Responses of Permafrost Microbial Communities to Climate-Driven Thaw

Researcher's Names and Affiliations: Dr. Eric Bottos, Thompson Rivers University; Gwendolyn Freeze, Thompson Rivers University and Adventure Canada

Project Locations: Dundas Harbour, Powell Inlet, Port Leopold, Beechey Island, Prescott Island, Pasley Bay, Grise Fiord Inlet, Coutts Inlet, Maxwell Bay, Aston Bay, Strzelecki Harbour, Fort Ross, Wrottesley Inlet

Timeframe: August 26 – September 27, 2026

Research Proposal:

In our warming climate, the rate of permafrost thaw (ground that remains frozen for at least two consecutive years) is increasing in the Canadian Arctic. Permafrost stores vast amounts of carbon, which, upon thaw, is released as carbon dioxide and methane into the atmosphere, significantly contributing to rising global temperatures. The microbial communities (groups of microorganisms living together in an environment) within permafrost play a central role in this process, becoming more active as the ground thaws and accelerating the release of carbon.

Interestingly, permafrost microbial communities are not all uniform. They can vary across Arctic landscapes, as shaped by local environmental conditions and the characteristics of the overlying soil layers. As permafrost thaws, it mixes with the microorganisms and nutrients from this overlying soil, which can alter its microbial community composition and, in turn, influence how much carbon is released. Despite their importance, the composition of permafrost microbial communities and its overlying soils across Arctic landscapes, as well as how these layers interact during thaw, remain largely understudied. The goal of this research is to study these factors, which could help us better predict the effects of permafrost thaw on future carbon emissions and global climate.

This August, Gwen will join Adventure Canada and travel by ship throughout northern Nunavut. Permafrost cores and overlying soil samples will be collected from multiple sites representing different Arctic environments. The proposed research will investigate the following questions: 1) How do permafrost microbial communities and overlying soil characteristics vary across different Arctic landscapes? and 2) How do interactions between permafrost and its overlying soil influence microbial community responses to warming?

Methodology:

In 3x3 meter sampling plots, a small quantity of overlying soil will be collected at 10 cm below the soil surface using a trowel and shovel, while 30 cm permafrost cores will be collected using a portable auger. Small bryophyte samples will also be collected (≤5 grams). Samples will be stored at -20°C onboard until transported to Thompson Rivers University in Kamloops, BC. DNA sequencing technologies will be used to characterize microbial community compositions, and simulated thaw experiments will be carried out in lab to assess how overlying soils influence permafrost microbial communities during warming events.

We expect environmental, wildlife, and community impacts to be minimal. Wildlife habitats and sensitive vegetation will be avoided during sampling, while any disturbance to soil and vegetation will be carefully restored. Soil layers will be kept separate during excavation to ensure accurate filling and restoration post-sampling. Research plans will remain flexible and be adjusted as needed in response to community member feedback and contextual considerations. Throughout the project, we are dedicated to ongoing collaboration

with communities and organizations, and for their input to guide how data and findings are best managed and shared. Our goal is to ensure the most accessible and inclusive approach for all Nunavut residents.