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Organic carbon dynamics in pigmented algal blooms on the Greenland Ice Sheet surface

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Pigmented algae colonizing the snow and ice darken the surface of glaciers and ice sheets, enhancing light absorption and accelerating melting. On the Greenland Ice Sheet (GrIS) meltwater availability further promotes snow and glacial ice-algae blooms. The amount and composition of the organic matter (OM) in these blooms are modulated by the relationship between carbon-fixing algae and carbon-respiring heterotrophic microorganisms. Until now, the OM variability from these algae-dominated habitats on the GrIS remains unclear. We address this knowledge gap by incubating algae-dominated snow and ice surface samples *in situ* under light and dark conditions. We evaluated the initial microbial community composition in the snow and ice samples via 16S and 18S rRNA gene sequencing and evaluated the molecular variability of both dissolved and particulate OM (DOM and POM), with help of ultrahigh-resolution Fourier transform ion cyclotron resonance mass spectrometry. We demonstrate that habitats dominated by the glacier ice-algae *Ancylonema* have a higher abundance of highly unsaturated and aromatic compounds, resistant to bio- and photo-degradation. In contrast, habitats dominated by the snow-algae *Chloromonas*, are enriched in bioavailable and more photosensitive unsaturated aliphatics and sulfur- and phosphorus-bearing compounds. Light exposure increased water-soluble DOM compounds derived from POM, that represented large proportion of the initial DOM composition of both algae habitats. Of these initial DOM pools, up to 50% were heterotrophically degraded in the dark, while light alone photodegraded less than 20%. The substantial accumulation of light-absorbing aromatics in both POM and DOM at the end of the ice-algae incubations, demonstrates the greater effect of ice-algae on altering glacier color compared to snow-algae, and consequently on decreasing glacier albedo and accelerating melting.