Molecular signatures of dissolved organic matter in a changing Arctic

A. KELLERMAN[1,2*], J. VONK[3], M. HUMAYUN[2], S. MCCOLAUGH[1], E. WINDEN[3], J. HAWKINGS[1,4], R. SPENCER[1]

[1] Department of Earth, Ocean and Atmospheric Sciences, Florida State University, Tallahassee, FL, USA *akellerman@fsu.edu

[2] Geochemistry, National High Magnetic Field Laboratory, Tallahassee, FL, USA

[3] Vrije Universiteit Amsterdam, Netherlands

[4] German Research Centre for Geosciences GFZ, Potsdam, Germany

Glaciers and ice sheets cover over 10% of land surface area and store a significant amount of organic matter. When exported to proglacial environments as dissolved organic matter (DOM), this material has been shown to be highly bioavailable in downstream ecosystems. Furthermore, recent rapid glacier mass loss is hypothesised to have increased fluxes of DOM from these environments. Glacial DOM can either be derived from ancient organic matter previously stored cryogenically or held in subglacial stores, atmospheric deposition, and recently produced DOM in either supraglacial or subglacial environments. DOM is a central component of the global carbon cycle and plays a multifacted role in ecosystem functioning; for example, forming the base of the microbial food web, and complexing and stabilizing bioessential metals. However, the detailed molecular composition of glacially-derived DOM has only been studied for a handful of glaciers and the impact continued glacial loss will have on DOM composition is not well established.

Here we present data from a diverse set of glacial environments, including Greenland and Svalbard, and highlight the dominance of energy-rich aliphatic DOM in glacially-sourced meltwaters. Using a space-for-time substitution of catchments with varying degrees of glacial coverage in place of glacial retreat, we show the energy-rich aliphatic DOM characteristic of glacier dominated catchments is quickly lost as glacier coverage declines. Aliphatic DOM is particularly abundant in supraglacial meltwater, suggesting the DOM quickly metabolized in previous incubations of glacial water originates from supraglacial sources. Therefore, loss of glacier mass will have ramifications for carbon cycling in downstream receiving ecosystems with less high quality fuel for microbial degradation.