Relationship between carbon, nitrogen and algal communities in Arctic glacial settings

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Snow and glacial ice cover about 10% of Earth's surface and their surfaces are colonized by various extremophilic microbial communities. Among these, green and red snow algae and ice algae are important primary colonisers and producers[1]. Furthermore, due to the development of variable pigmentation during their life cycle and their wide-spread and seasonal distribution they can have a significant effect on surface albedo. Snow and ice algae survive and even thrive in harsh cryogenic environments, yet, the relationships between environmental conditions and microbial abundance, diversity and function are still poorly understood.

Here we present results from a study on C and N cycling on 6 glaciers around Kongsfjoerden (Svalbard, Norway) during the 2013 summer melt season. A total of 66 samples representing various habitats were analysed for carbon (TC, OC, DOC, biomass and C isotopes), and nitrogen (TN, DIN and N isotopes) species and the results were cross-linked to biochemical inventories (algal metabolic fingerprints, pigment and fatty acid compositions) as well as microbial diversity and function (18S and 16S rRNA and metagenome sequencing). With a total carbon content (dry sediment weight) of up to 35% (mainly organic C) and DOC values of up to 100 μM C, it is clear that areas with high abundance of algae are an important source but also a prime recycler of carbon in the various glacial habitats. Similar trends in C/N ratios were observed for all glaciers with the highest nitrogen limitation in areas colonised by red snow algae (16 ± 2.8), followed by ice algae (11 ± 1.3) and green snow algae (10 ± 2.7). This N limitation can be linked to high bulk lipid and secondary carotenoid contents found in red snow algae. $d^{15}N$ values ranged between -8.9 and 4.2‰, but were predominantly negative reflecting the atmospheric source of the nitrogen and near complete N assimilation. Overall, algal communities contribute significantly to the C budget on all studied glaciers. However, N availability plays a major role in controlling their abundance, diversity and function.

[1] Lutz *et al* (2014). FEMS Microbial Ecology (in review).