



## Nunavut Research Institute

### License Holder Reporting requirements

For research undertaken in the 2025 calendar year

**Project Title:**

Permafrost Organic Carbon Export to the Canadian Arctic Ocean

License 01-022-25N-M

**Project Leader(s):** Full name, affiliation, and contact information (address, phone number, email) of each project leader (principle investigator and co-PIs)

Prof. Dr. Stephanie Kusch, Institute of Marine Sciences, University of Quebec Rimouski, 310 allée des Ursulines, Rimouski G5L 3A1, Quebec, Canada  
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**Project Team:** Full name, affiliation, and address (name of city/community and province/territory/state) of each member of the project team

Joana Steffens, Institute of Marine Sciences, University of Quebec Rimouski, 310 allée des Ursulines, Rimouski G5L 3A1, Quebec, Canada

Lydia Couture, Institute of Marine Sciences, University of Quebec Rimouski, 310 allée des Ursulines, Rimouski G5L 3A1, Quebec, Canada



**Objectives:** Project objectives, preferably in bullet form.

- investigate changes in permafrost organic carbon remineralization and erosion in response to climate change
- laboratory-based microcosm experiments performed to study the response of permafrost to natural climatic and anthropogenic forcing
- determine greenhouse gas production, organic matter transformations, and feedback mechanisms to the seawater chemistry
- link observations to longer sediment records obtained from Maktak, Coronation, and Pangnirtung fjords (Auyuittuq National Park/Penny Ice Cap) during CCGS Amundsen missions 2024 and 2025 to understand past permafrost dynamics beyond observational records
- assess sensitivity and response of permafrost OC to natural climatic as well as anthropogenic forcing

**Annual activities:** A description of activities and methods carried out during the current reporting period. This section should answer the questions: What? Where? When? Who? How? Include dates team members conducted research at remote field sites or collected data (including interviews) in communities; append a map with locations and/or coordinates of remote field sites, if applicable.

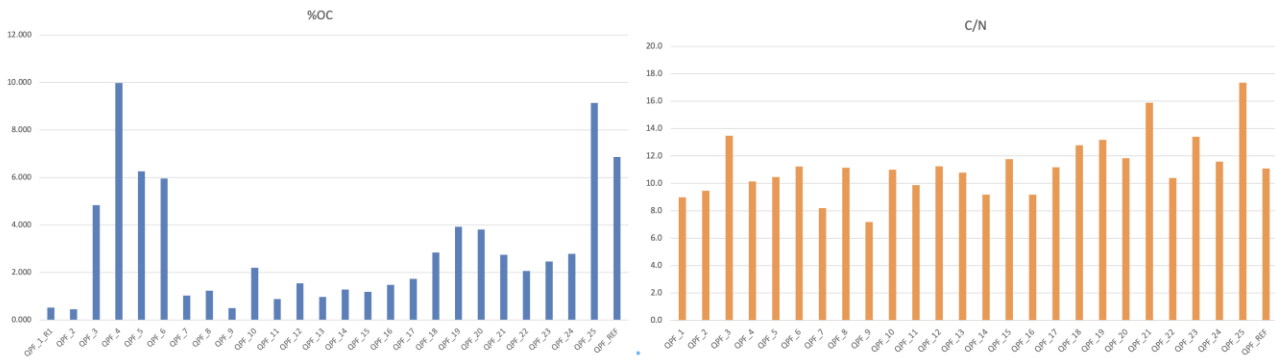
During the current reporting period, the project team conducted its first field campaign in and around Qikiqtarjuaq. Field sampling was performed from 28.07.2025 to 01.08.2025. The field team consisted of three University of Quebec Rimouski researchers: the principal investigator, Professor Stephanie Kusch, and graduate students Joana Steffens and Lydia Couture. Fieldwork was carried out across Broughton Island, focusing on locations representing major pathways of permafrost organic carbon export to surrounding marine environments. Sites included permafrost-dominated upland areas, flowstream channels that transport thawed material toward the coast, and floodplains. The team collected 25 active-layer permafrost soils, 16 flowstream sediments, and ~48L of coastal seawater following standardized environmental sampling protocols. Soil sampling involved digging small 15 × 15 cm pits using hand shovels to depths between 0-5cm and 0-25cm during this initial season. Sediments were retrieved from streambeds using hand shovels to scoop up the 0-2cm uppermost material. Seawater was collected nearshore for laboratory incubation experiments. All sampling was performed with minimal site disturbance and in accordance with community guidance provided prior to the field season. Following the field campaign, all samples were returned to the University of Quebec Rimouski for laboratory analyses. Measurements of organic carbon and nitrogen content were completed by fall 2025. In November 2025, the team initiated long-term microcosm incubations designed to quantify greenhouse gas production and track organic matter transformation when permafrost material is introduced to Arctic seawater as well as feedback mechanisms to the seawater chemistry. These controlled incubations, conducted under constant temperature conditions, will run until November 2026 and constitute the core component of Lydia Couture's master's thesis project. The data generated during this reporting period form the foundation for subsequent years of comparative sampling and longer-term incubations.

