# 2019 Ottawa-Carleton Student Northern Research Symposium

**March 15th, 2019**

**Dunton Tower room 2017, Carleton University**

**Overview:** The OCSNRS is an annual, one-day symposium for Ottawa-Carleton students to present their northern research to peers, gain valuable feedback, and network. The 2019 symposium will feature 18 oral presentations divided into the following themed sessions; Ground and Surface Field Measurements in the Arctic, Indigenous Knowledge and Community Based Research, Assessing Changes in the Arctic Environment Using Satellite Imagery, and Anthropogenic Impacts/Disturbances in the North.

**Location**

Dunton Tower, room 2017, Carleton University.

Dunton Tower is located on Carleton University campus (1125 Colonel By Dr, Ottawa, ON K1S 5B6). Carleton University can be reached by public transport. Please refer to this link for personalized directions from your starting location. There are also a number of paid parking lots on campus. Campus maps are located throughout campus to assist your navigation to your destination building. The campus maps can also be found online as can personalized walking directions to Dunton Tower based on your starting location.


**Organizing committee**

William Twardek – Carleton University

Emmelie Paquette – Carleton University

Ada Loewen – Carleton University

Jacqueline Chapman – Carleton University

# 2019 Ottawa-Carleton Student Northern Research Symposium

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| 08:15-09:00 | Registration | | |
| 09:00-09:10 | Land Acknowledgement | Barbara Dumont-Hill | Kitigan Zibi Anishinabeg |
| 09:10-09:20 | Opening Remarks - William Twardek & Dr. Chris Burn | | |
| 09:20-09:50 | Keynote presentation - Inuit Self-Determination in Research: Implementing the National Inuit Strategy on Research | Anita Kora | Inuit Tapiriit Kanatami |
| 09:50-10:00 | **Break** | | |
| **Oral Presentations Session 1** | **Ground and Surface Field Measurements in the Arctic** | | |
| Chair: William Twardek | | | |
| 10:00-10:15 | Upper mantle structure beaneath the diamondiferous Central Slave craton, Canada, from Teleseismic Body Wave Tomography | Clément Estève | University of Ottawa |
| 10:15-10:30 | Sm-Nd Isotopic Composition of Mantle-Derived Rocks from the Saglek-Hebron Gneiss Complex, Northern Labrador | Janick Flageole | University of Ottawa |
| 10:30-10:45 | A new novel technique for sampling soil 12CO2 as a tracer for hydrocarbon biodegration in permafrost climates | Lindsay Reynolds | University of Ottawa |
| 10:45-11:00 | Frost, fire, and flora: impacts of surface change on discontinuous permafrost near Nain and Postville, Nunatsiavut | Yifeng Wang | University of Ottawa |
| 11:00-11:15 | Field and laboratory investigations of electrical resistivity-temperature relationships, Southern NWT | Jean Holloway | University of Ottawa |
| 11:15-11:30 | **Break** | | |
| **Oral Presentations Session 2** | **Indigenous Knowledge and Community Based Research** | | |
| Chair: Jacqueline Chapman | | | |
| 11:30-11:45 | People, Plants and Culture in the Southern Canadian Arctic: A systematic review of Indigenous knowledge perceptions, considerations and communications | Lauren Watts | Carleton University |
| 11:45-12:00 | On-the-land with communities in the NWT | Stephanie Woodworth | University of Ottawa |
| 12:00-12:15 | Potential impacts of sea ice and ship traffic changes on caribou migratory routes surrounding King William Island, Nunavut | Emmelie Paquette | Carleton University |
| 12:15-12:30 | Temporal and spatial trends of marine tourism in the Canadian Arctic | Melissa Weber | University of Ottawa |
| 12:30-13:30 | **Lunch and Poster Presentations** | | |

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| **Oral Presentations Session 3** | **Assessing Changes in the Arctic Environment Using Satellite Imagery** | | |
| Chair: Ada Loewen | | | |
| 13:30-13:45 | Landscape changes in Tombstone Territorial Park (Central Yukon) from Tasseled Cap trend analysis of Landsat stack | Rosanne Frappier | University of Ottawa |
| 13:45-14:00 | Small glacier changes over the past 50 years in the Canadian High Arctic | Braden Smeda | University of Ottawa |
| 14:00-14:15 | Investigation of grounding line dynamics and thinning of Milne Glacier, Nunavut using in-situ and satellite data | Yulia Antropova | Carleton University |
| 14:15-14:30 | Tracing icebergs in Baffin Bay from source to sink | Abigail Dalton | University of Ottawa |
| 14:30-14:45 | **Break** | | |
| **Oral Presentations Session 4** | **Anthropogenic Impacts/Disturbances in the North** | | |
| Chair: Emmelie Paquette | | | |
| 14:45-15:00 | Sedimentomics: What is it? And how can it be applied to the Canadian Arctic treeline? | Madison Bell | University of Ottawa |
| 15:00-15:15 | Arsenic species in freshwater food webs near large gold mining operations in Yellowknife, NWT | Claudia Tanamal | University of Ottawa |
| 15:15-15:30 | Examining the potential impact of increased vessel traffic noise on marine mammals in the proposed Tallurutiup Imanga (Lancaster Sound) National Marine Conservation Area | Zuzanna Kochanowicz | University of Ottawa |
| 15:30-15:45 | The implications of climate change for polar bear tourism in Churchill, Canada | Jamie D'Souza | University of Ottawa |
| 15:45-16:00 | Country food valuation, securing indigenous food sovereignty in Denedeh NWT | Molly Stollmeyer | Carleton University |
| 16:00-16:10 | Photo Exhibition and Last Chance to View Posters | | |
| 16:10-16:20 | Closing Remarks | | |
| 16:20-19:00 | Informal Discussion and Beverages at Mike's Place | | |
| **Poster Presentations** | | | |
| | Lu-Hf age of rocks from the Saglek-Hebron Gneiss Complex (Northern Labrador) | Andreane Mitchell-Dupuis | Carleton University |
| | 142Nd study of mantle-derived rocks from the Saglek-Hebron Gneiss Complex | Alexandre Rouleau | University of Ottawa |
| | Ice wedge activity and biogeochemistry in the Eureka Sound Lowlands, Nunavut, Canada | Kethra Campbell-Heaton | University of Ottawa |
| | Food security from a local perspective: elder and youth perspectives in Gjoa Haven, Nunavut | Jacqueline Chapman | Carleton University |
| | Harvest Study: Harvest trip patterns in Gjoa Haven | Jacqueline Chapman | Carleton University |
| | Exploring the world’s longest Chinook Salmon migration in the Upper Yukon River | William Twardek | Carleton University |

