The Geochemistry of Surface Ice on the Greenland Ice sheet and its effect on the Primary Production of Microbes.

ALEXANDRA HOLLAND[1], CHRISTOPHER WILLIAMSON [2], FOTIS SGOURIDIS[3], MARTYN TRANTER [4], ALEXANDRE M. ANESIO[5], AND THE BLACK AND BLOOM TEAM[6].

[1,3] School of Geographical Sciences, University Rd., Bristol. (ah16063@bristol.ac.uk, f.sgouridis@bristol.ac.uk)
[2,4,5] 12 Berkeley Square University Rd., Brisol. (c.williamson@bristol.ac.uk, m.tranter@bristol.ac.uk, a.m.anesio@bristol.ac.uk)

Microbial communities have recently been shown to play key roles in the bio-albedo of the Greenland Ice Sheet (GrIs) and consequent melt rates. As such, there is significant interest in understanding how these microbial communities survive and thrive in such harsh and oligotrophic conditions. Current knowledge gaps include the effect of nutrient limitation on the primary production of surface ice microbial communites, and the impact of microbial production on dissolved organic carbon (DOC) concentrations. This study sampled a small section of the GrIS surface, approximately 35km inland from the margin, throughout the 2016 melt season. We report nutrient [phosphate, ammonium, nitrite, nitrate, total phosphorus, and total nitrogen] and DOC concentrations. Sampling focused on five main habitats representative of the supraglacial landscape, namely: surface ice with low, medium and high levels of visible particles, supraglacial stream water and cryoconite hole water. Concentrations of inorganic nutrients ranged 0.5-3ppb for PO_4^{3-}, 13-22ppb for NH_4^+, and 0-9.5ppb for NO_3^1 across the five representative habitats. In contrast, nutrients were found in higher concentrations in their respective dissolved organic phases with TP reaching 1.5-7ppb and TN reaching 8.5-250ppb. Concentrations of dissolved organic phosphorus (DOP) were found to be 2-3 times higher than inorganic fractions, while close to 99% of nitrogen was found in the dissolved organic phase (DON). DOC concentrations ranged from 80ppb to as high as 7ppm. The high relative concentrations of DON, DOP, and DOC, provide strong evidence for efficient nutrient cycling by microbial communities on the ice surface. Relatively low concentrations of DON, DOP and DOC in supraglacial stream water suggest that microbial habitats facilitate retention of such nutrients within the ice surface, permitting their continual reuse and recycling. Hence, microbial processes increase the localised concentration of both nutrients and DOC in ice surface habitats on the GrIS.