**Results and Achievements:** Findings and results to date of the above activities, highlighting any key research achievements (see guide below for formatting tips regarding tables and figures).

During the 2025 reporting period, the project generated its first analytical results from the soil and sediment samples collected across Broughton Island. Elemental analysis of nitrogen (N%) and carbon (C%) content has been completed for all samples, providing an initial assessment of spatial variability in organic matter quantity and quality across major permafrost-influenced export pathways. These data represent a foundational baseline against which future years of monitoring and incubation results will be compared. Preliminary findings indicate substantial heterogeneity in carbon and nitrogen contents, consistent with the island’s diverse surficial environments. Samples collected along organic-rich flowstream or low-lying wetland areas (e.g., QPF\_4, QPF\_5, QPF\_6, QPF\_25) exhibit the highest C% values (6-10%) and elevated N%, reflecting greater accumulation of organic-rich material and likely contributions from more advanced soil development or vegetation inputs. In contrast, samples derived from mineral-dominated upland areas (e.g., QPF\_1, QPF\_2, QPF\_9) show low C% (0.4–0.5%) and very low N%, characteristic of thin active layers and limited organic matter accumulation.

Across all sites, C% increases systematically with N%, indicating internally consistent dataset quality and suggesting that organic matter composition—not contamination or analytical error—drives the observed variability.

These initial results demonstrate that permafrost-influenced soils around Qikiqtarjuaq hold a wide range of organic carbon stocks. Samples with low, intermediate, and high organic carbon contents were chosen for the ongoing microcosm incubations. The observed spatial variability will allow the team to test whether soils with higher organic carbon content or distinct C:N signatures exhibit different greenhouse gas production and organic matter degradation trajectories when thawed and mixed with seawater. Combined with the long-term incubation experiments initiated in November 2025, these baseline measurements mark a key early achievement of the project and establish a robust platform for tracking carbon remineralization responses across future field seasons.



**Challenges/Obstacles:** In this section, please comment on any challenges/obstacles (if any) that you experienced during this project year. If there were any actions to mitigate or resolve these challenges, please list them here. Were any concerns raised regarding the conduct of research team members or the impacts of the project?

No significant obstacles were experienced. Field work activities proceeded as planned.

**Expected Project Completion Date:** Provide month and year of expected completion date of the project.

31.08.2028

**Project website (if applicable):** If your project has a presence on the internet, including a website and/or social media page, please provide the link and/or account handle.

<https://ibg.uqar.ca/projects/>

**Citations:** Please append a complete reference list if citations are used anywhere in the document.

#### **POLICY RELEVANCE**

Does this research support policy development or decision-making in Nunavut? If yes, please describe.

This research directly supports policy development and decision-making in Nunavut by providing quantitative data on how permafrost thaw is altering organic carbon release, greenhouse gas production, and coastal ecosystem conditions around Qikiqtarjuaq. By identifying vulnerable soil types, characterizing organic carbon export pathways, and assessing how thawed permafrost behaves once introduced into the marine environment, the project generates information that can inform land use planning, harvest area management, and climate adaptation strategies for communities reliant on local terrestrial and marine resources.

In addition, the project investigates seawater feedback mechanisms, including changes in pH, alkalinity, and related biogeochemical processes that occur when terrestrial organic matter enters coastal waters. These measurements provide insights relevant to coastal fisheries management, marine habitat conservation, and monitoring programs aimed at understanding how ocean chemistry may affect species important to subsistence harvesting. The resulting baseline data can be incorporated into territorial environmental assessments, used to guide local co-management bodies such as the Nattivak Hunters and Trappers Association, and support evidence-based policy discussions at the hamlet and within Nunavut's broader climate resilience planning.

## RESEARCH OUTCOMES: BENEFITS

**Community engagement:** Briefly list and describe any community consultation, engagement, collaboration and outreach activities that you have undertaken for the project; describe the role(s) that community members and/or specific organizations have played in research co-design and activities.