**Ice Wedge Activity and Biogeochemistry in the Eureka Sound Lowlands, Nunavut, Canada.**

Kethra Campbell-Heaton & Denis Lacelle

University of Ottawa, Department of Geography, Environment and Geomatics, MSc, Supervisor: Denis Lacelle

Polygonal terrain underlain by ice-wedges (IW) are nearly ubiquitous to continuous permafrost areas and can occupy 20-35%$_{vol}$ of the ground ice in the upper few meters of permafrost (French, 2013). Although many studies have examined the factors that control IW cracking, their development and degradation, relatively few have explored IW activity in relation with past climate and vegetation conditions; those that did relied on the dating of particulate organic carbon (POC) material above the IW or enclosed it the ice itself. In the Eureka Sound region, IW occupy 5-65% of the permafrost terrain (Couture and Pollard, 1998; Ulrichh et al., 2014) and their recent degradation is leading to the growth of thaw slumps (Pollard et al., 2015). The objective of the study is to determine the formation and timing of ice wedge development on the Eureka Sound region and their biogeochemical composition. This objective is reached by: 1) describing the cryostratigraphy of sedimentary units exposed in the headwall of the slump (with emphasis on the quantification of ground ice content and the identification of unconformities in permafrost); 2) using δD-$\delta^{18}O$ measurements to determine the IW moisture source; 3) using $^{14}C$ measurements from dissolved organic carbon (DOC) to determine IW age; and 4) determining the IW's biogeochemical composition from major and trace ions and occluded $CO_2$-$CH_4$ gases. Preliminary results reveal an average gravimetric moisture content in the active layer of 14.1 ± 4.3% and an average $\delta^{13}C$ DOC of -25 ± 0.5‰. Surface water samples have average $\delta^{13}C$ DOC values lower than the active layer samples (-27.8 ± 1.1‰) and average $\delta^{13}C$ DIC (dissolved inorganic carbon) values of -3.1 ± 2.7‰. The results from this project will allow for the reconstruction of ice wedge activity over the Holocene and demonstrate the value ice wedges have as paleo-climate proxies.

**Landscape changes in Tombstone Territorial Park (Central Yukon) from Tasseled Cap trend analysis of Landsat stack**

Roxanne Frappier[1], Robert Fraser[2] and Denis Lacelle[3]

[1]Presenting author, PhD candidate, Department of Geography, Environment and Geomatics, University of Ottawa

[2]Canada Centre for Remote Sensing, Natural Resources Canada

[3]Supervisor, Department of Geography, Environment and Geomatics, University of Ottawa

The stability of permafrost is threatened by the ongoing climate warming, which is enhanced in the Arctic and Sub-Arctic. Degradation of ice-rich permafrost has important effects on terrestrial and freshwater ecosystems, impacting soil's hydrology, strength and vegetation cover. Determining regions that are sensitive to permafrost degradation therefore represents a major challenge for construction engineering, land managing, resource development, survival of certain species, and subsistence of aboriginal peoples. The Tombstone Territorial Park (TTP) located in the North Ogilvie Mountains, Central Yukon, represents one of those sensitive permafrost environment that needs to be monitored.

Remote sensing is an efficient first step into identifying broadscale landscape changes in the TTP area. A Tasseled Cap (TC) indices trend analysis was performed following the Landsat Arctic Rgb CHanges (LARCH) method (Fraser et al., 2014). 17 top-of-atmosphere reflectance Landsat 5 TM and Landsat 7 ETM+ images corresponding to the peak phenology period of single years between 1986 and 2017 were selected, preprocessed and masked for clouds and cloud shadows. The three TC indices (brightness, greenness, and wetness) were calculated. The TC indices were stacked in order to perform a pixel-based time series analysis. The output datasets containing the three TC indices trends (slopes) were composited into a RGB image which results in an image depicting the three-dimensional TC trajectory. The image resulting from the LARCH provides a visual representation of a variety of subtle and more sudden landscape changes, such as degradation of ice-wedge polygons, drainage of lakes, and earlier melt of icings.

**Sm-Nd Isotopic Composition of Mantle-Derived Rocks from the Saglek-Hebron Gneiss Complex, Northern Labrador**

J. Flageole[1], J. O'Neil[1] & H. Rizo[2].

[1]Department of Earth and Environmental Sciences, University of Ottawa

[2]Department of Earth Sciences, Carleton University

The Saglek-Hebron Gneiss Complex (SHC) located in Northern Labrador has recorded multiple magmatic events over more than 1 billion years, making it ideal to study the evolution of mantle-derived rocks through time. Here we present a $^{147}Sm$-$^{143}Nd$ isotopic study of the different generations of mantle-derived rocks in the SHC in order to constrain their age and the evolution of their mantle source. These include: 1) mafic metavolcanic rocks; 2) two groups of ultramafic rocks (a Fe-rich group enriched in incompatible elements and a more depleted group with lower Fe contents); 3) mafic metamorphosed Saglek dikes; and 4) undeformed mafic dikes. The mafic metavolcanic rocks combined with co-genetic low-Fe ultramafic rocks yield an age of 3819±190 Ma with an initial εNd= +2.3. The high-Fe ultramafic rocks yield a younger age of 3433±220 Ma with an initial εNd=+1.8. The Saglek dikes yield an age of 3565±120 Ma with an initial εNd= +1.7, while the undeformed mafic dikes yield an age of 2694±79 Ma with an initial εNd= +1.7. All generations of mantle-derived rocks yield positive initial εNd values, where only the Eoarchean rocks display isotopic composition similar to the depleted mantle. The Mesoarchean ultramafic rocks, Saglek dikes and Neoarchean mafic dikes display almost identical initial εNd values, despite an age difference of ~800 Ma suggesting the contribution of distinct mantle sources or, if all generations of mantle-derived rocks in the SHC were produced from the same mantle source, it evolved with a nearly chondritic Sm/Nd ratio for more than 1 billion years.

