Newfoundland Ice Sheet Shelf (NISS) Survey

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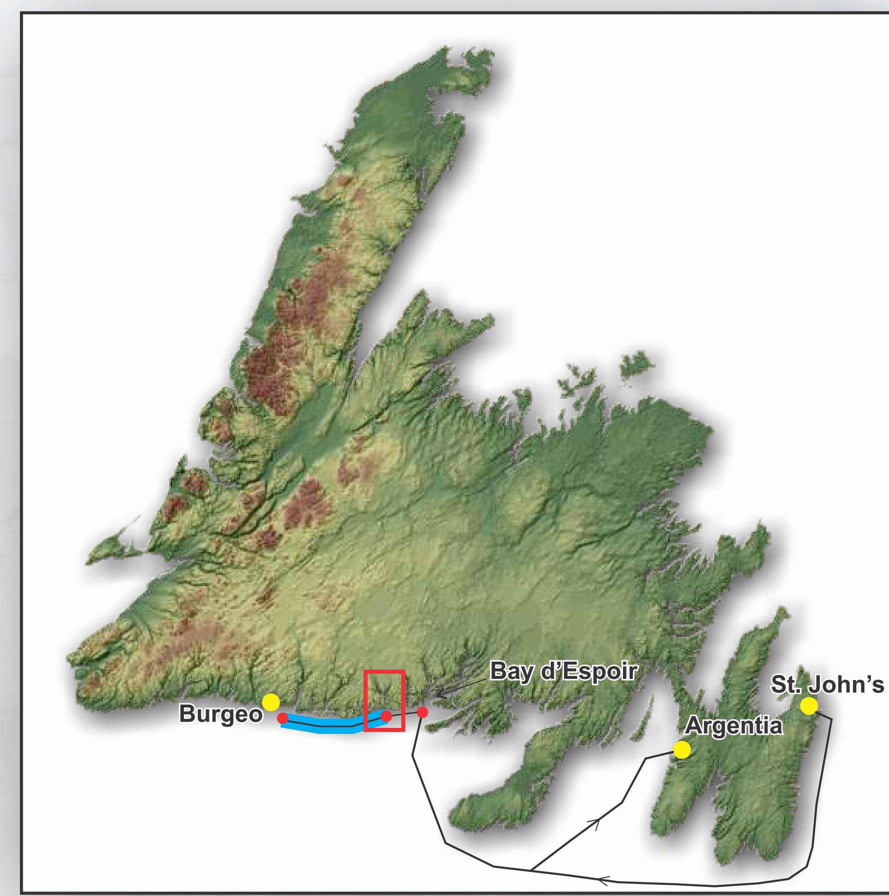
INTRODUCTION

The Newfoundland Ice Sheet Shelf (NISS) survey project is a collaboration of researchers from Ulster University (UU), the Marine Institute of Ireland (MII), Memorial University of Newfoundland (MUN) and the Geological Survey of Newfoundland and Labrador (GSNL) that is being funded under the National Research Vessels 2016 Ship-Time Programme.

The aims of this project are:
(1) to collect sediment cores, using a vibrocorer and gravity corer, from known submarine moraine locations; and
(2) to map fjord mouths and locate additional submarine moraine systems using multibeam and seismic surveys.

Materials contained within the cores can be carbon-dated to provide a time constraint on when the moraines were formed, and to reconstruct the pattern of Wisconsinan deglaciation of the Newfoundland Ice Cap, 18,000 years ago.



The Celtic Explorer left St. Johns and travelled 23 hours to the outer mouth of Bay d'Espoir. Coring locations are denoted with red circles, and multibeam and seismic surveys with a blue line. After completion of the survey, the ship returned to Argentia, Placentia Bay.

