Ground ice and geochemical variability in nearby permafrost cores from Eureka, Nunavut

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1) BACKGROUND

'Permafrost' refers to perenially-frozen ground (French, 2017). The study of permafrost is important in the context of the effects of climate change on periglacial landscapes. Kokelj et al (2017) predict that Arctic permafrost landscapes will undergo geomorphic changes in response to climate change and rising temperatures. This project analyzes permafrost cores taken from the Eureka Sound Lowland in Nunavut, which is a continuous permafrost zone with thick permafrost (Roy, Master's Thesis, 2017).

Figure 1: Eureka, Nunavut site. Source: Google Maps Screenshot

Figure 2: Eureka, Nunavut landscape. Source: By ceedub13 (2005 Eureka, NU) [CC BY 2.0 (http://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons

2) ABSTRACT

This project investigates the variability between nearby cores of permafrost, taken from Eureka Sound Lowland, Nunavut. Until now, permafrost cores have been analyzed under the assumption that there is little local variability in the contents of the permafrost, even between samples that were collected in close proximity. The purpose of this study is to determine whether local variability exists among permafrost cores that were collected ~1m distance from each other. The variables in the permafrost analyzed are: excess ice content, organic matter and carbonate contents. These components of two adjacent permafrost cores, both 1.5m in length, were statistically compared in order to examine any potential variation in contents. This study is part of a larger project that seeks to identify the chemical variations in permafrost, as well as identify processes involved in ground ice formation in the continuous permafrost region of Eureka Sound Lowlands of Ellesmere and Axel Heiberg islands (Roy, Master's Thesis, 2017). Ultimately, the results of this research will help to indicate accuracy in permafrost sampling techniques, and thus help to improve the methods involved in the increasing field of research of permafrost environments.

Figure 3: Coring process during field work in Eureka. Source: Professor Wayne H. Pollard

3) METHODS

- Two permafrost cores, BT1 and BT2 were taken from the Eureka Sound Lowland, Nunavut in summer 2017 using a SIPRE corer (see Figures 1-3).
- The cores were then cut into 2 cm sub-samples for analysis.
- The variables that were analyzed and compared were: excess ice (%), organic matter (%), and carbonates (%).
- Organic matter and carbonates contents were determined using the Loss On Ignition method. (Heiri et al., 2001)

4) RESULTS

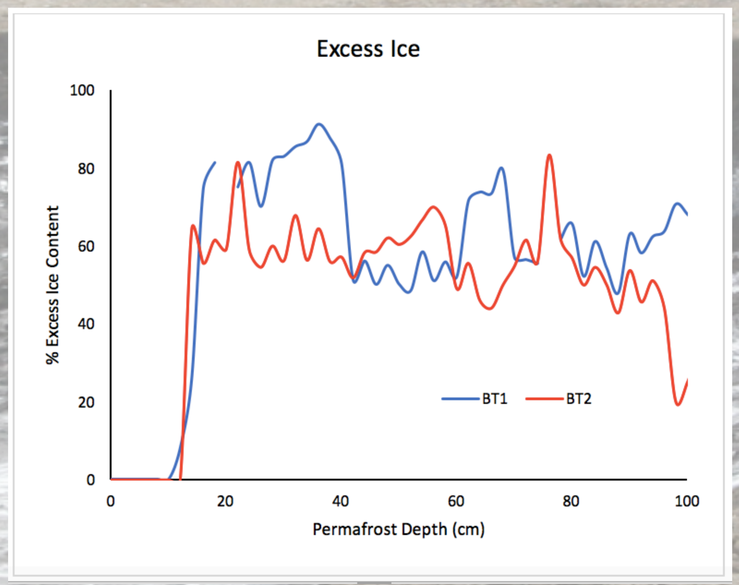

Figure 4: Percentage of Excess Ice Content in BT-1 and BT-2 permafrost cores, Eureka Sound Lowland, NU.