**Lu-Hf age of rocks from the Saglek-Hebron Gneiss Complex (Northern Labrador)**

Andréane Mitchell-Dupuis1, Hanika Rizo1, Jonathan O'Neil2

1Ottawa-Carleton Geoscience Centre, Department of Earth Sciences, Carleton University, Ottawa

2Ottawa-Carleton Geoscience Centre, Department of Earth and Environmental Sciences, University of Ottawa, Ottawa

The oldest rocks preserved at the Earth's surface help us understanding the time of formation of our planet's first crust. However, only few outcrops of crustal rocks older than 3.6 billion years (Ga) are still preserved on Earth. Moreover, these rocks are often affected by post emplacement processes such as metamorphism, making it difficult to unravel their geological history. The Saglek-Hebron Gneiss Complex (SHGC) located in Northern Labrador is one of the oldest terrains on Earth, offering the opportunity to study the formation the most ancient crust. It includes two supracrustal units, the Nulliak and Upernavik formations, respectively dated by the Sm-Nd method at 3.365±0.100 Ga and 3.782±0.093 Ga (Morino et al., 2017). Zircons from rocks interpreted as intruding the Nulliak formation have yielded an age of 3.920 Ga, which could represent the minimum age of the Nulliak unit (Shimojo et al., 2016). Here, we present a study of the $^{176}$Lu-$^{176}$Hf long-lived isotopic system to further constrain the age of the Nulliak metamorphosed basalts and ultramafic rocks. Preliminary results yielded a Lu-Hf age of 3.265±0.280 Ga for the Nulliak unit. This age is more than 500 million years younger than what was proposed. It could suggest that the Nulliak is younger than previously thought or alternatively, the Lu-Hf age could correspond to a metamorphic event that affected the region. In that case, the 3.2 Ga Sm-Nd age proposed for the Upernavik formation could also represent a metamorphic age rather than crystallization age, calling into question the presence of two distinct formations.

**Investigation of grounding line dynamics and thinning of Milne Glacier, Nunavut using in-situ and satellite data**

Yulia Antropova[1], Derek Mueller[1], Jill Rajewicz[1,2] and Achim Roth[3]

[1]MSc, Department of Geography and Environmental Studies, Carleton University, Ottawa, Ontario, Canada

[2]Nunavut Field Unit, Parks Canada, Iqaluit, Nunavut

[3]German Aerospace Center, Wessling, Germany

MSc supervisor: Dr. Derek Mueller

The most pronounced mass loss in marine terminating glaciers is where ice is in direct contact with warming water masses. The grounding line where glaciers transition from grounded to floating is particularly susceptible to changes. Grounding line retreat is a good indicator of ice thickness reduction due to increased ice melt or dynamic thinning associated with enhanced ice discharge.

Milne Glacier located on Ellesmere Island, Nunavut, is prone to marine ice sheet instability and it will likely retreat rapidly in the coming decades. In order to better understand and predict these processes, the location of the current grounding line and the glacier's thinning rate need to be determined. The objectives of my M.Sc. research are to (1) delineate the position of the Milne Glacier grounding line, (2) examine the thinning of Milne Glacier since the 1980s, and (3) analyze the recent ice dynamics at the Milne Glacier grounding line. To meet these objectives, the Milne Glacier grounding line position is being mapped using spaceborne synthetic aperture radar (SAR) data. Ice-penetrating radar (IPR) data collected in summer of 2016 and 2018 are used to validate the position of the grounding line and retrieve ice thickness. Airborne radar data collected in the 1980s will be compared to the IPR field data collected in 2016 and 2018. Recent ice dynamics will be assessed at the Milne Glacier grounding line using tidal and GPS data collected in the field. The preliminary results of mapping of the Milne Glacier grounding line position using SAR and IPR data will be presented.

**The implications of climate change for polar bear tourism in Churchill Canada**

Jamie D'Souza*, Jackie Dawson

Department of Geography, Environment and Geomatics & Environment, Society and Policy Group, University of Ottawa

*Presenting Author, MA Candidate supervised by Dr. Jackie Dawson

The decline of polar bear populations, due in part to climate change, is thought to have led to an increase in the volume of tourists visiting the Arctic to view them. The irony of the increase in demand for polar bear viewing experiences is that air travel to remote Arctic locations where polar bears can easily be seen, causes an intensification of greenhouse gas (GHG) emissions, which directly contributes to climate change and indirectly impacts polar bear health. Churchill, Manitoba, Canada, a location often referred to as 'the polar bear capital of the world', attracts thousands of polar bear viewing tourists annually. This study presents the results of a tourist survey conducted in Churchill, Manitoba during the 2018 viewing season (October 17- November 17). The objectives of the study included to: 1) calculate the total greenhouse gas emissions from the polar bear viewing industry; and 2) identify polar bear viewing tourists' travel habits; attitudes and knowledge about climate change; willingness to modify their travel behavior in response to the long-term implications of climate change; and understanding of how their environmental impacts might be reduced. Project results were analyzed to determine what strategies tourism industries can implement to reduce carbon emissions while continuing to provide visitor experiences. These strategies include educational programs and travel alternatives (e.g. train). The results of this study will be shared with stakeholders and relevant policy makers in the region in order to support the continued development of a sustainable tourism industry in the region.

