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Atlantic Universities Geoscience Conference 2022

ABSTRACTS

October 27–29, 2022

72ND ANNUAL CONFERENCE HOSTED BY:
FLETCHER GEOLOGY CLUB, ACADIA UNIVERSITY
WOLFVILLE, NOVA SCOTIA

Abstracts from the Atlantic Universities Geoscience Conference (AUGC) are published annually in Atlantic Geoscience. Such publication provides a permanent record of the abstracts, and also focuses attention on the excellent quality of the oral presentations and posters at the conference and the interesting and varied geoscience topics that they cover. Although abstracts are modified and edited as necessary for clarity and to conform to Atlantic Geoscience format, the journal editors do not take responsibility for their content or quality.

THE EDITORS

**Groove casts? More like whose cast?
What made these anomalous structures?**

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The Meguma terrane is home to the metasandstone-rich Goldenville Group. This Cambrian unit contains many sedimentary structures including but not limited to flute casts, wave and current ripples, sand volcanoes, and large enigmatic groove casts. The origin of these large groove casts is currently unknown, but given the consistency and size of the grooves, it is speculated that they may have been formed from a biogenic source such as a large organism being dragged across the sediment surface. Analysis of the structures is made more complex because the rocks within the Goldenville Group have been deformed, causing structures within these rocks to be strained. Reversing strain is an important step in determining the possible origin of the large groove casts. One method to reverse strain is to examine sedimentary structures, such as equant sand volcanoes and circular and meandering trace fossils and determine an overall strain ratio and then apply an inverse strain value to the groove casts. A 3D model of the groove casts created using photogrammetry software will then be compared to various large objects or organisms that were present in the Cambrian to find a potential match for the groove casts. The results of this investigation have implications including the size and abundance of animals from the Cambrian in Nova Scotia. *[Poster presentation]*

**Where's the carbon? Spatially mapping
carbon on the seafloor**

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Coastal sediments contain the largest stocks of organic carbon and play a vital role in influencing the carbon cycle. Protecting organic carbon hotspots is essential to mitigating climate change because development and bottom trawling can disturb the seafloor, driving the remineralization of organic carbon into carbon dioxide. Terrestrial carbon stocks are well studied and mapped, but our knowledge of standing stocks of marine sedimentary carbon and the role that it can play in minimizing the effects of climate change are poorly understood. One of the challenges in mapping

the seafloor environment is the issue of characterizing spatial heterogeneity of different substrata, which is critical in estimating organic carbon standing stocks in the marine environment. In this study, we use high-resolution multibeam echosounder (MBES) data from the Eastern Shore Islands off Nova Scotia to predict the distribution of percent organic carbon in surface sediments. We applied benthic habitat mapping approaches, utilizing high-resolution continuous coverage environmental variables (bathymetry, backscatter, current velocity, bottom salinity, bottom temperature, ruggedness, slope, Euclidean distance) combined with subsea video and ground truthing to generate thematic maps of sediment types for the area. We then compared those to the measurements of organic carbon from the samples, which were spatially modelled using different methodologies to estimate organic carbon standing stocks in the area by substrate type. These high-resolution sedimentary organic carbon maps can help determine the best approach for using MBES surveys to map carbon and identify carbon hotspots, which are essential for seabed management and climate mitigation strategies. *[Oral presentation]*

**Pebble provenance across a syn-tectonic braided
fluvial to alluvial fan transition, Flatrock Cove
Formation, Flatrock, Newfoundland**

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The Ediacaran Flatrock Cove Formation in the Avalon Zone, eastern Newfoundland, is composed of the Knobby Hill Member conformably overlain by the Piccos Brook Member. These units record syn-tectonic sedimentation and a change from a braided fluvial to alluvial fan environments during progressive folding and thrusting along the proximal margin of the Signal Hill Basin, coinciding with the Avalonian Orogeny (ca. 600–545 Ma). This project aims to constrain the provenance of clasts in conglomerates of the Knobby Hill and Piccos Brook members to identify changes in sources and sediment routing coinciding with Avalonian deformation in sediment hinterlands. Point counting of clasts in the field from the middle of the Knobby Hill Member upward through to the Piccos Brook Member reveals significant changes in clast compositions. In Knobby Hill, there is an upward change in igneous clast populations from angular black rhyolite, andesite, and granite, to a mainly subrounded to rounded weathered granite. Clasts in the Piccos Brook Member are dominated

by sandstone, mudstone, and siltstone. Based on these data, significant changes in clast hinterlands occurred throughout the Flatrock Cove Formation sedimentation, from mainly volcanic, to plutonic, to sedimentary. Fourteen representative igneous clasts were also selected for bulk major and trace element geochemistry, with a focus on high field strength elements (HFSE), rare earth elements (REE), and Y, which will be used to discriminate the petrogenesis of igneous source areas and provide more detail of the sequence of hinterland uplift and exhumation coinciding with Flatrock Cove Formation sedimentation. *[Oral presentation]*

