

21 December 2017

Mosha Cote
Research Liaison
Nunavut Research Institute
Box 1720, Iqaluit, NU X0A 0H0
mosha.cote@arcticcollege.ca



RE: Scientific Research License # 03 010 16N-A, 03 003 17R-M

Dear Mr. Cote,

Please accept this application for renewal of scientific research license # 03 010 16N-A, 03 003 17R-M for the year 2018. I have attached our Annual Summary Report for 2017 that details our research activities and findings in English and Inuktitut.

Currently, there are no anticipated substantive changes to the project objectives, study locations or research methods. Our tentative fieldwork plans for 2018 are as follows:

- 1) March 2018: 2 personnel for 5 days for data collection and observation at established sites during winter conditions.
- 2) June/July 2018: 3 personnel for 15 days for permafrost coring and observations of ground ice in the region of Rankin Inlet. Methods and study locations are as described in the original research proposal.
- 3) September/October 2017: 2 personnel for 10 days for data collection and observation at established sites.

Best Regards,

A handwritten signature in black ink, appearing to read "Greg Oldenborger".

Greg Oldenborger
Geological Survey of Canada
Natural Resources Canada
183-601 Booth St., Ottawa, ON K2C 1A3
Phone: 613-943-4288
Email: greg.oldenborger@canada.ca

Annual Summary for Nunavut Scientific Research License # 03 010 16N-A, 03 003 17R-M

Permafrost and ground ice are important features of the Nunavut landscape. Information on ground temperatures and ground ice conditions is important for modelling the response of permafrost to climate warming, understanding surface water-ground water interactions, and predicting the behaviour of permafrost as an engineering substrate. However, there is a scarcity of permafrost data along the western coast of Hudson Bay and in the Kivalliq region of Nunavut. In the summer of 2016, the Geological Survey of Canada and the Canada-Nunavut Geoscience Office started a multi-year research study to provide geoscience knowledge on permafrost for the western coast of Hudson Bay and the greater Kivalliq region of Nunavut.

Fieldwork in 2016 involved landscape observations, examination of surficial geological materials, installation of preliminary ground temperature monitoring stations, and site selection. Analysis of field observations in combination with surficial geology, historical air photos, satellite images, and climate data revealed evidence for thermokarst terrain – a land surface affected by thawing of ice-rich ground. Certain lakes were observed to be expanding in area and other lakes were observed to be shrinking in area or draining. For many lakes, water levels are linked to precipitation. In other cases, water levels, significant changes in shoreline morphology, and coincidence of permafrost landforms indicative of ice-rich ground, all support the interpretation of thermokarst.

Subsequent fieldwork in 2017 involved installation of several permafrost monitoring stations and the collection of ground geophysical data in the vicinity of Rankin Inlet. Two permanent ground temperature boreholes were established to record the long-term thermal state of permafrost in the Rankin Inlet region for developed and undeveloped land use scenarios. Sites were located with the help of staff from the Hamlet of Rankin Inlet. Boreholes were drilled in March, 2017 and instrumented with thermistors and data loggers the following June, 2017. Four additional shallow sites in the vicinity of Rankin Inlet were instrumented with temperature sensors, moisture content sensors and water level sensors. Locations were chosen to represent different terrain types including raised beaches, tills, nearshore marine sediments, and ice-wedge polygons. At several sites, ground geophysical data were acquired to map the electrical conductivity associated with different surficial geology and permafrost terrain.

These on-the-ground data will be compared to data collected from airborne- and satellite-based mapping to better understand ground conditions and active permafrost processes shaping the land, and to improve methods for remote mapping of landcover and permafrost terrain. Preliminary results suggest that permafrost in the Rankin Inlet area is warmer than historically reported with an increased active layer thickness. Furthermore, observations of ground movement and thermokarst appear correlated to surficial geology. In particular, high ground surface displacement as measured from satellite data occurs predominantly associated with till and marine sediments. The surficial geology prone to thermokarst is also observed to be prone to relatively high ground surface displacement. The results establish surficial geology as a rough proxy for areas subject to landscape change due to permafrost processes in the region.

More detailed reports are publically available as part of the 2016 and 2017 Summary of Activities of the Canada-Nunavut Geoscience Office: <http://cngo.ca/summary-of-activities/>

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