# $^{142}$Nd study of mantle-derived rocks from the Saglek-Hebron Gneiss Complex

A. ROULEAU[1], H. RIZO[1], J. O'NEIL[2], B. WASILEWSKI[2], J. FLAGEOLE[2]

[1] Ottawa-Carleton Geoscience Centre, Department of Earth Sciences, Carleton University, Ottawa, Canada

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Supervisors: Hanika Rizo and Jonathan O'Neil

The $^{146}$Sm-$^{142}$Nd short-lived isotope system is a useful tool to investigate Earth's early geological evolution. Because of the short half-life of the parent isotope ($^{146}$Sm), variations in the daughter product ($^{142}$Nd) can only be produced by geological processes occurring during the Hadean Eon (first 500 million years of Earth's history). Furthermore, this isotope system is only affected by processes such as melting and crystallization of rocks, and thus it can be used as a tool to study magma ocean episodes in the early Earth. The Saglek-Hebron Gneiss Complex (SHGC) in Northern Labrador is one of the few preserved terrains on Earth with rocks as old as 3.8 Ga. Recent $^{142}$Nd work on SHGC mantle derived rocks hint at a complex early history for their mantle source(s). Some of the rocks have $^{142}$Nd excesses whereas others have isotopic compositions indistinguishable from the modern mantle [1]. The Nd isotope results suggest the possible involvement of distinct mantle sources, one of which would have been produced by silicate differentiation in the Hadean. Here, we present a $^{146}$Sm-$^{142}$Nd study of metamorphosed basalts and ultramafic rocks from the SHGC. The studied samples were collected from different lithologies as well as from distinct metamorphic zones from granulite to amphibolite facies. Preliminary results obtained for high-precision Nd isotopes, reveal $^{142}$Nd excesses and suggest that the mantle source of the Saglek lavas differentiated at least 4468 million years ago.

[1] Morino et al., 2017, EPSL.

**Temporal and Spatial Trends of Marine Tourism in the Canadian Arctic**

[1]Weber, M., [1]Dawson, J., & [2]Stewart, E.

[1]University of Ottawa; [2]Lincoln University

Melissa Weber (Department of Geography, Environment and Geomatics, PhD)

Supervisor: Dr. Jackie Dawson

A changing climate and reduction in sea ice has made the Canadian Arctic more accessible to maritime traffic through increases in open water and total season length. Over the past 25 years shipping traffic in Arctic Canada has more than tripled. Marine tourism (both passenger ships and pleasure craft) has become popular over the past decade, and it is speculated that because of the allure of the Northwest Passage and the growing interests in "last chance" tourism, the demand will continue. The presence and expansion of the marine tourism industry could be highly advantageous for coastal Arctic communities, given the potential for enhanced economic development. This study uses a recently developed geospatial database of ship traffic from 1990 to 2016 to provide an overview of the spatial and temporal variability of marine tourism in Arctic Canada. To supplement this, a comprehensive database of shore locations visited by passenger ships from 2008 to 2018 was used to understand where passenger ships visiting. These findings enhance our understanding of marine tourism in the Canadian Arctic, historical trends and potential future demand. This is vital for the management and planning of a sustainable tourism industry that ensures both respect of northern ecosystems and rights and traditions of Indigenous northerners.

**Field and Laboratory Investigation of Electrical Resistivity-Temperature Relationships, Southern Northwest Territories**

J. Holloway[1] and A. Lewkowicz[1]

[1]*University of Ottawa, Department of Geography, Environment and Geomatics*

*Jean Holloway, PhD Candidate*

Determining the extent of permafrost is of concern for northern land and infrastructure managers, as thaw and subsequent ground settlement can be extremely damaging. Electrical resistivity tomography (ERT) is increasingly being used to delimit permafrost bodies, but choosing a threshold value to differentiate between frozen and unfrozen ground is needed for data interpretation. Much of the existing literature focuses on relatively cold, ice-rich permafrost with high resistivities which could lead to misinterpretation of ERT results for warm permafrost. In this study we compare resistivities measured in peat and silts across a range of temperatures both in the field and laboratory. Field surveys were conducted at four sites in the southern NWT (60.9-62.5°N) using an ABEM LS system across 160 m (2 m electrode spacing; maximum depth of penetration 25 m) or 40 m transects (0.25 m spacing and 6 m depth). Ground temperatures were measured in shallow boreholes at each site. In the laboratory, soil samples were wetted to field moisture content, frozen in closed containers, and resistivity was measured across a range of temperatures during thaw. Resistivity generally decreased by an order of magnitude between -0.5°C and +0.5°C from about 3000 Ωm to below 100 Ωm. However, the minimum measured resistivity between -0.15°C and 0°C was 85 Ωm, well below the value typically used to delimit frozen soil. This study shows the great range of resistivity values at temperatures close to 0°C, and emphasizes that lower resistivity thresholds need to be considered for warm or thawing permafrost.

**On-the-Land with Communities in the Northwest Territories**

Author: Stephanie Woodworth, PhD Candidate

Supervisor: Dr. Sonia Wesche

Department of Geography

University of Ottawa

Northern Canada is one of the most rapidly warming regions on Earth, resulting in dramatic changes to ecosystems (i.e. varying quantity/quality of water and unprecedented rates of permafrost thawing). Northern communities deal directly with the impacts, which affects their livelihoods, food and water security, health and wellbeing, and the future for young Northerners. Hence, it is imperative that the younger generation are empowered to monitor and measure the changes impacting their territorial lands in order to protect the land and water for the future. I am collaborating with Northern Water Futures (NWF) and Dehcho, Tlicho, and Inuit communities to enhance land-based education for Indigenous youth in the Northwest Territories (NWT). With funding from NSERC PromoScience, three youth-focused, 1-week on-the-land camps (Camp #1: Willow Lake, 2018; Camp #2: Daring Lake, 2019; Camp #3: Trail Valley Creek, 2020) are planned with community partners. These camps aim to engage, educate, and empower youth in NWT with scientific and traditional knowledge to protect the land and water. Each camp involves traditional activities led by Elders, and hands-on science-based learning led by NWF. During Camp #1 (August, 2018) at Willow Lake (Edéhzhíe), I helped facilitate and deliver activities to educate Dehcho youth from Fort Providence and Fort Simpson. My experiences and relationships from Camp #1 guide this research and provide insights for Camps #2 and #3. This presentation will focus on Camp #1, specifically the lessons learned, various activities facilitated, knowledge co-production, and the role of land-based education for communities in the North.

