Dr A J Hodson

Peter installing monitoring equipment on the surface of Midre Lovenbreen.

Life on ice

Seemingly inhospitable ice can support thriving microbe communities, says Peter Wynn.

Glaciers and ice sheets can at first seem cold, hostile and inhospitable to life, but polar scientists are beginning to think they actually sustain thriving populations of micro-organisms. It's not as unrealistic as it sounds. Communities of microbes have been found on glaciers and ice sheets all over the world, most remarkably in Arctic and Antarctic regions where sub-zero temperatures provide some of the world's most inhospitable climates. Microbes are found not only within the cold winter snowpack, but also as a biofilm (a thin layer of meltwater containing micro-organisms), and within small cylindrical melt pools on the surface of the glacier, known as cryoconite holes. Tell-tale signatures from the nitrogen isotopes contained within the organic matter here suggest these microbes may be fixing substantial quantities of nitrogen from the atmosphere and locking it into the glacial nutrient cycle.

Microbes are also found within meltwaters bursting out under pressure from beneath glaciers, where they thrive despite the extreme temperatures and pressures. Feeding on nutrients and organic matter washed in from the surface of the glacier, these microbes influence nutrient cycling. During the winter, when the drainage system beneath the glacier is poorly connected to the atmosphere, chemical evidence suggests some of the microbes cause reactions such as denitrification. Here, nitrate is converted to nitrogen gas, reducing the amount of nutrients available for transport away from the glacier. However, during spring, as the drainage system begins to carry more meltwater and develops a connection to the atmosphere, more oxygen becomes available, and resident microbial communities switch to a process known as nitrification. This now increases the amount of nitrate leaving the glacier in the meltwaters.

Glacial microbes can help us understand biogeochemical cycling and how nutrients are transferred to neighbouring freshwater and marine ecosystems. This microbial cycling appears to help regulate the flow of nutrients from coastal glaciers and ice sheets into sensitive polar marine environments. Changing this flow of nutrients could influence how much carbon microscopic marine plants and algae can absorb during photosynthesis, and in turn affect how much carbon dioxide is transferred between the ocean and the atmosphere. Appreciating how this system works could be crucial for understanding our current era of climatic change.

It is becoming apparent that glaciers and ice sheets are much more than just physical features in the landscape—they are ecosystems in their own right. Microbes surviving in these conditions suggest glaciers and ice sheets could have provided a refuge for life during ice ages. And perhaps this is true not just for Planet Earth. Given the recently discovered vast stores of underground ice on Mars, could microbial communities be seeking refuge within the Martian sub-surface? Perhaps there really is life on Mars!

Glaciers and ice sheets are much more than just physical features in the landscape.

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