

Application for NRI Research License: Non-Technical Project Proposal Description

Investigating the Devon Ice Cap subglacial lakes

(Extends work proposed under NRI License 02 005 19R-M)

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Field Team (May 2021-June 2021): Christine Dow (Assistant Professor, University of Waterloo), Siobhan Killingbeck (Postdoc, University of Waterloo), Martyn Unsworth (Professor, University of Alberta), Chris Nixon (PhD student, University of Alberta) James Killingbeck (Geophysicist).

Project Location:

1. Devon Ice Cap, Devon Island, Nunavut
2. Resolute Bay, Nunavut

Motivation: A recent study revealed the first evidence for a hypersaline subglacial lake complex beneath Devon Ice Cap, Canadian Arctic using airborne geophysical survey methods. These lakes are salty enough that they can exist at temperatures of -10.5°C where freshwater would rapidly freeze. As such, the lakes are globally unique and may represent a microbial habitat, which makes them compelling targets to ask fundamental questions about the existence, evolution and diversity of life in extreme environments on Earth and on other icy planetary bodies in the Solar System. The airborne geophysical data collected to date is highly effective at locating the upper surface of the lakes however, the airborne geophysical signals cannot penetrate through the lake. Therefore, to map the lake thickness, properties (e.g. salinity) and investigate the structure beneath the lake, multiple surface-based geophysical methods must be used.

Additional, the field team who are working on the Devon Ice Cap project are also part of a major geothermal energy initiative funded by NSERC. Geothermal energy can provide an efficient and low carbon source of energy. In the Canadian Arctic, ongoing research is investigating how subsurface heat could be used in Nunavut for direct heating of buildings which would greatly reduce oil and gas consumption. The electromagnetic instruments can image the subsurface to ~ 2 km depths and greatly assist in the selection of locations for drilling geothermal wells. This geophysical survey around Resolute Bay would also provide opportunities for outreach to the community and school.

Project Objectives:

1. To image and characterize the subglacial lakes under Devon Ice Cap, where the ice is ~ 800 m thick, using ground-based geophysical methods.
2. To explore for geothermal energy around Resolute Bay using electromagnetic methods.

Methodology: On Devon Ice Cap we will acquire three ground-based geophysical techniques: acoustics to map the lake thickness, time-domain electromagnetics to determine the lake properties, and magnetotellurics to investigate the structure and hydrology system beneath the lakes. At Resolute Bay, we will use the electromagnetic methods to image the subsurface structure

to define the thickness of the permafrost layer, map regions of saline and fresh groundwater and determine the distribution of rock layers at depth.

Data and Reporting: We anticipate that this research will result in numerous journal publications and presentations at international conferences. Results will be communicated to the Nunavut Research Institute (NRI) and local community. NRI will receive copies of published articles. Data resulting from this project will be released and archived upon publication for the use of other researchers and outreach efforts, and for long-term storage.