The hamlet of Qikiqtarjuaq and the Nattivak Hunters and Trappers Association of Qikiqtarjuaq were consulted in the Qikiqtarjuaq research station (operated by Laval University) on 3 February 2025. Stephanie Kusch presented the specific objectives of the project, the planned fieldwork activities, and planned outreach/engagement activities with the community as well as the Inuksuit School and received input from hamlet and HTA members about project design (specifically from Geela Kooneelusie). The hamlet was visited during the summer campaign and Stephanie Kusch briefly reported the on-going activities to hamlet member Daisy.

A first outreach session in the Inuksuit School was held on 5 February 2025. Stephanie Kusch and Joana Steffens presented a video about permafrost thaw due to climate change and performed 2 hands-on experiments with the kids.

During the summer campaign 2025, a second outreach activity was organized at the Qikiqtarjuaq research center after field sampling had finished. On 6 August, Stephanie Kusch, Lydia Couture, and Joana Steffens organized the 'permafrost guardians' rally. Kids could experience various experiments and games inside and outside of the station to win prizes. The activity was shared via Facebook (by the research center as well as Michael Aliqatuqtuq (local radio). A total of ~50 kids participated.

**Youth engagement:** Briefly list and describe any outreach, school or classroom activities that you have undertaken for the project; describe the role(s) that youth have played in your research activities.

A first outreach session in the Inuksuit School was held on 5 February 2025. Stephanie Kusch and Joana Steffens presented 'what is permafrost?' (via video and oral storytelling) about permafrost thaw due to climate change and performed 2 hands-on experiments with the kids: 1) experiment demonstrating the effect of permafrost thaw on physical soil stability (melt of artificial permafrost and effects on popsicle buildings) and 2) experiment demonstrating the effect of permafrost thaw on decomposability of organic matter (frozen potato experiment). During the summer campaign 2025, a second outreach activity was organized at the Qikiqtarjuaq research center. On 6 August, Stephanie Kusch, Lydia Couture, and Joana Steffens organized the 'permafrost guardians' rally. Kids could experience various experiments and games inside and outside of the station to win prizes (see attachment).

**Training and Employment:**

How many Nunavummiut received training from team members? Please describe training and/or compensation provided.

During the 2025 summer campaign, no experiments or advanced sampling activities were performed, thus, no Nunavummiut received training. Soils were simply put into plastic bags and stored until return to the laboratory, no training is required to perform this task.

How many team members received training from Nunavummiut? Please describe training received and/or what knowledge sharing and/or skills exchange took place.

All team members received knowledge during sampling from one Nunavummiut. In his role as bear monitor, Colin shared his knowledge about the land. Likewise, Laila Alookie, station manager, shared her experience with changes in vegetation in recent years.

How many Nunavummiut received employment? Please describe employment type and length, role(s) and responsibilities, and compensation provided.

One Nunavummiut was employed as bear monitor throughout the sampling period (5 full days of employment compensated at 200/day).

How many Nunavummiut received honoraria as research participants? Please describe method of participation (interview, observation, sample, survey, etc.), including compensation provided.

One Nunavummiut was employed as bear monitor throughout the sampling period (5 full days of employment compensated at 200/day).

Please explain how the project directly benefited Nunavut organizations and/or businesses (e.g., through contract services, local purchases, equipment donations, etc.)

Hiring of the guide/bear monitor was organized via Nunavut Experience Outfitting Services Qikiqtarjuaq (owned by Billy Arnaquq). An ATV was rented for the sampling period (6 full days at 200/day). All team members also engaged regularly with local artists and artisans and purchased a suite of products (drawings/paintings, carvings, sewn articles etc.).

**OPTIONAL: Nunavut Team Members, hires, and/or trainees (excluding research participants e.g., interviewees)**

*The NRI is creating an inventory of Nunavummiut who are skilled and/or interested in research. The information provided below will not be shared publicly but will support long-term capacity sharing by connecting local and visiting researchers with research talent in each community.*

Name	Expertise/skills	Training/interest areas	Contact Info	Community
Colin	bear monitor		Via Billy Arnaquq (billy_arnaquq@qiniq.com)	Qikiqtarjuaq


**Academic Mobility**

If you are affiliated with an academic institution, please answer the following question: For which Level of Project(s) will the data be used? (Check all that may apply)

- Research
  - Post-Doctoral Research
  - PhD Thesis
  - Masters (Major Research Paper)
  - Masters (Thesis)
  - 
  - Graduate Course Project Staff/Administration Research
  - Undergraduate Honours Thesis

Other

**BUDGET**

Please complete the table below to detail your projected and actual research expenditures during the reporting period.