**Sedimentomics: What is it? And how it can be applied to the Canadian Arctic treeline?**

Madison Bell (PhD Candidate at UOttawa) *Oral presentation preferred

Authors: Bell M*, Saleem S, Korosi J, Kimpe L, Arnason J, Blais JM

Supervisor: Dr. Jules Blais

Biomarkers are organic molecules that can be used as proxies to reconstruct historical, ecological, archaeological and climatological conditions from paleoarchives like lake sediments. Biomarkers are very useful indicators for past climate conditions and have been used to train predictive models for future climate changes. The focus of this work is to investigate and discover new biomarkers relevant to long-term climate change. Currently, we are adapting “omics” workflows to use as a systematic biomarker discovery method. We are currently applying this method to the Canadian Arctic treeline. The treeline is the border between boreal and tundra ecosystems. The Arctic treeline is sensitive to climate changes and is expected to move northward as the Arctic warms. To generate a better picture of the future treeline we need to be able to reconstruct the past treeline. In order to identify treeline-specific biomarkers we used sediment cores from 61 lakes from northern Canada. Untargeted sample extraction followed by high resolution mass spectrometry allowed us to screen the sediment organic matter. Data mining then differentiated between the boreal and Arctic tundra sedimentary organic matter and identified key potential biomarkers. In conclusion, this sedimentomics method has many future applications to expand and improve multi-proxy approaches used when investigating key questions pertaining to environmental and climatic changes.

**Tracking Icebergs in Baffin Bay from Source to Sink**

Abigail Dalton[1], Luke Copland[1], Wesley Van Wychen[2]

[1]University of Ottawa

[2]University of Waterloo

Supervisors: Luke Copland, Wesley Van Wychen

Tidewater glaciers drain a significant proportion of the Greenland Ice Sheet, and the ice caps of the Canadian Arctic Archipelago (CAA), Nunavut, and provide the primary source of icebergs and ice islands (large tabular icebergs) in Canadian waters. The Canadian Ice Service produces charts which identify the presence of icebergs, but currently has little knowledge about the sources and sinks of icebergs in Canadian waters. Recent studies have shown that as of 2016, Trinity and Wykeham glaciers on the Prince of Wales Icefield (SE Ellesmere Island) are responsible for ~62% of all iceberg production from the CAA, compared to 22% in 2000. This work used SAR and optical imagery to identify the most active iceberg producing glaciers from the Prince of Wales Icefield over the last ~20 years. In 2016, a time-lapse camera system was installed at the terminus Trinity Glacier to monitor iceberg production on a local scale. Using the CCGS Amundsen from 2016-2018, a total of 39 iceberg tracking beacons were deployed to monitor the movement of icebergs from northern Baffin Bay through Canadian waters. Helicopter-deployed satellite tracking beacons were used to monitor the near real-time (hourly) movement of these icebergs. Initial results show that the most active iceberg travelled >5600km over a span of ~1 year Jones Sound to the Hudson Strait. Results from this work illustrate patterns of iceberg movement and the interactions between iceberg drift patterns and primary shipping routes along the east coast of Canada.

**Arsenic species in freshwater food webs near large gold mining operations in Yellowknife, NT**

Claudia Tanamal[1], Laurie Chan[2], Jules Blais[2]

Department of Biology, University of Ottawa

[1]Presenting author: Claudia Tanamal, MSc. Candidate in Chemical and Environmental Toxicology

[2]Supervisors

Yellowknife hosted some of the largest gold mining industries in Canada, including the renowned Giant Mine that produced more than 220,000 kilograms of gold between 1948 and 2004. Roasters at these mines were used to extract gold from the arsenopyrite ores, releasing toxic arsenic trioxide dust to the environment as a by-product. Because of this contamination from gold mines, arsenic in soils and lake water is typically 100 times higher near the roaster stack than sites unaffected by mining activities. Here we examined arsenic concentrations in aquatic food webs of three lakes in the area: two lakes within 5 km of the roaster: Lower Martin Lake and Long Lake, and a third lake was 27 km away from the roaster (Small Lake). We collected submerged macrophytes, periphyton, phyto- and zooplankton, benthic invertebrates and various fish species from all lakes. Arsenic species (As(III), As(V), MMA, DMA and Arsenobetaine) were subsequently separated and quantified by HPLC-ICP-MS. Trophic position in food webs was determined using $\partial^{15}$N analysis. Total arsenic concentration was inversely related to trophic position in the food webs of all lakes (Long Lake ($r = -0.43$, $p<0.05$), Lower Martin Lake ($r = -0.56$, $p = 0.13$) and Small Lake ($r = -0.54$, $p < 0.005$), indicating that arsenic biominified in these aquatic foodwebs. The proportion of inorganic arsenic (As(III)+As(V)) to total arsenic was negatively correlated with trophic position in Long Lake ($r=-0.25$, $p<0.05$) and Lower Martin Lake ($r = -0.35$, $p<0.05$), and was just below significance in Small Lake ($r=-0.14$, $p=0.07$). In addition, the proportion of arsenobetaine to total arsenic concentration was positively associated to the trophic position in the food webs in Long Lake ($r=0.48$, $p<0.001$), Lower Martin Lake ($r=0.38$, $p=0.05$) and Small Lake ($r=0.27$, $p=0.09$). Our results indicated that inorganic arsenic species were bioconcentrated at the base of the food webs, and that there was higher metabolic conversion to arsenobetaine happening at higher trophic position.