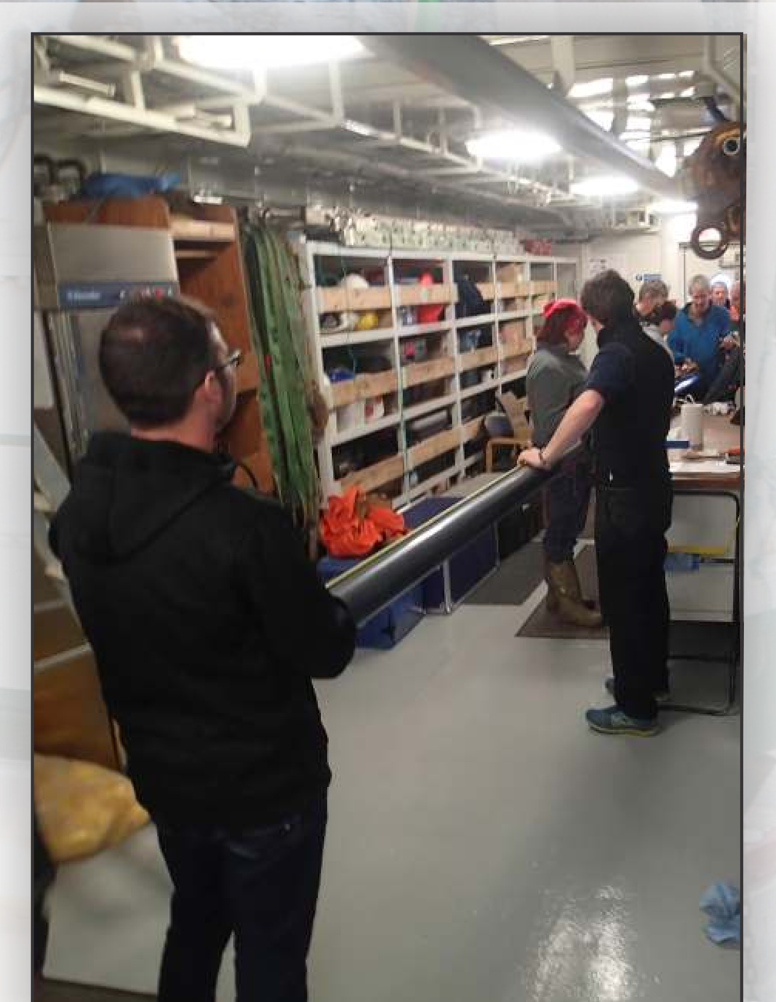
The research team spent three and a half days aboard the Celtic Explorer collecting data on submarine fjord-mouth moraine systems located on the inner shelf, along the south coast of Newfoundland between Bay d'Espoir and Burgeo.

The research crew standing in front of the MII ship Celtic Explorer. (L-R): Oisin McManus (MII), Heather Campbell (GSNL), Robert Deering (MUN), Paul Dunlop (UU), Serena Tarlati (UU), Denise McCullagh (UU), and Jennifer Organ (GSNL).

VIBROCORER

A vibrocorer is used for sampling unconsolidated submarine sediments. The core shaft contains a plastic liner, that is driven into the sediment by gravity; penetration is enhanced by vibration energy from an electrical source.

The vibrocorer can hold up to 6 m of core, 10 cm in diameter. Before being placed in the core shaft, the liner (right) is marked on both sides. This line indicates where the core will be split.



One side of the core is retained as the working half, from which samples are taken for analysis; the other side is preserved in the archive as an intact portion of the glacial sedimentary record.

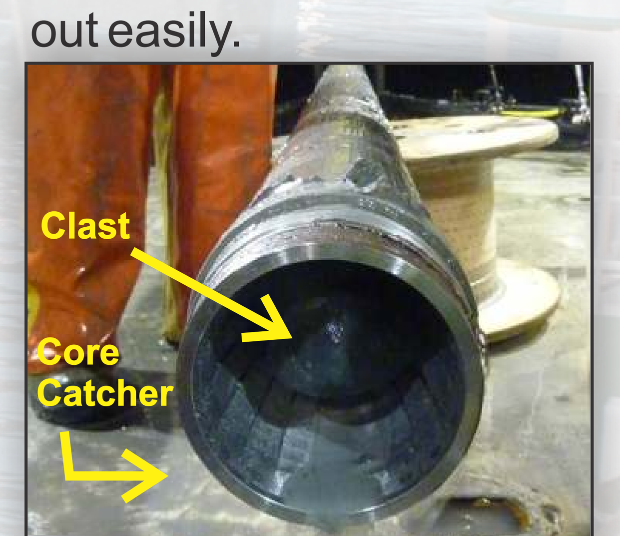
The vibrocorer is lowered to the seafloor, and at that location the GPS beacon records the exact coordinates of the sediment surface.

An ammeter on deck indicates when the vibrocorer has reached maximum depth, signaling for the viborcorer to be returned to the surface for sediment recovery.

Once the core shaft has been retrieved and put on deck, the core catcher (a small circular sieve like device that retains sediment while allowing water to drain) and the core liner are removed.