Chemical characterization of melt inclusions in Blake River Volcanics of the Swayze area, Abitibi Greenstone Belt, Ontario, Canada

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Volcanogenic massive sulphide (VMS) deposits are important sources of economic concentrations of copper, zinc, lead, gold, silver, and other strategic minerals. The Neoproterozoic Abitibi Greenstone Belt (AGB) is a world class mining district straddling the Ontario and Quebec border and is host to numerous world-class VMS deposits. In terms of total metal endowment, the Blake River Group (BRG; 2704-2695 Ma) is the most enriched group within the AGB. The megacaldera complex has 31 known VMS deposits, most of which are concentrated around the Noranda and Doyon-Bousquet-LaRonde (DBL) mining camps. However, in the Swayze area of the AGB, no economic VMS deposits are known, despite considerable volumes of BRG rocks present in the area. This raises the question as to what factors control the occurrence of BRG-hosted economic VMS deposits in the AGB. This study will investigate whether the Swayze BRG rocks had the same initial melt compositions as the BRG rocks in the prolific DBL camp, specifically ore metals available to be concentrated by magmatic-hydrothermal systems. To achieve this, the study aims to chemically characterize the BRG rocks in the Swayze area, including a sub-economic VMS occurrence, through litho-geochemical melt inclusion chemical analysis. Integrated with detailed petrography, these geochemical data will be compared to data from temporally and lithologically similar rocks of the DBL mining camp. The use of laser ablation- inductively coupled plasma mass spectrometry on zircon-hosted

melt inclusions will enable the base and precious metal fertility of the melts associated with the sub-economic VMS occurrence to be determined. *[Poster presentation]*

Geochronology of the Loki's Castle hydrothermal vent field, Arctic Mid-Ocean Ridge

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Loki's Castle is an active high-temperature hydrothermal vent field located on the northern end of the Mohns Ridge, where it transitions into the Knipovich Ridge. The Mohns Ridge is part of the slow spreading ridge system that extends northward from Iceland to Gakkel Ridge in the Arctic Ocean. At 2400 m depth, Loki's Castle consists of black smoker chimney clusters located atop two coalesced hydrothermal mounds that are up to 30 m high and 200 m across. In 2017 and 2019, rock samples were collected from Loki's Castle using a remotely-operated vehicle operated from the Norwegian research vessel G.O. Sars. These samples were collected from hydrothermal mounds, and include an active and an inactive barite chimney, an active chimney flange, and an exposed fault surface. In our study, we will use the ²²⁶Ra/Ba isotopic system to date hydrothermal barite from a subset of ten samples from the vent field. Chronological analysis will be completed using gamma spectroscopy combined with bulk geochemical analyses. Sample ages will be used to determine how long this system has been forming. These results will be combined with deposit volume estimates determined from analysis of high-resolution bathymetry, to calculate the rate of deposit formation. The barite ages will be compared to previously determined ²³⁰Th/²³⁴U ages of pyrite from the same samples to evaluate the accuracy and reproducibility of both methods. Along with this geochronological analysis, a petrographic examination of the samples will be conducted to determine mineral paragenesis as it is related to barite and pyrite. *[Oral presentation]*

You had me at "Reflector": interpretations of seismic data for the earliest formations in the Scotian Basin, Canada

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The Scotian Basin is a rifted continental margin that began forming in the late Triassic during the breakup of Pangea as the North American and African plates began to separate. Rifting created horsts and grabens which formed a series of depocenters, into which sediment could accumulate, bounded by intervening platforms. The first formation deposited was dominantly sandstone, shale, and siltstone of the Eurydice Formation. Directly overlying the Eurydice Formation is the Argo Formation, which is dominated by halite units and lesser anhydrite evaporite units. These formations represent an underexplored potential reservoir for petroleum systems in the petroleum rich Scotian Basin. The purpose of this project is to investigate these earliest Mesozoic (Eurydice and Argo formations) as potential reservoirs in terms of depocenter connectivity early in the basin history using interpretations of 2D seismic data, and through that gain a better understanding of initial basin architecture from which basin petroleum system elements evolved. The ultimate objective for this project is to produce a 3D model of basin geometry and connectivity between the Mohican Graben Complex and the Shelburne sub-basin. *[Oral presentation]*

Aspects of morphology, taphonomy and growth orientation of *Charnia* sp. from Sword Point, Conception Bay, Little Catalina and Catalina, Newfoundland, Canada