**People, Plants and Culture in the Southern Canadian Arctic: A systematic review of Indigenous knowledge perceptions, considerations and communications**

Lauren Watts (presenter), MA Student; Dr. Gita Ljubicic (supervisor) & Dr. Elyn Humphreys (supervisor), Dept. of Geography and Environmental Studies, Carleton University

The NWT has been said to be warming four to five times faster than the global average due to climate change. As a result widespread environmental shifts are occurring. Arctic regions are showing signs of greening, dramatically altering terrestrial ecosystems and carrying important implications for human-environment Interactions. Local, scientific, and Indigenous knowledge (IK) are required to better understand the extent and implications of such shifts. However, IK does not feature predominantly in studies of vegetation change despite being highlighted as a key priority in understanding environmental change in Canada's North. Furthermore, histories and geographies of the North reveal the colonial oppression of Indigenous peoples, cultures and knowledges. Geographic and environmental research has long been linked to such oppression, and contemporary research can risk perpetuating colonial legacies. This project takes a critical place-based approach to systematically review historical records, academic and grey literature relevant to IK of plants and vegetation (change). The project is intended to serve as a step toward enhanced understanding of the cultural context and significance of vegetation change in Canada's North, and how this connects to broader environmental changes. As such, it may contribute to better understanding local and regional scale changes within the context of northern research interests and priorities. Key findings emphasizing perceptions, considerations, and communications may help to expand broader academic conversations around Arctic vegetation change, and to provide a starting point for future studies to better acknowledge the important connections, languages, and nuances of people-plant relationships in northern Indigenous communities.

**Small glacier changes over the past 50 years in the Canadian High Arctic**

1. Braden Smeda1 (Presenting Author) , Dr. Luke Copland1, and Dr. Laura Thomson2

1University of Ottawa

2Queen's University

2. Department of Geography, Environment and Geomatics, University of Ottawa, MSc in Geography. Dr. Luke Copland (Supervisor) and Dr. Laura Thomson (Co-supervisor)

Over the past 50 years the Arctic has warmed at twice the global rate, partly due to increased atmospheric water vapour and polar amplification. Previous studies have demonstrated rapid reductions in the area of small glaciers on Axel Heiberg Island (AHI) between 1959 and 2000, with the complete loss of >90% of ice masses smaller than 0.2km2. However, little is known about how small glaciers have changed since 2000, and the processes driving these changes. Baby Glacier, located in Expedition Fiord on Axel Heiberg Island, is a high-altitude niche glacier with a mass balance record extending from 1959 to present. Detailed measurements of this small ice body (0.60km2) are being used to understand the patterns and causes of small glacier changes in the Canadian Arctic, and improve our ability to detect and monitor small glacier changes with remote sensing. Using topographically corrected orthoimagery derived from historical air photography and high-resolution satellite imagery, we calculate extent and area change of Baby Glacier from 1948 to present. Optical imagery (Landsat-7, 8, and Sentinel-2) from summers 2000 to 2016 has been used to derive initial results, which illustrate a reduction in size of the size of Baby, Trent, and Crown glaciers with the growth in nunataks signifying a reduction in volume. This project provides the most comprehensive recent assessment of small glacier changes on Axel Heiberg Island, from which a better understanding of the drivers impacting small Arctic glaciers (<1km2) is established.

**Upper Mantle Structure Beneath the Diamondiferous Central Slave Craton, Canada, from Teleseismic Body Wave Tomography**

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Cratons are, by definition, the most tectonically stable and oldest parts of the continental lithosphere on Earth. The Archean Slave craton is located in the northwestern part of the Canadian Shield. The propensity of diamondiferous kimberlite pipes in the central Slave craton raises many questions regarding their structural environment and source. Here, we provide the most robust teleseismic P and S body wave tomography models over the Slave craton region based on 20,547 P-wave delay times, 6,140 direct S-wave delay times and 3,381 SKS delay times. The P-wave model reveals an alternating pattern of relative positive and negative anomalies over a fine scale region within the central Slave craton. Furthermore, the P-wave model revealed two fine structures located in the lithosphere beneath the Lac de Gras kimberlite field, with relatively slow anomalies that extend from 75 km to 350 km depths with an apparent dip to the north. These relatively slow P-wave anomalies are associated with metasomatised regions within the lithosphere. The most recent kimberlite pipes (75-45 Ma) located in the Lac de Gras field are located on steep $V_P$ and $V_S$ gradients. The S-wave model displays a slow S-wave anomaly lying from 300 km depth to the transition zone beneath the central Slave craton. This anomaly is located beneath the Lac de Gras kimberlite field. We suggest that this anomaly is not the cause of the actual kimberlites at the surface since the last eruptions occurred 75-45 Ma ago but may be related to a potential kimberlite magma ascent in the asthenosphere.

**A new novel technique for sampling soil $^{14}CO_2$ as a tracer for hydrocarbon biodegradation in permafrost climates**

Lindsay Reynolds, University of Ottawa

Dr. K. Ulrich Mayer, University of British Columbia; Dr. Ian Clark, University of Ottawa

The accidental release of hydrocarbon into the environment is a common source of soil and groundwater contamination. In certain locations these contamination events are best mitigated through natural source zone depletion (NSZD). NSZD is an appealing option for remote locations, sites with minimal risk of human interaction, or ecologically sensitive environments. To determine the viability of this method for remediation efforts, the attenuation rate of these contaminants must be quantified. This can be achieved by surveys of $CO_2$ efflux coupled with analysis of $^{14}C_{CO_2}$ to apportion $CO_2$ emissions between natural soil respiration and biodegraded hydrocarbon in the impacted soil.

