Active microbial ecosystem in glacier basal ice fuelled by iron and silicate comminution-derived hydrogen

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Abstract

The basal zone of glaciers is characterised by physicochemical properties that are distinct from firnified ice because of strong interactions with underlying substrate. Basal ice ecology and the roles that the microbiota play in biogeochemical cycling, weathering, and proglacial soil formation, remains poorly known. We report bacterial diversity and potential ecological roles at three temperate Icelandic glaciers. We sampled three physically distinct basal ice facies (stratified, dispersed, debris bands) and found biological similarities and differences between them; basal ice character is therefore an important sampling consideration in future studies. High abundance of silicates and Fe-containing minerals could sustain the basal ice ecosystem, in which chemolithotrophic bacteria (~23%), especially Fe-oxidisers and hydrogenotrophs, can fix C, which can be utilised by heterotrophs. Methanogenic-affiliated detected sequences showed that silicate comminution-derived hydrogen can also be utilised for methanogenesis. Metabolism predicted by 16S rRNA diversity revealed that methane metabolism and C-fixation are the most common pathways, indicating the importance of these metabolic routes. Carbon concentrations were low compared to other ecosystems, but we report the highest carbon concentration in basal ice to date. Carbon release from melting basal ice may play an important role in promoting pioneering communities establishment and soil development in deglaciating forelands.

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