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Animal-like lifeforms from the Ediacaran period (ca. 635–541Ma) have been preserved as impressions in sedimentary rocks from the Avalon and Bonavista peninsulas of Newfoundland. These lifeforms are better known as the Ediacaran macrobiota and are some of the earliest multicellular life preserved on Earth. *Charnia* is a well-known Ediacaran macrofossil which is a member of the extinct clade, Rangeomorpha: a group of sessile, epibenthic organisms that occupied deep marine environments in the Ediacaran period. The purpose of this study is to describe *Charnia* fossils in their sedimentological context as well as focusing on morphometrically quantifying and explaining asymmetric, tumbled, and disrupted specimens. A number of *Charnia* specimens were photographed at several localities to digitally measure length, width, and orientation, using the program imageJ. Sedimentary structures indicating a paleocurrent were observed and noted where possible to

analyze fossil orientation with respect to current direction, and several casts were made from well preserved specimens to observe morphological aspects and further understand taphonomy. Further investigation into the morphology, taphonomy, and growth orientation of *Charnia* will help reveal an accurate depiction of this early animal-like lifeform, which can help us further understand animal evolution. *[Oral presentation]*

Composition and origin of xenocrysts in the Eastern Shore lamprophyre dykes, Nova Scotia, Canada

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The Eastern Shore dykes are a swarm of lamprophyric dykes in the Sheet Harbour area of eastern Nova Scotia. Two of the dykes, Pleasant Harbour–Borgles Island and Popes Harbour, contain a huge number of exotic xenoliths and xenocrysts, at least some of which were derived from the deep crust. Hence, they may provide insights about the composition of the deeper crust under the Meguma terrane. Although the xenoliths have been studied previously, no studies have been reported on the xenocrysts, and hence this study was undertaken to determine the petrological characteristics of the xenocrysts, including possible connection to the orogenic gold deposits of the Meguma terrane. Twenty-three samples from the dykes collected by previous workers were examined for xenocrysts, from which one sample each from the Borgles Island and Pleasant Harbour dykes was selected for detailed study, based on the abundance and variety of xenocrysts seen in hand specimen. About twenty thin section-sized chips were cut from those samples, and 14 chips with abundant xenocrysts were made into polished sections and used for major and trace element analysis by electron microprobe and LA-ICP-MS. Based on the petrographic evidence, the xenocrysts are subdivided into three groups: (1) small silicate xenocrysts, including quartz, K-feldspar, garnet, and kyanite, all with reaction rims; (2) large silicate xenocrysts; and (3) sulphide xenocrysts. The sulphide xenocrysts are pyrite, with small inclusions of chalcopyrite. The silicate xenocrysts may have been derived from disaggregated xenoliths in which similar minerals have been reported. However, the origin of the large silicate and sulphide xenocrysts remains uncertain. *[Oral presentation]*

Late Quaternary geochronology and stratigraphy of St. Anns Basin, offshore Nova Scotia, Canada

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St. Anns Basin is a Quaternary offshore intrashelf basin located southeast of Cape Breton Island, Nova Scotia. The eastern Scotian Shelf remains a poorly understood area due to its complex physiography and late glacial history. St. Anns Basin has a high frequency of widely distributed mass-failures, yet a complete chronology for the deglacial sediment record has not been developed to date these deposits. Here, we present preliminary results that utilize an archival sediment core of a glaciomarine sediment package on the eastern margin of the basin to revise the St. Anns Basin sediment chronology using radiocarbon dating of benthic foraminifera and shell fragments. The sediment core contains suspected brick red mud layers associated with major deglacial ice-calving events that have been precisely dated in the nearby Laurentian Channel. An updated lithostratigraphic section alongside existing biostratigraphic interpretations will be used to provide a framework for the deglacial chronology of the basin. Additionally, the updated chronology enhances the understanding of the seismostratigraphic framework of the St. Anns Basin. These data will collectively be used to interpret if mass failures found throughout the basin are contemporaneous, possibly constituting a seismically induced event and constraining an assessment of modern geohazard risk in the basin. The revision of the chronology of sediments in St. Anns Basin could also further constrain the timing of shelf-ice cover on the eastern Scotian Shelf. *[Oral presentation]*

Microplastic in beach sediment from Mary's Point, Shepody National Wildlife Area, southeast New Brunswick, Canada*