Radiocarbon is present in all biomass, but absent in biological materials older than 50,000 years. The use of radiocarbon provides a two-end member system to apportion emissions at contaminated sites between natural, $^{14}C$-active soil $CO_2$ and $^{14}C$-dead hydrocarbon. Traditional radiocarbon sampling involves costly, time intensive techniques. Here we present results of field tests at a contaminated site at Old Crow, Yukon following the successful deployment of a new in-field method for $CO_2$ extraction from soil gas and precipitation as $BaCO_3$ by injection into 2mL solution vials. The stable $BaCO_3$ sample precludes glass septum bottles for soil gas samples and is easily transported to the laboratory. We analyze $BaCO_3$ targets for $^{14}C$ directly by accelerator mass spectrometry (AMS) at the Lalonde AMS Laboratory, University of Ottawa. In a case study from a permafrost site in the northern Yukon, final radiocarbon results were obtained within one week of returning from the field.

**Potential Impacts of Sea ice and Ship Traffic Changes on Caribou Migratory Routes Surrounding King William Island, Nunavut**

Emmelie Paquette[1]; Gita Ljubicic[1]; Simon Okpakok[2]; Cheryl Johnson[3]; Melissa Weber[4]; Jackie Dawson[4]

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Environment and Climate Change Canada; [4]University of Ottawa.

Caribou ( *Rangifer tarandus, tuktuit* in Inuktitut) use sea ice for seasonal migrations among islands of the Canadian Arctic Archipelago, and between the islands and the mainland. Sea ice is a critical part of caribou habitat and supports their ecological persistence. Climate change models predict the lengthening of summer open water season, which is expected to increase the length of Arctic shipping season along with the frequency and diversity of ship traffic. Such changes could have negative impacts on caribou health and movement, as well as curtail hunting success and travel safety for nearby communities. This research is a part of an ongoing collaboration with the Inuit community of Gjoa Haven (Uqsuqtuuq), on King William Island (KWI; Qikiqtaq). We explore community concerns surrounding changes in sea ice conditions and ship traffic, in relation to caribou crossings to/from KWI previously mapped by Uqsuqtuurmiut (people of Uqsuqtuuq) Elders and hunters in Gjoa Haven. Using Canadian Ice Service regional ice charts we characterize changes in break-up/freeze-up timing, and length of summer open water season between 1983-2017 for key caribou crossings. Using NORDREG datasets that record ship traffic timing and movement routes, as well as ship type, we also characterize changes in the magnitude and timing of ship traffic around KWI between 1990-2017. Preliminary results were discussed in workshops in Gjoa Haven in the fall of 2018, and community feedback helps refine and orient our sea ice and ship traffic analysis to the local conditions. The knowledge shared with us in workshops was fundamental to our work's understanding of the local context, and our application of lessons learned into our interdisciplinary analysis. The sea ice and ship traffic conditions required for local travel safety, and caribou movement were described in workshops. These conditions inform the parameters and variables of interest included in our analysis by defining what qualifies as sea ice break-up and freeze-up in a way that is more relevant to the local community and caribou's use of the environment. Our work emphasizes the importance of multidisciplinary and collaborative research guided by Inuit knowledge. In this presentation, I will discuss lessons learned from the workshops, and discuss ways that Uqsuqtuurmiut knowledge has guided our research.

**Country Food Valuation, Securing Indigenous Food Sovereignty in Denedeh (NWT)**

Molly Stollmeyer, MA, Institute of Political Economy, Carleton University

Supervisor: Dr. Peter Andrée, Political Science, Carleton University

Associated Institutions: FLEdGE Research: Food Locally Embedded, Globally Engaged; The Gordon Foundation

The significance of country food could be expressed in terms of health, social, cultural or economic wellbeing. The usual mechanisms used in economics to measure the volume and value of production are not available as country food items, are not usually regulated through formal markets of exchange and do not have monetary values attached to them[1]. Some researchers argue that assigning economic value to country foods is misleading, culturally inappropriate and inadequate[2]. Beyond this, reducing the value of country food to its associated monetary costs runs to risk of undermining different understandings of the importance of food in culture[3]. I aim to find ways to represent the value of country food by considering alternate approaches to the normative valuation of food and nature. The proposed research will review and synthesize relevant literature, undertake an environmental scan to identify related projects and potential partners, interview decision-makers at multiple levels, community representatives, and experts in food systems and valuation.

The early findings of this research demonstrate the limitations of normative forms of measurement considering the intangibility of mixed, subsistence economies for quantification. The resistance to the commodification of country food[4] can be attributed to a number of explanations that include, but are not limited to, concerns of disrupting sharing networks, a kincentric relation to land broadly associated with an Indigenous worldview, and embedded laws prohibiting the sale of country food items within treaties, hunting and wildlife regulations.

**Exploring the world's longest Chinook Salmon migration in the Upper Yukon River**

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Upper Yukon River Chinook Salmon populations (Oncorhynchus tshawytscha) maintain some of the longest salmonid spawning migrations on earth (~3200 km) despite experiencing severe declines over the past century. To access the majority of spawning habitat, Upper Yukon River Chinook Salmon must pass the Whitehorse Hydro Plant (WHP) via the world's longest wooden fishway (366 m). More than five decades of successful passage and subsequent spawning upstream provide clear evidence of individual passage success, although sub-lethal and population-level consequences of passage are unclear. Stakeholders have identified the movement of Chinook Salmon through the Whitehorse Rapids Fishladder as a priority research initiative in the recovery of Upper Yukon River Chinook Salmon populations. We evaluated the effectiveness of this fish ladder at facilitating fish passage including the attraction efficiency of the ladder and the ultimate fate of fish following successful passage. To address these objectives, acoustic transmitters were gastrically implanted into approximately 150 fish of wild and hatchery origin that were released either within or below the fish ladder in 2017 and 2018. An array consisting of twenty acoustic receivers was deployed providing coverage at the WHP and all major tributaries both up and downstream of the WHP. Behaviour below the fish ladder, proportion of fish entering the ladder, and the ultimate fate of each fish were quantified. This research will provide insight on the potential implications of fish ladder design and operations on the productivity of Upper Yukon River Chinook Salmon populations which may inform future management of ladder operations.