The picture below shows a clast stuck in the sieve of the core catcher; a good sign that there may be glacial diamicton inside the core liner.

With the core catcher removed, the liner slides out easily.



Note the competent (firm) dark grey glacial marine mud (above).

The core liner is then cut into 1m sections (right).

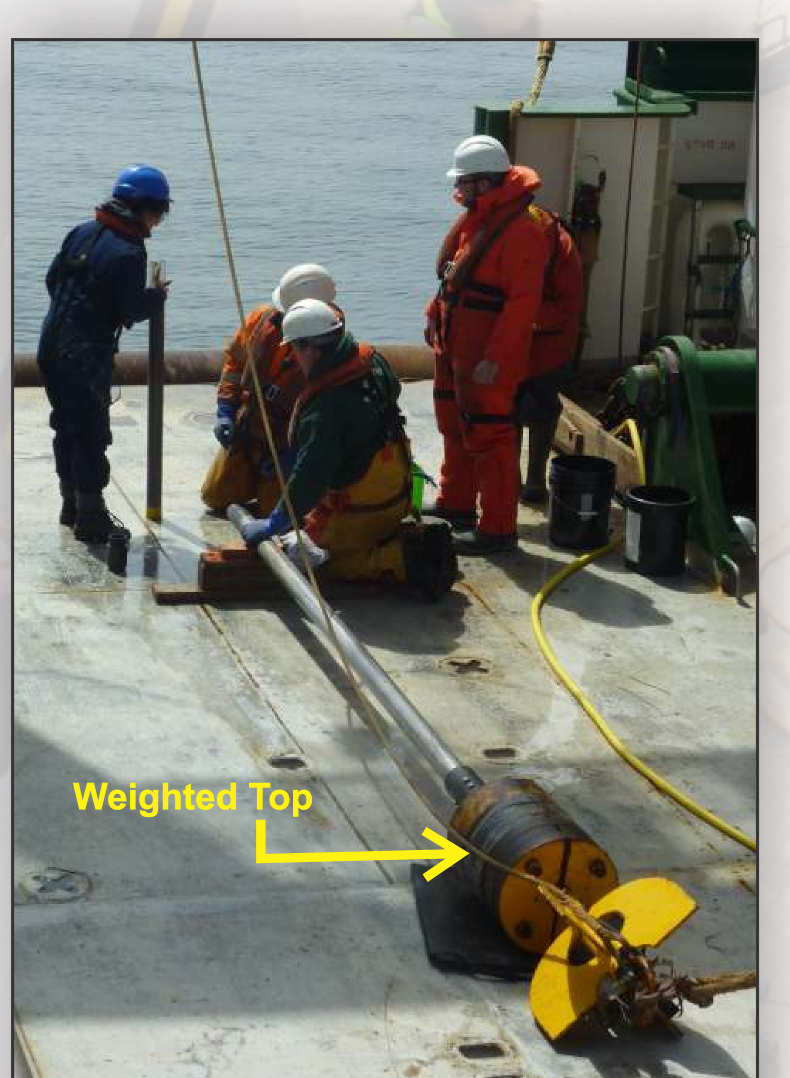
The visible sediment at each end of the core liner is described in a brief core log, with observations (including striated clasts, shell fragments, clast and matrix composition and sediment competency) recorded. The core liner is capped, and sent to the wet lab for labelling and packing.

Initially the vibrocorer worked well, recovering four cores up to 4.7m long, from seven sites, two of which contained the target glacial diamicton. Subsequently it suffered an electrical malfunction when the motor stopped working. However, the crew was well prepared for this contingency and a gravity corer was used instead.

GRAVITY CORER

The gravity corer is a smaller device, with a maximum recovery of 3 m and a diameter of 7 cm. The weighted top of the corer (bottom right of photograph) works with gravity to provide the momentum needed to penetrate the sea floor.

A disadvantage of the gravity corer is that it will likely only penetrate the glaciomarine mud covering the glacial diamicton, as the consolidated clast-rich nature of the glacial diamicton prevents the core shaft from penetrating below the surface of this unit.