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The Shepody National Wildlife Area (NWA) hosts 50–95% of the world's Semipalmated Sandpiper population

during their >3000 km migration south. The sandpipers rest and feed on a variety of biota, including mud shrimp, other crustacea, molluscs, worms, biofilms, etc., that live on and in the NWA's inter-tidal mudflats backed by sand and gravel beaches. Plastic waste is now widely documented as polluting these environments, where it often breaks down into particles of <1 mm size (microplastic), becoming difficult to collect and remove, while becoming more available for ingestion by biota in the sediment and eventually accumulating progressively up the food chain, potentially in humans or sandpipers. Previous studies investigating the microplastic fraction have focused on the readily visible, surficial sediment (<5 cm depth), disregarding the processes active in sediment that may mix the vertical sediment column, distributing the plastic to a greater depth. This initial study aims to investigate microplastic distribution across and vertically within a sandy beach section at Mary's Point, using a sediment corer. Samples are analyzed in 4 cm depth increments, with microplastics separated and compositionally classified for each increment via a novel procedure using low-cost, non-toxic chemicals: four density separations, involving solutions with increasing densities (fresh water, saline water, and low and high concentration NaH₂PO₄ solutions), followed by an oleophilic separation. Separated microplastics were then further analyzed by microscopy to determine size, shape, colour, and degradation; compositions were validated using Raman Spectroscopy. Preliminary results indicate clear and blue fibres (from fishing gear, potentially) dominate. *[Oral presentation]*

***Winner of the Science Atlantic Presentation and Communication Award for best overall presentation**

Long-term changes in the Nain landfast sea-ice edge, Labrador, Canada

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Since 1971, the Arctic has warmed three times faster than the rest of the world. This warming has led to drastic changes in land and sea-ice environments that are particularly challenging for northern sub-Arctic coastal communities. Sea ice loss due to accelerated Arctic warming is jeopardizing important habitats for ice-dwelling life, as well as areas that have been used for fishing, hunting, and gathering for millennia by the Dorset, Thule, and Inuit cultures. Changing

sea-ice conditions also impact the abundance and diversity of algal communities that form the basis of the marine food web. Many algae, such as dinoflagellates, produce robust resting cysts that are preserved in marine sediments. By analyzing these and other palynomorphs alongside other biogenic proxy indicators and geochemical signals preserved in marine sediment cores, past trends in primary production and sea-ice conditions can be inferred. Understanding past responses to climate fluctuations can provide critical insights into understanding current trends and predicting future changes to primary production and the local environment. Using standard palynological methods this project aims to analyze two gravity cores (7 cm diameter) collected in the Nain area (Nunatsiavut), one located within and the other outside of the present-day landfast sea-ice edge. Each core is approximately 60 cm long, allowing for a comparison of the observed changes in each respective environment. The data resulting from this project will contribute to a larger research program, combining other zooarchaeological and collective knowledge to better understand climate-induced changes in the coastal ecosystem of Nain. *[Oral presentation]*

Pyrite paragenesis and relation to gold-bearing fluid phases in the Lone Star deposit, Yukon Territory, Canada

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The Klondike region of the Yukon Territory, Canada, is famous for extensive placer deposits, recovering over 20 million oz since discovery, but lacks any major defined bedrock resources. As a result of a surge in exploration activity, recent drilling efforts have delineated several new bedrock targets, including the Lone Star deposit near Dawson City, Yukon. The Lone Star deposit is hosted by a suite of Late Permian plutonic, volcanic, and sedimentary units known as the Klondike Assemblage. This assemblage formed as a result of subduction-related arc-magmatism, followed by Late Permian–Early Triassic regional greenschist-amphibolite facies metamorphism during accretion onto Laurentia as part of the Yukon–Tanana terrane. Gold deposition is thought to be middle–late Jurassic, mainly occurring within discordant quartz veins with common pyrite mineralization but overall low sulfidation (galena, sphalerite, chalcopyrite, etc. only trace). This study will add to the overall understanding of the Lone Star deposit by establishing relations between pyrite paragenesis and gold mineralization. This will be done through detailed examination of a suite of ten samples, selected based on

differences in pyrite occurrence. Textural relations will be determined using reflected light microscopy and SEM on polished mounts. Following this, samples will be analyzed for major and minor elements by electron microprobe and LA-ICP-MS will be used to measure the 2D distribution of trace chalcophile elements. Correlations between texture type and element distributions will be used to determine if there were discrete pyrite-forming events, and whether these events can be related to the influx of gold-bearing fluids. *[Oral presentation]*

How to measure changes in topography without eroding an undergraduate research budget

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Quick, efficient, and affordable monitoring of coastal surface erosion is an ongoing challenge for scientists and stakeholders. The current standard, aerial LiDAR surveying, can yield precise surface elevations, even through dense foliage. However, LiDAR surveying is expensive and inaccessible to researchers on a tight budget. Additionally, LiDAR surveying does not collect data on complex steep intertidal and subtidal surfaces with caves or indentations that significantly change through time. In contrast, ground-based technicians can collect photographs from multiple angles to create nuanced, coloured photogrammetry clouds with high temporal frequency. However, stakeholders are unable to pin their photogrammetry clouds to accurate coordinates on a map because consumer GPS accuracy is relatively low. This project provides an opportunity for consumer products and open-source software to be tested with the ultimate goal of decreasing the barrier of entry. Merging GeoNova's open coastal elevation LiDAR point cloud to drone or action camera photo-clouds combines the strength of both techniques described above. This work necessitates an evaluation of point cloud similarity which can be done with the open-source software, Cloud Compare. The methodology of creating photogrammetry point clouds, merging point-clouds with LiDAR data, and overcoming challenges is here described. The area of study is at Kingsport Beach, an area of relatively constant topographic change in short amounts of time. *[Oral presentation]*

