Geophysical Research Abstracts
Vol. 20, EGU2018-898, 2018
EGU General Assembly 2018

The secret life of icy bacteria: physiological adaptations to the variability of cryoconite hole environments.

Ewa Poniecka (1), Elizabeth Bagshaw (1), Henrik Sass (1), Christopher Williamson (2), Alexandre Anesio (2), and Martyn Tranter (2)

(1) Cardiff University, School of Earth and Ocean Sciences, United Kingdom (ponieckaea@cardiff.ac.uk), (2) University of Bristol, Bristol Glaciology Centre, Bristol, United Kingdom

Polar regions serve as a natural laboratory to study simplified microbial and biogeochemical processes in habitable niches. An example of such niches are cryoconite holes, regarded as hotspots of microbial processes on glacier surfaces. Microscale measurements of oxygen show that the cryoconite environment is spatially and temporally variable, with complex feedbacks between physical and biogeochemical conditions. Within the community, heterotrophic bacteria are believed to sustain the ecosystem by decomposing organic matter and releasing nutrients. Data on how microorganisms, especially anaerobic ones, function in cryoconite holes are, however, scarce.

We applied a range of microbiological tests to understand the physiological capabilities of the most abundant cultivable microorganisms from cryoconite holes worldwide (Greenland, Svalbard, Antarctica). Oxic and anoxic conditions were applied to mimic the microniches within the habitat. The growth of bacteria was assessed under a range of treatments: freeze-thaw cycles, temperature gradients, and varying organic carbon substrates.

In anaerobic incubations, the largest proportion of community was able to grow in the lowest tested temperature (0.2°C). Furthermore, most of the anaerobic strains were able to thrive in oxic conditions. Similarly, many oxic strains were able to survive without oxygen. Freeze-thaw incubations revealed the contrasting capacity of microorganisms to survive multiple cycles, depending on the presence of a cell wall. The heterotrophs were able to utilize a wide range of carbon substrates, with preference to less complex organic compounds.

Our study demonstrates that heterotrophs of cryoconite holes are adapted to fast – changing environmental conditions by their ability to survive multiple freeze-thaw cycles and changing oxygen conditions, and scavenging a wide range of organic substrates. The elevated growth of the anaerobic part of the community in the lowest temperatures indicates they might be key players in winter conditions or in early melt season, when the oxygen is likely depleted and accumulated dead cells provide a source of organic matter for scavenging. Consequently, anaerobic heterotrophs might contribute to spring time 'ionic pulses' and the reactivation of the community after the polar night.