ArcS III 若手人材海外派遣プログラム
派遣支援 終了報告書

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対象となる取組みの名称
Fieldwork of post-fire permafrost evolution in the boreal region of North Yukon
■ 派遣中の活動と成果

From September 16th to 26th, 2026, I traveled to the North Yukon Territories, Canada, accompanied by Professor Furuya and Doctor Yanagiya. We performed field investigations at a series of sites along the Dempster Highway across the boreal forest regions, where wildfires occurred frequently, to study the permafrost ground evolution after fire disturbances.

Our investigation aimed to ground-truth the findings derived from interferometric synthetic aperture radar (InSAR) analysis, which had revealed distinct ground deformation patterns across burned areas of different ages. The InSAR data suggested an evolution of post-fire permafrost from initial thaw subsidence to gradual uplift and eventual stabilization. Thanks to the ArCS3 Overseas Fellowship Program, I have the opportunity to perform the fieldwork to validate these remotely sensed signals with in situ measurements of thaw depth, soil temperature, ground ice, and vegetation cover, and to understand the mechanisms driving the observed surface deformation.

After three flights from Sapporo to Whitehorse and two days of driving along the Dempster Highway (Figure 1), we arrived at Eagle Plains, the only settlement with reliable accommodation in that area. From this base, we conducted daily excursions to both burned and unburned sites between approximately 30 and 70 km southwest of Eagle Plains. Site selection followed our pre-analysis, which helped identify contrasting deformation behaviors, vegetation conditions, and topographic settings. The field sites represented a gradient of post-fire ages, from areas burned within the last decade to those affected more than thirty years ago, allowing us to capture various stages of permafrost evolution under comparable environmental conditions.

Figure 1. Dempster Highway across the permafrost and the boreal forests region in the North Yukon Territories

At each site, we carried out systematic permafrost and vegetation surveys. For permafrost characterization, we measured the active layer thickness using a metal frost probe. The end of September marks the end of the thaw season in this region, making it suitable for capturing the maximum seasonal thaw depth. We dug a soil pit (at each site and measured soil temperature at 5 cm intervals down to the frozen layer. In several locations where ice lenses and pore ices were visible in the soil pits (Figure 2). These observations provided essential ground evidence of ice-rich layers that may contribute to seasonal or long-term ground deformation.

Figure 2. Soil pit with ice lens detected

Figure 3. Burned area by a wildfire in 2023

We also notice the vegetation regeneration process across sites. The vegetation type revealed clear differences corresponding to post-fire age. Recently burned areas were dominated by early-successional tussocks, while older scars exhibited denser shrubs, accompanied by re-established black spruce stands. The presence of thick moss mats and organic layers in fire scars from fires decades ago, and with favorable soil moisture concentration and topographic conditions, suggested strong insulating effects that likely promote permafrost recovery and stability, consistent with our InSAR-derived evidence of reduced subsidence and even slight uplift.

In addition to scientific measurements, we paid attention to logistical and environmental challenges inherent to northern fieldwork. The weather was unstable and cold, with temperatures ranging from –2 °C to +10 °C. Early wet snow began to fall and form a thin snow pack over high-altitude ridges. We used a four-wheel-drive vehicle to reach remote sites via the Dempster Highway, which at times became slippery and muddy. Safety considerations and clear daily planning were therefore essential. The permafrost degradation also gives rise to potential risk to the stability of the roadbed in that area. Despite these challenges, all planned measurements were successfully completed without major incidents.

The field data collected during this fieldwork will be integrated with our satellite observations to refine the interpretation of InSAR-derived ground deformation. The combination of field and remote sensing information will allow us to better describe the relationship between vegetation recovery, organic layer thickness, and permafrost dynamics under the disturbance of wildfires. Preliminary inspection of the data already suggests that areas showing long-term uplift on InSAR correspond to sites with dense vegetation cover and thick organic mats, supporting the hypothesis of fire-greening positive feedback in promoting permafrost recovery. More detailed and technical data and analysis are currently under organization and analysis, and will be formally published later in a scientific journal.

Overall, any future possible fieldwork in North Yukon was highly productive and provided invaluable insights into the long-term permafrost dynamics after wildfire. It not only validated the remote sensing results but also deepened our understanding of the interactions between vegetation succession, permafrost regimes, and ground deformation. The findings will contribute to our ongoing efforts to model disturbance-driven permafrost evolution and to improve predictions of circum-Arcric permafrost landscape responses under continued climate warming.

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