspiration Index (SPEI) at 1-, 3-, and 12-month timescales, capturing both short-term moisture deficits and the prolonged water stress that shapes ecosystem functioning.

Results revealed substantial heterogeneity in drought dynamics across the region: while trends varied spatially, longer SPEI timescales indicated an intensification of extended water deficits in recent years. Notably, some areas that appear relatively stable under precipitation-based metrics or under extreme dryness showed different trends when evapotranspiration was accounted for, highlighting the limitations of rainfall-only drought indices in energy-limited systems.

These patterns point to emerging hotspots of drought vulnerability with direct implications for vegetation stress, carbon storage, and species composition. Together, these findings advance understanding of TDF resilience to climate extremes and provide a spatially explicit basis for conservation planning across one of the world's most biodiverse forest biomes.

## **Inspiring Change Through Conceptual Design: A Student-Led Library Initiative**

**Authors:** Reem Elawad (1), Anjeli Flores (1), Asha Neumann Dar (1), David Song (1), Andrew Symak (1), Jacob Tan (1), Aayan Chaudhary (1), Malay Desai (1), Hazem Elsinbawi (1), Rhea Kumar (1), Sophia Young (1), Burhanuddin Yamani (1)

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Many small communities are lacking sufficient public development in comparison to larger cities. Additionally, these communities often do not have sufficient funding to fulfill this need. One such solution is through the help of multidisciplinary student groups that aim to make a difference. This project was developed to help a small town in Alberta improve their library facilities.

We aimed to create a proposal for a new library space in the town of New Sarepta that would better suit the needs of the community and region. This was accomplished by implementing urban planning, earth sciences, and engineering principles.

This project aims to build on the pre-existing feasibility study by providing designs and cost analysis for the creation of a library space. Additionally, we included input from the local community and surrounding area to determine what would best meet their needs. We consulted the information from the previous study and available building space and developed a plan to create a modern, usable space for the residents. We addressed and implemented the feedback from public officials throughout the course of the project, and successfully determined a realistic proposal to create an effective library.

We learnt about the importance of understanding diverse perspectives and accommodating them in the shared space. We created a successful framework for the community to build upon for their future community developments. This research could be used by the governing bodies to implement a plan to create a positive community center to increase the accessibility of public services in the surrounding area.

## **Hydrologic Flow Model Analysis of *Paraonis fulgens* Traces (Willapa Bay, Washington)**

**Authors:** Samantha JL. Zaplotinsky (1), Brian D. Smerdon (1), and Murray K. Gingras (1) *Affiliations:* (1) Department of Earth and Atmospheric Sciences, University of Alberta

Graphoglyptids are a group of geometrically complex trace fossils that are commonly found within the deep-marine Neritic ichnofacies. A member of this group, *Paraonis fulgens*, is a polychaete annelid worm that creates horizontal planispiral shaped burrows (Spirorhaphid- and Helminthoida-type). As a Graphoglyptid, *Paraonis fulgens* is a prominent outlier, residing in sandy intertidal flats and not typical deep-marine environments. This study investigates whether the selective deposit feeding behaviour and complex geometries of *Paraonis fulgens* impacts the burrow saturation through the use of a hydrologic flow model. The flow model simulates variably-saturated water movement, with input parameters determined through the analysis of burrow photos and sediment samples from Willapa Bay, Washington. The simulation results demonstrate that burrow depth plays a significant role in fluid retention over the duration of the tidal cycle, providing sufficient evidence that a nutrient advantage may be a reason for *Paraonis* residing in a sandy intertidal flat.

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**Authors:** Ziyu Chen

Sea ice is a key component of the high-latitude ocean, playing a crucial role in heat exchange, freshwater, and brine injection, which further affect climate feedback. During the Last Interglacial (MIS 5e), Arctic temperatures were warmer than today, so this interval is important for understanding how sea ice changed during past warm climates. Meanwhile, there are still many debates about Arctic sea ice conditions during MIS 5e, especially whether the central Arctic retained summer sea ice or was seasonally ice free.

This project focuses on reconstructing sea ice during past warm intervals, with the main focus on Arctic sea ice conditions during the Last Interglacial, and also includes the synthesis of MIS 6 and later MIS 5 variability to place this interval in a broader climatic context. I chose MIS 5e because it is the central debate focus and offers an important natural benchmark for understanding future Arctic change. The project compares different lines of evidence, including biomarker-based sea ice proxies, microfossil evidence from central Arctic sediment cores, and climate model simulations.

Particular attention is given to the contrast between Stein et al. (2017), which reconstructed persistent summer sea ice in the central Arctic, and Vermassen et al. (2023), which used microfossil evidence to argue that the central Arctic might have been seasonally ice free in summer during MIS 5e. This comparison shows that proxy choice can strongly influence interpretations of Arctic sea ice conditions during past warm intervals. Understanding these past sea ice changes is important because they provide a geological analogue for future climate change and help explain how sea ice retreat may affect Arctic climate feedbacks.