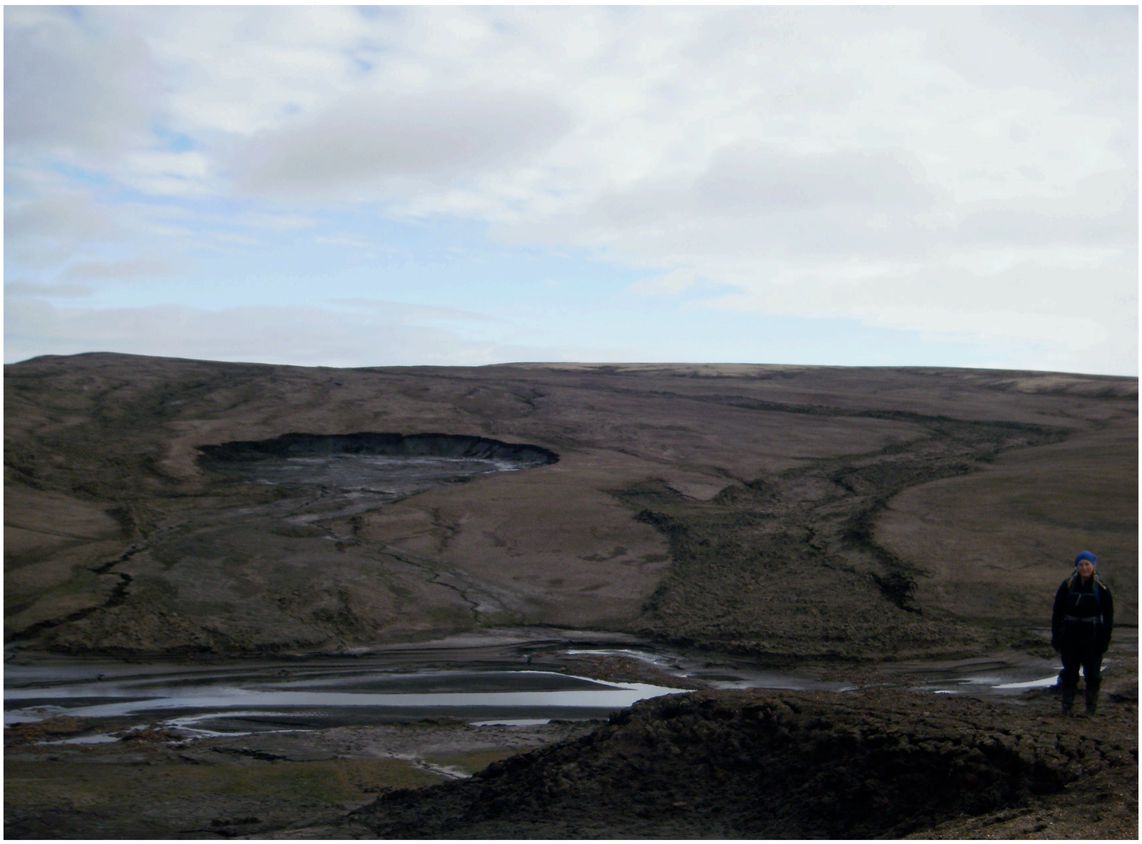
Report of 2012 Field Activities
Drake Point, Sabine Peninsula, Melville Island

High Arctic permafrost landscape stability and water quality, Sabine Peninsula, Melville Island, Nunavut



Dr. Melissa Lafrenière
Department of Geography
Queen's University, Kingston, ON K7L 3N6
Phone 613-533-6000 x 78720
Email: Melissa.lafreniere@queensu.ca

Nunavut Science Research Licence No02-105- R-M

February 12, 2013

2012 Field Activities
In the summer of 2012, we investigated water chemistry, permafrost disturbances, and permafrost temperatures across the large study area (150 km^2) near Drake Point, Melville Island.76 deg 27' N, 108 deg 33' W). The field season was approximately 2 weeks (July 15th- to August 31st) with two people in camp during this period. Our field site was located near Cape Collingwood (76°30’4” N, 108°39’20”W), where there is a reliable airstrip and a source of drinking water near by.

We collected water and sediment samples from streams, ponds and mud ejections across the study area. Mud ejections are pools or cones of mud that has been squeezed up from deep beneath the ground surface. We also mapped permafrost disturbances in different types of bedrock and soils. This is important to help us understand why disturbances occur in some areas and not others. Finally, we collected data from three stations that were recording air and ground temperatures over the fall and winter of 2011-2012.

Community activities
We have not met with the community to discuss our work, as we had few results to share until very recently. M. Lafrenière plans to arrange to meet with community members in Resolute Bay in May 2013 to present these results to the community members, ahead of one of her trips to Resolute for fieldwork.

Preliminary results
The disturbance mapping reveals that the greatest area and number of disturbances were found in areas where the underlying bedrock was shale. These shale bedrock areas also contained the greatest amount of ground ice, which likely plays an important role in the formation of landslides. A preliminary hazard susceptibility map has been created for the study area, that highlights areas that have low, moderate and high susceptibility to permafrost slope disturbance.

The air and ground temperature data collected in 2011-2012 show that proximity to the ocean has a cooling effect on permafrost in the study area.

Analyses from water samples collected in 2012 indicate that high amounts of dissolved minerals in stream and pond waters likely comes from melting of ground ice near the top of the permafrost (the transient layer). Ponds with higher dissolved mineral content had higher nutrient content, indicating that water inputs from deeper permafrost thaw augment biological activity relative to similar ponds where thaw depth is shallower. Our analysis of mud ejections shows that these mudflows are chemically similar to seawater and are likely fed by stored water from the transient layer or even deeper stored brines. The results indicate that the storage of water in the subsurface allows for breakdown of minerals, nutrient production, and salinization of meltwater in the transient layer. Mud ejections can therefore deliver dissolved organic carbon, nutrients, and metals from the subsurface to the surface, where surface water flow can redistribute these materials to downstream ecosystems. The mud ejections also contain an active microbial community. We are analysing the DNA from these features to determine the types of organisms that are being brought up from the subsurface.

Results from satellite images and fieldwork in 2011 and 2012 indicate that by combining different types of satellite images (optical and radar) it is possible to accurately map and monitor the abundance of vegetation and soil moisture across large areas, and at very fine spatial scales (e.g. for areas less than 1 km^2 in some cases)

Proposed activities for 2013

We plan on having will have 2-4 people in camp for three weeks, from July 10th to August 1st, 2013, for a total of approximately 55 person days. Field activities in 2013 will focus on characterizing how river and pond water quality and biological activity varies with the depth of seasonal thaw, and input of water from the subsurface. We will resample some of the ponds examined in 2013 to better determine the processes and organisms responsible for nutrient production. We will sample stream water and measure flow volumes in order to better characterise the impact of sources of subsurface water on water quality in rivers. We will continue to collect satellite images and to survey disturbance features and map variations in surface soil moisture to refine our ability to monitor and map changes in soil moisture and permafrost disturbance. We sill also record observation of vegetation communities types on the ground, to determine if the vegetation map that we have made from satellite images is accurate.