Sustainable gold mining: replacing gold mining with novel ionic thiourea ligands for gold extraction

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Cyanidation has been the most widely applied gold extraction method world-wide for over a century. Unfortunately, there have been many accidental releases of toxic cyanide, which have resulted in extensive damage to the environment and surrounding communities. Due to this, various alternatives are being explored in efforts to replace cyanidation but have yet to be implemented due to the high material costs and infrastructure changes that would be needed. The current project is working to develop an alternative to cyanidation using novel ionic thiourea derivatives, which can selectively extract gold and silver. Two imidazolium salts have been functionalized with a thiourea group and a dodecyl sulfate [DS]⁻ anion. Up to 98% extraction of gold(III) from a model leachate solution has been achieved reproducibly to date and future efforts are being made to develop a method of extraction from raw gold-containing ore. *[Poster presentation]*

Petrology and metamorphism of the 'Bright-eyed' Gneiss, Grand Teton, Grand Teton National Park, Wyoming, USA

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The Archean southern Teton range, Wyoming, hosts a unique 'bright-eyed gneiss' unit exposed in Death Canyon, Grand Teton National Park. These rocks are biotite orthogneisses with magnetite (Fe³⁺2Fe²⁺O₄) porphyroclasts surrounded by lenticular quartzofeldspathic pods. The major minerals are biotite, alkali feldspar, plagioclase, quartz, magnetite, ilmenite and titanite. The accessory minerals are apatite, allanite, some sulfides, and small zircon grains. Evidence suggests that these rocks underwent low degrees of partial melting at amphibolite-facies conditions as recorded by melt pseudomorph microtextures. A variety of analytical techniques were applied to eleven hand samples. These include μXRF mapping, SEM backscattered imagery, optical microscopy, and X-ray CT to obtain central cuts through the magnetite grains. Hypotheses to be tested are whether

the rocks formed in an open system involving water-fluxed biotite dehydration melting. Another key step in this experiment is to determine the role of original oxidation of possible protoliths for these gneisses including tonalite-granodiorite. EPMA chemical analyses and laser ablation will also be used in tandem to examine mineral zoning and develop a reaction model to help explain how these rocks formed. The significance of this project is to determine the relative ages of the rock, whether it was metamorphic or magmatic in origin. Therefore, this project will be crucial to understanding the Archean rocks in the Grand Teton, and most importantly, the formation of the 'magnetite eyes'. *[Oral presentation]*

Survey of porewater geochemistry within deep marine hydrocarbon seep sediments of the Scotian Slope, Canada*

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The ocean floor surface sediments of the Scotian Slope, Nova Scotia, are host to a complex network of microbially mediated reactions that knit together the various biogeochemical cycles. Limited diffusion between the upper water column and ocean floor mud pore spaces, coupled with competitive microbial ecological niche partitioning, leads to the formation of biogeochemically controlled redox gradients. These microbial biogeochemical zones change if surface sediments are impregnated by hydrocarbon seepage that migrates up from deeper within the basin. Porewater profiles of F⁻, NO²⁻, NO³⁻, CO₃²⁻ and SO₄²⁻ were used to reconstruct biogeochemical stratification depth profiles that can provide comparative evidence for anion behaviour in active cold seep sites. A comparative study between two methods of data analysis was applied to the samples. The method of standard addition proved to be a better method than the external calibration curve method to measure porewater anion concentrations of natural samples with complex matrices and a varying range of concentrations. For this reason, porewater anion concentrations were compared using the standard addition method. Sulfate concentration decreases dramatically in both ambient and hydrocarbon impacted marine benthic sediments although, in hydrocarbon impacted sites, it appears to occur at a much shallower depth, suggesting that the redox gradient is much

more pronounced and as much sulfate reduction has not yet transpired with the ambient sediments at the same depth. Nitrate and NO²⁻ trends also show similar pronounced reduction patterns occurring at shallower depths for hydrocarbon impacted sediments suggesting widespread increased microbial and bacterial activity in these regions. *[Poster presentation]*

***Winner of the Canadian Society of Petroleum Geologists Award for the best petroleum geology-related presentation**

Zircon petrochronology of the West Barneys River Plutonic Suite: insights into the origin of a potential critical element (REE and Zn) deposit in Nova Scotia, Canada