**Frost, Fire, and Flora: Impacts of surface change on discontinuous permafrost near Nain and Postville, Nunatsiavut**

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Supervisor's Name: Dr. Antoni Lewkowicz

Permafrost is ground that remains at or below 0°C for at least two consecutive years. The thermal state of permafrost is influenced by overlying vegetation, which is changing throughout the circumpolar North. While technology is improving monitoring of surface changes, associated impacts on underlying cryotic terrain are often harder to discern. This research examines the impacts of shrub growth on discontinuous permafrost in coastal sub-arctic Labrador, within the context of forest fire disturbance.

Field and modelling techniques are applied to investigate discontinuous permafrost near the Nunatsiavut communities of Nain and Postville, following fire-associated surface change. Permafrost distribution at three main sites of varying shrub extent and fire disturbance was evaluated using direct current electrical resistivity tomography (ERT), temperature measurements, and frost probing. Vegetation along ERT lines was evaluated through surveys of soil characteristics, shrub heights and densities, canopy cover estimates, and snow depth. Summer and winter field observations will be incorporated into two-dimensional thermal models in the TEMP/W (Geoslope) program to investigate long-term changes to these sites.

Preliminary field results show the presence of frost in the unburned, closed-canopy forest, where there are fewer and shorter shrubs and a thicker organic layer than in the burned area. Field observations and analysis results, such as sediment characteristics, are being incorporated as model inputs in the TEMP/W program. These research results will be combined with collaborative studies on post-fire vegetation community composition and tree regeneration to provide insight into fire-associated ecosystem change in Nunatsiavut.

**Examining the potential impact of increased vessel traffic noise on marine mammals in the proposed Tallurutiup Imanga (Lancaster Sound) National Marine Conservation Area**

Zuzanna Kochanowicz, Jackie Dawson (University of Ottawa), William Halliday (Wildlife Conservation Society Canada and University of Victoria)

Presented by: Zuzanna Kochanowicz: MSc candidate in Geography at the University of Ottawa (Supervised by Jackie Dawson)

Recent reductions in sea ice extent in the Canadian Arctic have led to an increase in maritime navigability and it is expected that there will be an increase in shipping activities related to tourism, fisheries and trade in the future. There is already increased interest in the commercial viability of the Northwest Passage as evidenced by the recent sailings of cargo vessels such as the Nordic Orion (2011) and the Nunavik (2014) and the unprecedented number of yachts, cruise ships and new research vessels.

Tallurutiup Imanga (Lancaster Sound) a marine area that will soon become a National Marine Conservation Area (NMCA) that spans approximately 110,000 square kilometers, is located at the eastern entrance of the Northwest Passage. The area is rich in ecological and cultural significance and the protection of Tallurutiup Imanga has been in progress for decades. With the official boundaries set in August of 2017, the future protection and management of the new NMCA will be crucial to protecting its integrity, especially as commercial shipping is expected to increase precisely in this area.

Our ongoing research project aims to: 1) utilize an existing ship track database to evaluate shipping trends in Tallurutiup Imanga from 1990 to 2016; 2) project future shipping traffic in the region based on best available data; 3) model the current and potential future impact of vessel noise on relevant marine mammal species in the NMCA; and 4) propose spatial management options for reducing noise impacts from increased marine traffic.

**Harvest Study: Harvest trip patterns in Gjoa Haven.**

Jacqueline M. Chapman1, Parisa Khosraviani2, Amos Hayes3, James Qitsualik4, 4Brent Puqiqnaq, and Stephan Schott2.

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Subsistence harvest is the cornerstone of food security in the majority of Northern communities across Inuit Nunangat. Unfortunately, harvest rates have decreased over time, often attributed to the decreased availability of harvested species. However, barriers to harvest are often reported to be driven by socioeconomic factors. To address this question, the community of Gjoa Haven worked with researchers from Carleton University to design a harvest study that addresses both harvest rates and economic factors associated with harvesting. Here we present preliminary results based on insights regarding socioeconomic data as well as harvest cost, frequency, and seasonality.

**Food security from a local perspective: elder and youth perspectives in Gjoa Haven, Nunavut.**

Jamie Desautels5, Jacqueline M. Chapman*1, Simon Okpakok4, Virginia K Walker6, Stephan Schott2.

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We examine the meaning and challenges of food security in the local context of the Hamlet of Gjoa Haven, Nunavut. We conducted three different focus groups with a range of residents and food consumers. The first focus group (in May 2017) included 10 elders (seven women and three men), the second group (August 2017) included nine youth at the Gjoa haven High School, and the final group (August 2018) took place at an Elder-Youth Workshop on the land, and included four elders and a middle-aged interpreter and participant . Insights from our focus groups indicate that food security perceptions differ by age. Elders still desire and report a strong reliance on country food supplemented with some store-bought food that is currently not subsidized by Nutrition's North (e.g. baking goods). They experience a disruption in country food supply from January to March when it is too cold and costly for many others to hunt and fish. In contrast, youth desire a combination of country food staples (Arctic char, caribou and muskox meat) with store bought food staples typical of a southern diet. The sharing economy is reported to go through cycles. It peaks in the spring when many active hunters first go out and actively share, but is less pronounced in summer and winter months. In summer, many harvest for themselves as everyone has access to the land, while not enough food is harvested in the winter. Some country food is now being sold door to door, over the radio, to the local Hunter Trapper Association, or on Facebook. Approximately 25 % of people reported difficulty to go out to hunt or to manage to receive country food from others. Generally, participants reported concerns about contaminants if they are visible. We noticed a number of coordination problems in the matching of youth and elders and educational and training deficits that prevent both elders and youth from going fishing and hunting as often as they desire. Recommendations by focus group participants include a country food store and country food bank, a commercial fishery plant, a revision of Nutrition North subsidies that is based off of community consultations, as well as more training and capacity for maintenance and repair of hunting equipment.