Histories of Arctic climate and environmental contaminants from a shallow ice core, Mt. Oxford, Ellesmere Island

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Introduction: With the support of the AAC, I drilled an ice core on the plateau of Mt. Oxford, a peak on northern Ellesmere Island, Nunavut, in the Canadian high Arctic in May 2017. This new ice core will allow me to investigate Arctic Ocean sea-ice variability, as well as climate and pollutant histories in this important and under-studied region of the Arctic. This new ice core will complete a suite of four ice cores (the other three drilled by myself in May 2015 and April 2016 on Devon Ice Cap, Prince of Wales Icefield, and Agassiz Ice Cap), offering powerful insight into the spatial variations in accumulation, moisture source, contamination, and marine aerosol deposition across the eastern Canadian high Arctic.

Purpose: The goal of this project was to drill a shallow ice core from Mt. Oxford, Ellesmere Island to: (1) reconstruct climate and Arctic Ocean sea ice histories, and subsequent effects of sea ice variability on ice cap dynamics, (2) explore how dynamics in the tropics control Arctic Ocean sea ice behavior and marine aerosols delivered to this understudied region of the Arctic, and (3) investigate how pollutant aerosols in the region have changed from the pre-Industrial era to present. Records from this new ice core will be particularly powerful as a spatial comparison dataset with records from the ice cores mentioned above (drilled over the past two seasons by myself). Validation of the use of sea ice proxies in ice cores from Mt. Oxford will complement ongoing work on other ice caps in the high Arctic, enabling future reconstructions of Arctic sea ice variability prior to the satellite era. Ultimately, this ice core record will lay the groundwork for future deep ice coring on Mt. Oxford aimed at investigating the coupled variability of Arctic climate and sea ice over longer timescales.

Methods: I will be analyzing this ice core using suppressed ion chromatography; data will include MSA, Na, Cl^-, Mg, Ca, NH_4, K, NO_3, and SO_4. Oxygen isotopes will be measured as well, and will allow for temperature reconstructions that aid in dating. Chemical time series from the new Mt. Oxford ice core will be compared with ice core results from the summit of Prince of Wales Icefield, Agassiz Ice Cap, and Devon Ice Cap (all in the Canadian high Arctic), offering insight into spatial variations in accumulation, climate, and moisture source variability. By additionally analyzing air mass back trajectories, we can determine the moisture source regions of air masses reaching the northernmost reaches of the Canadian Arctic's Queen Elizabeth Islands, which contain 14% of the global glacier and ice cap area.

A short walk to work. Field camp (in background) on northern Ellesmere Island consists of three tents, and also marks the spot where the Twin Otter lands and takes off. The core site is just a short walk away on the icecap, in an area free of contamination from humans and planes.

Ice coring under the midnight sun (yes, this is the middle of the night)!

Discussion: Analysis of this valuable new ice core will allow us to investigate interactions between Arctic sea ice variability, Arctic climate, and ice cap mass balance in the far north of Ellesmere Island. My previous related work in the Antarctic utilized a suite of ice cores in a similar fashion, which proved valuable in comparing ice core chemistry from locations that capture local phenomena with locations that capture regional sea ice variability (*1*, *2*). Here, I anticipate that the Mt. Oxford ice core will capture regional Arctic Ocean and Baffin Bay conditions as well as large-scale pollutant fingerprints, as shown in very recent work on Prince of Wales Icefield, Nunavut (*3*).

This was an incredibly successful field campaign, and I look forward to sharing the results with the AAC once I have analyzed the ice core this fall and submitted manuscripts for publication!

References:

1. Criscitiello et al., *J. Geophys. Res.* **118**, 118-130 (2013)
2. Criscitiello et al., *J. Clim.* **27**, 1343-1363 (2014)
3. Criscitiello et al., *J. Geophys. Res.* **121**, 9492-9507 (2016)

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