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The transition to a green-energy future requires a significant increase in the supply of critical elements. Therefore, it is essential that we advance our knowledge of the processes that concentrate these elements. Of the 31 elements that Canada has deemed to be critical, many of them can be concentrated by igneous rock-forming processes. For example, rare earth elements (REE) are known to be concentrated by magmatic processes associated with the emplacement of alkaline to peralkaline igneous rocks. This research focuses on the West Barneys River Plutonic Suite (WBRPS) in Nova Scotia, which has elevated concentrations of both REE and Zn. The WBRPS is a complex, heterogeneous mix of coeval plutonic lithologies ranging in composition from mafic to felsic. Published U–Pb data indicates a range of crystallization ages between ca. 495 and 460 Ma; however, many knowledge gaps remain related to the origin of these rocks and the associated REE and Zn mineralization. Ten representative samples were collected from the WBRPS that range in composition from gabbro to quartz syenite. Of those, seven samples yielded dateable zircon, with preliminary interpretations of LA-ICP-MS U–Pb data yielding a crystallization age range between ca. 465 and 430 Ma. Zircon trace element and hafnium isotope data were also collected and will be analyzed to determine the magmatic processes and magma source(s) involved in the generation of the plutonic suite. These new petrochronological data and interpretations will help to better understand the petrogenesis of the WBRPS and the processes that concentrated the REE and Zn. *[Oral presentation]*

Machine-learning focal mechanism inversion for hydraulic fracking- induced earthquakes*

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Hydraulic fracking has contributed to an increase in induced seismicity in recent years in Fox Creek, Alberta. Earthquake focal mechanisms, relying on polarities of earthquake first motions, provide insight into the state of stresses in a region. Traditional methods for manually determining the polarities of first motions are not suitable for microearthquakes due to the large volume of data and owing to their low signal-noise ratio. Machine learning provides a reliable and efficient way for polarity classification. Using data obtained from the Tony Creek Dual Microseismic Experiment, this study aims to show that machine learning can reliably solve for polarities of earthquake first motions and characterize the focal mechanisms of hydraulic fracking-induced earthquakes. The project will provide greater insights into the state of stresses and geologic structures (such as faults) in the study area and will improve our understanding of earthquake-triggering mechanisms during hydraulic fracking. In this presentation, we are going to introduce the seismic data, proposed methods, and preliminary results. *[Poster presentation]*

***Winner of the Canadian Society of Exploration Geophysics Award for best presentation of a geophysics-related paper**

Coastal erosion study on the Flats Road property in Conception Bay South, Newfoundland, Canada

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This study focuses on the sensitivity of the Newfoundland coastline to erosion, specifically surrounding the beach located at the end of Flats Road in Conception Bay South, Newfoundland. In this study, various geophysical instruments from the Memorial University equipment pool can be used to locate the bedrock or any other subsurface features that will affect the erosion rate in the area. Thus far, a ground-penetrating radar (GPR) survey, a real-time kinematic positioning survey (RTK), and a direct current

resistivity survey (DCR) have been conducted. This research aims to locate the bedrock or subsurface properties that will affect the rate of erosion happening on the land located at the end of Flats Road in Conception Bay. This information is directly proportional to the effects of climate change on the province of Newfoundland. Currently, the average coastal erosion rate for the region is approximately 20 cm/yr. This number will increase with the rise of climate change and sea levels, as the volume of water increases in the oceans, the speed and strength of coastal erosion grows. Post-glacial rebound in Newfoundland varies from coast to coast. The west coast is rising and the east coast, although no precise numbers are known, is generally sinking slowly with respect to the Earth's center. High winds, hurricanes, and storm surges are all factors that result in the shrinking coastline. This project is going to research the rate of erosion and how changing climate affects it. *[Poster presentation]*

Dating fault motion at the northern Appalachian structural front, western Newfoundland, Canada

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The Appalachians formed during Cambrian through Devonian orogenesis, as a result of multiple microcontinent and terrane accretions which occurred as the Iapetus Ocean episodically closed. In western Newfoundland, folds and faults that formed during the Taconian and Acadian orogenies are preserved. The limit of deformation, or Appalachian structural front, extends along Newfoundland's west coast. This front is defined by a structural triangle zone, the upper detachment of which is marked by the Tea Cove Thrust, a back-thrust that only outcrops in one location on the Port au Port Peninsula, our study area. Timing of motion along the structural front is constrained as Devonian through Viséan using structural and stratigraphic relationships largely observed in seismic records. However, previous work suggests that earlier Ordovician (Taconian) movement is likely. Observations and data collected during fieldwork suggest that significant structures associated with the structural front, outcropping along the Port au Port Peninsula, have been reactivated. Faults parallel to the Tea Cove Thrust preserve two generations of motion:

NW-directed and SE-directed. Later, cross-cutting NW-directed faults with an orientation consistent with post-Taconian basement faults are present too. These cross-cutting and kinematic relationships, combined with data we aim to collect using in-situ dating of calcite slicken-fibres and mica using U-Pb and Rb/Sr by LA-ICP-MS, respectively, will allow us to determine an absolute age of generation and reactivation of faults defining the structural front. New data will also provide information to petroleum models for active exploration in the region, whereby structures at the structural front are demonstrated petroleum traps. *[Oral presentation]*

Mineralogy and corundum trace element composition at the Hopedale "ruby" occurrence, Labrador, Canada: comparison to till-hosted pink corundum

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In the Hopedale Block, Labrador, pink to reddish-purple corundum occurs in gneiss and has also been found as pink detrital grains (0.25–0.50 mm) in till. The till-hosted corundum grains occur 28 km west of the hard rock occurrence; however, the ice flow direction is to the east. This indicates that at least two reddish corundum ("ruby") localities occur in this region, and are separated by a vast distance, making the region attractive to ruby exploration. The hard-rock corundum occurrence consists of weakly foliated corundum-biotite-plagioclase gneiss containing accessory rutile, pyrrhotite, pentlandite, and zircon as well as trace galena, titanite, Bi-Ag telluride, and thortveitite (a rare Sc silicate). Corundum occurs as ~10 mm to ~70 mm porphyroblasts with cross-hatched twinning within a finer-grained matrix of corundum, biotite, and plagioclase (An₅₀). Both corundum from the outcrop and the till show minor amounts of diasporite retrograde alteration along fractures. This study will compare the mineral associations and corundum trace element composition in the till-hosted grains with those at the gneiss-hosted occurrence to determine whether they come from geologically similar sources. *[Poster presentation]*

The impacts of historical gold mining on chironomid assemblages in Lake Thomas, Nova Scotia, Canada

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Gold mining operations were one of the predominant economic activities in Nova Scotia between the late 19th and early 20th centuries. The Waverley gold mine district was active from 1862 to 1940 and mine tailings produced were transported into the local environment that contributed to the pollution of the Shubenacadie Canal drainage basin. In this study, we used paleolimnological approaches to understand the long-term ecological effects of historical gold mining operations on Lake Thomas. Concentrations of mining-related contaminants (arsenic and mercury) were measured from a dated sediment core to track pollution history and subfossil chironomid remains were analyzed to examine biological effects. Sedimentary arsenic and mercury levels were low prior to gold mining activities; however, during the mining era concentrations of both elements increased. Sedimentary arsenic and mercury levels reached concentrations of 980 ppm (dry weight) and 31 400 ppb (dry weight), respectively. Arsenic and mercury levels have decreased in the most recent sediments but continue to be higher than national sediment quality guidelines, arsenic levels are 58× and mercury 65× higher than national guidelines. Notable declines in the number of chironomid head capsules per gram of dry sediments during the mining era suggest biological impacts. Although the Waverley gold mine was closed eight decades ago, elevated contaminant levels may still be affecting aquatic biota. This research contributes to the growing number of environmental assessments that are aiming to understand the long-term ecological consequences of past gold mining operations on aquatic ecosystems. [Poster presentation]

Mineralogy of the Boundary volcanogenic massive sulfide (VMS) deposit of the Tally Pond Group, Victoria Lake Supergroup, Newfoundland Appalachians, Canada*

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The Cambrian Boundary volcanogenic massive sulfide (VMS) deposit is in the Victoria Lake Supergroup in the Newfoundland Appalachians, Canada. The deposit is hosted within chlorite-sericite-quartz–altered rhyolite lapilli tuff and represents one of the best preserved seafloor-replacement-style VMS deposits globally. The purpose of this study is to provide insights into the mineralogical evolution of the replacement style mineralization in the North Zone of the Boundary deposit using mineral textures, paragenesis, and reflected light microscopy, scanning electron microscopy (SEM), and electron probe microanalysis (EPMA). Initial textural results show that the Boundary deposit is dominated by an assemblage of pyrite, sphalerite, chalcopyrite, galena, and pyrrhotite. Pyrite is the dominant sulfide, displaying many textures disseminated, the latter occurring as sulfide stringers. Pyrrhotite is present as small inclusions in pyrite intergrown with chalcopyrite. Sphalerite is present in majority of the mineral facies, but its abundance varies from disseminated, massive, and sulfide stringers; sphalerite also locally exhibits chalcopyrite disease. Galena occurs as irregular grains commonly intergrown with sphalerite and pyrite. SEM and EPMA work are ongoing. [Oral presentation]