Category	Planned/Approved Expenditure	Actual Expenditure
Travel and Accommodation		23,986 CAD
Equipment, Materials and Supplies		2,200 CAD
Salaries/Wages for Nunavut residents		1,000 CAD
Salaries/Wages for non-Nunavut resident researchers		
Professional Fees and services in Nunavut		1,200 CAD
Professional Fees and Services outside of Nunavut		820 CAD
<b>TOTAL EXPENDITURES</b>		

List the total \$ amount of funding from each funding source for your full research program, including in-kind support

11,500 CAD/year via NSERC Northern Research Supplement, 40,000 CAD / year via NSERC Discovery Grant, 160,000 CAD via NFREF Transforming Climate Action.

### RESEARCH OUTPUTS / REPORTING TOOLS

What research outputs were generated? Please list below and append copies of each. Specify which outputs (if any) may be made public on the NRI research licensing database.

Thus far, no research outputs have been generated. Laboratory experiments are still on-going. Microcosm experiments will finish in November 2026. Other related projects (sediment core records from Auyuittuq National Park to be analyzed in a PhD project) will generate data by 2027.

Have peer-reviewed manuscripts been published as a result of your project? If Yes, complete the following table:

Full citation	Publicly accessible/ free to access (Y/N)	Link (if available) and DOI (if available)

If No, do you intend to submit a manuscript (or manuscripts) for peer reviewed publication? Y /

Yes, the results of this project will be submitted for peer reviewed publication.

Were non-peer reviewed materials produced to either communicate or synthesize results to the public? Examples of these materials include (but are not limited to): websites, reports, brochures, podcasts, webinars, presentations, non-peer reviewed publications, etc.

If Yes, complete the following table:

Title	Description of Materials	Link (if available)	DOI (if available)

Did your project develop a communications plan? Please describe communications/reporting tools used, and list the target audience for each and/or who requested which.

Activities are reported via <https://ibg.uqar.ca/news/>. A communication plan is in place via the NFREF Transforming Climate Action program’s transformation hub (<https://www.agora-uqar.com>) and will be used as soon as data are available.

How were Nunavummiut credited and/or acknowledged in all project outputs, such as co-authorship, participant biographies, article acknowledgements, etc.

No output has been generated yet, but any help received by Nunavummiut will be acknowledged. Community members engaged in co-production will be credited in the resulting publications (authorship).

**DATA AND INTELLECTUAL PROPERTY**

Did you enter into a research agreement, data-sharing agreement and/or intellectual property rights agreement with a community and/or designated Inuit organization (DIO)? If yes, please explain.

Do intellectual property rights apply to your research? If yes, please explain.

No.

Who owns the data? Has the raw data been shared with the appropriate community and/or DIO? If yes, how? How is data security and storage handled by community-based co-owners?

The data will be shared with the hamlet of Qikiqtarjuaq.

Where is the data stored and will the data be destroyed within a set timeframe?

The data generation is still in progress. For scientific archival purposes (FAIR principle), data will be stored using the Pangaea repository (<https://www.pangaea.de>).

Is the data trackable and/or available in a public data repository? If yes, please provide the appropriate information and/or link to ensure the findability and accessibility of the data.

Once available, data will be stored using the Pangaea repository (<https://www.pangaea.de>).

Please append a copy of your data management plan.

#### **CLIMATE CHANGE**

Is your research about climate change (causes, impacts, mitigation, adaptation, etc.)? If yes, explain.

Yes. The research directly addresses climate change by examining how warming-induced permafrost thaw alters the release, transformation, and remineralization of organic carbon in terrestrial and coastal Arctic environments. By quantifying greenhouse gas production, tracking organic matter export to the ocean, and evaluating associated feedbacks in seawater chemistry, the project improves understanding of both the causes and impacts of climate change and supports the development of informed adaptation strategies for northern communities.

**PHOTOGRAPHS**

*If possible, please provide high-resolution photos of licensed research activities that NRI may use in communication materials, organizational reporting, and other promotional purposes. The photographer and all recognizable people in each photo must sign the attached Photo and Video Release form. Please also complete the table below for each photo provided and submit to NRI along with all required NRI photo release forms. The photographer/owner will be credited in all uses of the photograph(s).*

File Name	Location	Description	Subjects	Photographer/Owner	Date
QPF-4	QPF-4	Sampling floodplain		Joana Steffens	28.07.2025
QPF-6	QPF-6	Sampling soil		Joana Steffens	28.07.2025
QSED-2	QSED-2	Sampling stream sediment		Joana Steffens	28.07.2025
QSED-12	QSED-12	Sampling stream sediment		Joana Steffens	31.07.2025

Would you like your project to be considered for a research profile and promotion by the NRI? YesY /