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Rates of autotrophic and heterotrophic activity in samples of Greenland cryoconite incubated under varying light intensity.

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Irvine-Fynn and Edwards (2013) showed the traditional view of ice-surface microbes as limited to cryoconite holes and surficial algal blooms to be oversimplified; rather, microbes can be ubiquitous and constantly transported throughout the weathering crust. The weathering crust represents a zone of low density ice in the top ∼2m of glacier surfaces through which water, ions, organic and inorganic molecules and cellular biomass are constantly transferred. The hydrologic properties of the weathering crust are thought to evolve over summer due to progressive degradation of the surface ice due to exposure to solar irradiance. Incoming solar radiation is attenuated with depth in the weathering crust, likely establishing a range of habitable 'photic zones'. In these photic zones, microorganisms are probably subjected to various environmental stresses, primarily related to light intensity. For example, intense irradiance in near-surface zones might be associated with photo-protective adaptations, whereas at the deepest extent of the weathering crust physiological adaptations related to maximising phototrophic efficiency might dominate.

The continuous transfer of microbes between photic zones puts doubt upon current estimates of nutrient fluxes in the supraglacial environment that focussed exclusively upon cryoconite and surface algae. Furthermore, future climate warming is likely to enhance the transfer of microbes between photic zones due to enhanced melt runoff and energy balance shifts that destabilise cryoconite holes. Therefore, deeper knowledge of microbial activity throughout the weathering crust is crucial for understanding nutrient cycling, biodiversity and biotic-abiotic interactions on glaciers.

This study makes initial investigations into the likely responses of cryoconite microorganisms to redistribution between photic zones within the weathering crust by monitoring Net Ecosystem Productivity (NEP) using the Total Dissolved Inorganic Carbon method and rates of photosynthesis using pulse amplitude modulation (PAM) during laboratory incubations of Greenland cryoconite under varying light intensities. Preliminary investigations suggest that Greenland cryoconite 'awoke' to full activity within 24 hours of thawing from cold storage, and showed maximum rates of photosynthesis at light intensities between 700 and 900 Wm-2.

References:

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