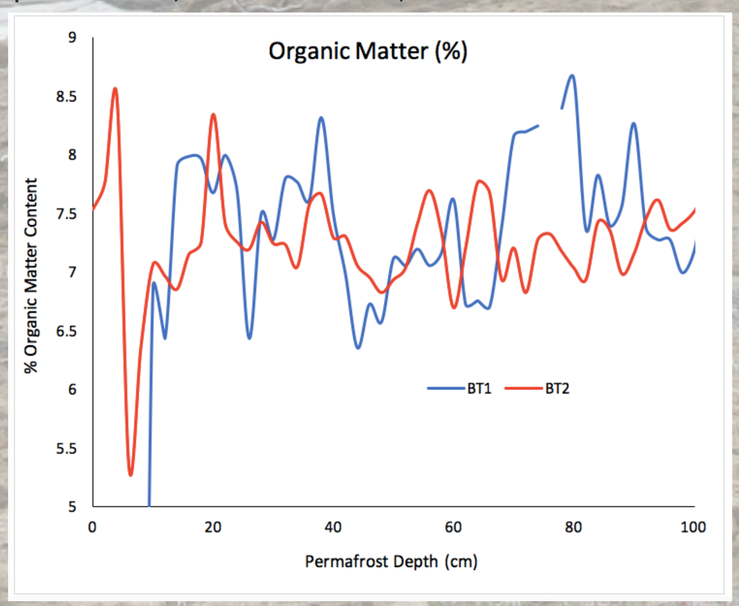

Figure 5: Percentage of Organic Matter Content in BT-1 and BT-2 permafrost cores, Eureka Sound Lowland, NU.

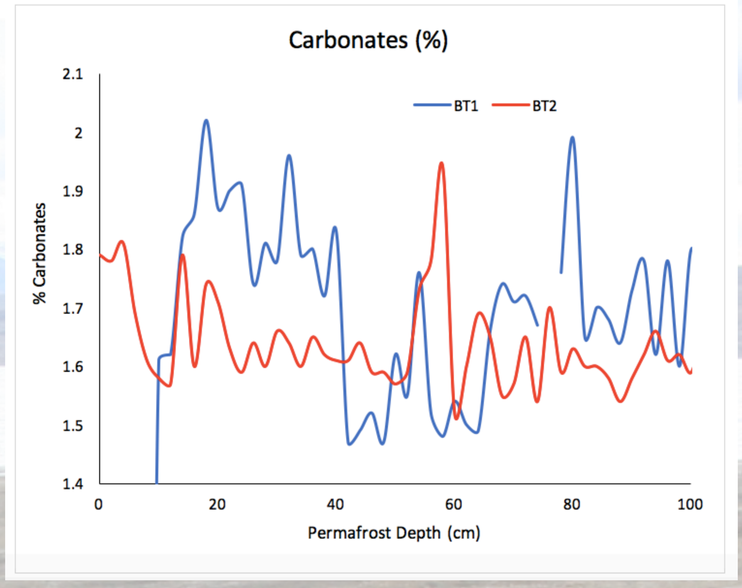

Figure 6: Percentage of Carbonates Content in BT-1 and BT-2 permafrost cores, Eureka Sound Lowland, NU.

Variable	Core BT1	BT2
Excess Ice		
Average	63.4	47.8
Standard Deviation	16.1	21.8
Organic Matter		
Average	7.4	7.3
Standard Deviation	0.6	0.5
Carbonates		
Average	1.7	1.6
Standard Deviation	0.1	0.1

Table 1: Descriptive statistics for Excess Ice, Organic Matter and Carbonates Content in BT-1 and BT-2 permafrost cores, Eureka Sound Lowland, NU.

5) DISCUSSION & CONCLUSIONS

Although there is some vertical variation in excess ice, organic matter and carbonate contents (Figures 4-6), overall there was little significant variability in the excess ice, organic matter, and carbonates content between cores BT1 and BT2.
The greatest variability between content variables (Table 1), was in the excess ice, which is to be expected as water can still be displaced throughout permafrost. Averages and standard deviations of the organic matter and carbonates between both cores had similar values.

Variability between the two permafrost cores was thus insignificant based on organic matter and carbonates content. This confirms that samples of permafrost in close proximity can be analyzed together under the assumption that there is little variability in their contents.

6) REFERENCES AND ACKNOWLEDGEMENTS

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Background photo: Eureka, NU landscape. Source: Professor Wayne H. Pollard.