Dining on dust? Examining the link between mineral dust and microbial life in supraglacial habitats

JENINE MCCUTCHEON[1], CHRISTOPHER WILLIAMSON[2], JOSEPH COOK[3], ANDREW TEDSTONE[2], STEFANIE LUTZ[4,5], SIOBHAN WILSON[6], ANTHONY STOCKDALE[1], ALEXANDRA HOLLAND[2], JAMES MCQUAID[1], MARTYN TRANTER[3], LIANE G BENNING[1,4,7]

[1]University of Leeds, Leeds, United Kingdom, j.mccutcheon@leeds.ac.uk
[2]University of Bristol, Bristol, United Kingdom
[3]University of Sheffield, Sheffield, United Kingdom
[4]GFZ, German Research Centre for Geosciences, Potsdam, Germany
[5]Agroscope, Wädenswil, Switzerland
[6]University of Alberta, Edmonton, Canada
[7]Free University of Berlin, Berlin, Germany

Light absorbing particulates (LAPs) reduce the albedo of the Greenland Ice Sheet (GrIS), thereby increasing surface melting and ice mass loss. LAPs found on the GrIS include algae, mineral dust, and black carbon. Blooms of pigmented ice algae[1,2] can cover up to 78% of the ice sheet surface in the SW margin and may be responsible for up to 29% of the albedo loss in this region in recent years[3].

Ice algal blooms form in a layer of meltwater at the interface between the cryosphere and the atmosphere. In this study, we use electron microscopy to examine ice algae and other LAPs, which collectively exist as complex aggregates of biological and lithological materials. Results of Rietveld refinement of X-ray diffraction data of LAP samples collected along a transect across the ablation zone suggest that biological weathering may play a role in the evolution of supraglacial dust mineralogy. Characterisation of the nutrient availability in this environment indicates that the system is likely phosphorus limited, and nutrients are retained within the microbial community[4]. The combined results of mineralogy and solid-phase nutrient analyses suggest that algal biomass accumulation may be closely linked to the availability of mineral phosphorus. These outcomes indicate that microbe-mineral interactions may augment ice algal bloom development, thereby contributing to albedo loss and surface melting of the GrIS.

[1]Williamson et al. *FEMS Microbiol. Ecol.* 94(3) (2018). [2]Lutz et al. *Microbial Genomics* 2018(4). [3]Cook et al. Under review. *The Cryosphere*. (2019). [4]Holland et al. Under review. *Biogeosciences*. (2019).