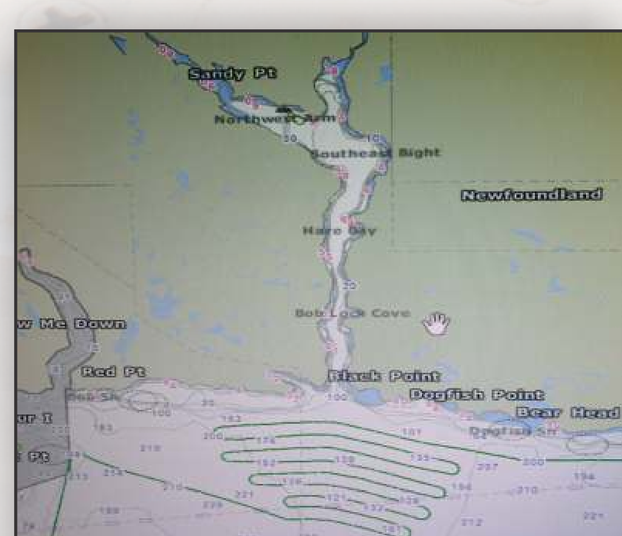


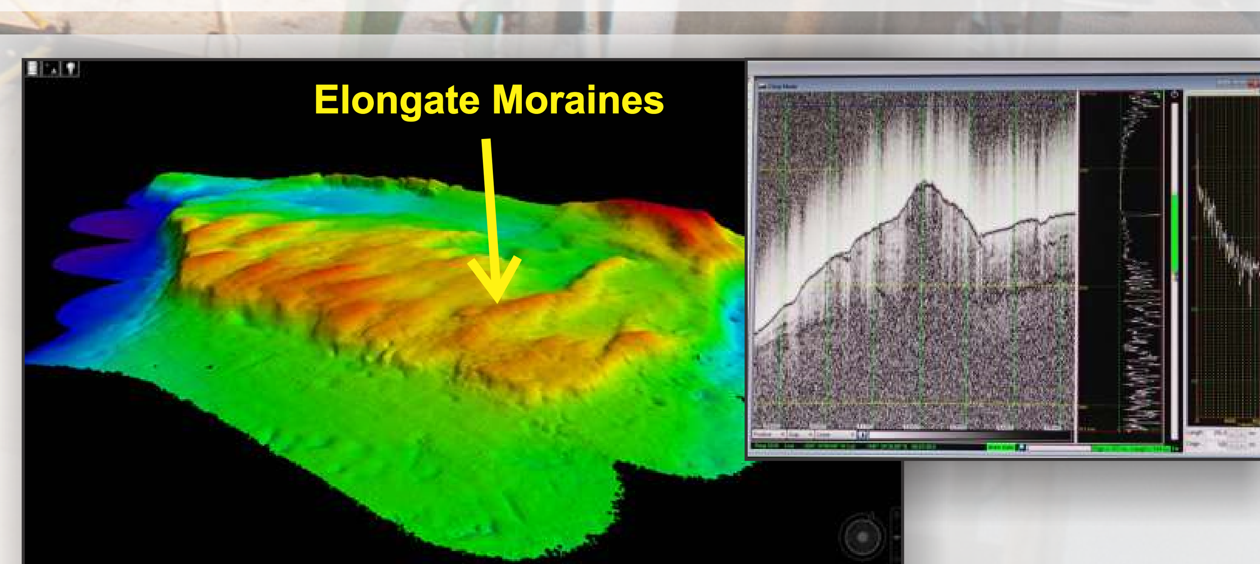
Out of nine sites, five were successful in recovering core ranging in length from 1-3 m. No material was recovered at two sites due to the hardness of the sea floor. Only the upper 50 cm of material was recovered from the remaining four sites.

MULTIBEAM AND SEISMIC SURVEY

The second phase of the project focused on conducting a multibeam and seismic survey at the mouth of Hare Bay (green line, below; red box, upper map) and between Hare Bay and Burgeo (blue line, upper map).

This will provide data and assist in identifying moraine systems at the mouths of the fjords.





(Above left) New multibeam data showing a number of elongate moraines forming a lobate shape at the mouth of Hare Bay fjord. (Above right) Seismic data showing a moraine ridge profile.

From these two surveys, coring sites were identified from which a gravity corer was used to retrieve sediment.

The survey concluded on the Hare Bay moraine system which was newly identified during the multibeam survey. Over 12 m of core was collected from eight sites; one of the core contained glacial diamicton with shell fragments which will be radio-carbon dated to provide an age of formation of the moraine system.

Overall, project was a great success with over 24 m of core recovered, a morainal system at the mouth of Hare Bay identified for the first time, and over 65 nautical miles of high-resolution multibeam and seismic data collected. Reports and data from this survey will clarify the chronology of ice retreat in southern Newfoundland and elucidate patterns during the Wisconsinan deglaciation.