*Winner of the Frank S. Shea Memorial Award for best economic geology-related presentation

On the discovery of fossil land snails (*Dendropupa* sp) from the Minto Formation of central New Brunswick, Canada

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The Pennsylvanian (late Bashkirian–early Moscovian) Minto Formation of central New Brunswick was previously studied for its diverse paleofloral, rare invertebrate fauna (*trigonotarbid*), and rare disarticulated vertebrate fauna. The Minto Formation has been interpreted as a peat-forming wetland that experienced occasional euryhaline influence within back-barrier or delta front depositional settings. A recently discovered fossil locality situated along the southern shoreline of Grand Lake yields a diverse array of plant fossils, tetrapod and invertebrate footprints, and invertebrate body fossils from the Sunbury Creek Member of the middle to upper Minto Formation. Recent work has described a new Carboniferous stem dragonfly (*Brunellopteron norradi*) and a new specimen of the tetrapod footprints *Batrachichnus*, the latter with new tracemaker interpretations. Here we describe two new terrestrial gastropod (pupa) shells (NBMG 21521) that broadly conform to the Carboniferous land snail *Dendropupa*, with a similar apex and post-apical whorls. However, the Minto Formation pupa differ from *Dendropupa* by possessing axial (longitudinal) sculpture on the shell. *Dendropupa* exhibits an axial lirae along its shell that is not preserved in the Minto Formation specimens. Both Minto Formation specimens exhibit the same morphology but differ in size, suggesting one is an adult and one a juvenile. The diminutive size of the shells suggests that they may represent the smallest known Carboniferous land snails in the fossil record. The two shells are associated with invertebrate ichnofossils (*Gordia*, *Helminthoidichnites*, and cf. *Helminthopsis*) that are of similar width, implying a trace and trace-maker relationship, and broadening the tracemaker interpretations for those ichnogenera. [Oral presentation]

Documenting recent human influences using remote sensing techniques on the Tekes River alluvial fan, Xinjiang, China*

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The Tekes River alluvial fan is in Xinjiang Province which has an arid to semi-arid climate as well as a historically unpredictable precipitation rate. Further, increasing population and urbanization means that all water resources must be used efficiently. The Tekes River alluvial fan has had a vast amount of human influence in recent decades in the form of dam construction, irrigation, and agriculture expansion. Although development on and surrounding the Tekes River alluvial fan is apparent, there is a lack of

research on how these human impacts have affected the fan. The primary objective of this project is to use remotely sensed image analysis to document the human influence that has occurred to the Tekes River alluvial fan. A 31-year time series (1990–2021) was created using Landsat imagery from 1990–2021. The results have found that four dams have been constructed upstream from the fan, irrigation canal length had increased by approximately 400 km, and agricultural fields had increased by approximately 250 km². Average seasonal NDVI values were calculated on agricultural fields and compared to natural vegetation in the area for seven dates in 2021. The results do not show great observable differences between agricultural field and natural vegetation cover. However, these results are limited temporally and spatially. Further research should continue to document and test NDVI as well as consider measuring groundwater levels to build upon this research and provide a greater understanding of the anthropogenic impacts on the fan. [Poster presentation]

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Methane flux, source, and lipid biomarkers of serpentinite-hosted groundwater springs at contrasting sites of terrestrial serpentinization*

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Serpentinization sites are a point of recent scientific interest because of their implications toward primitive microbial metabolisms and astrobiological exploration. Serpentinization occurs when circulating groundwater hydrates ultramafic rocks, a reaction that is common in submarine environments and on land at ophiolite complexes. Three sites of terrestrial serpentinization were studied through their groundwater springs, which act as windows into the subsurface with respect to geochemistry and microbial activity. Serpentinization causes groundwater springs with unique parameters including ultra-basic pH levels (>10), low redox values, and methane and hydrogen gas enrichment. The Tablelands (Newfoundland, Canada), The Cedars (California, USA), and Aqua de Ney (California, USA), produce groundwater springs which act as endmembers, displaying a range of values with respect to the above properties. These sites have been extensively studied in the past and changes have been observed over the last

decade, proving it imperative to characterize these changes and interpret the temporal variations in these systems, made possible through the present comparison. Through past research it has been determined that the source of methane gas is different at each of the sites, but the flux of methane gas had not been quantified. This study intends to relate the methane flux to their source, aqueous geochemistry, and lipid biosignatures. Through gas chromatography and mass spectrometry, this study contributes to the knowledge around what microbial life consumes, what it produces, and how these things are preserved in terrestrial serpentinization systems. *[Oral presentation]*

***Winner of the Atlantic Geoscience Society Environmental Geoscience Award for the best Environmental Science-related presentation**