New genome reveals how Arctic microbes survive in cold extreme habitats

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The cyanobacterium Phormidesmis priestleyi BC1401 was isolated from cryoconite on the Greenland Ice Sheet. Credit: Nathan Chrismas

Scientists at the University of Bristol have revealed how a tiny Arctic microbe, crucial to shaping the surface of glaciers, survives in such extreme conditions.

For the first time, researchers at the Bristol Glaciology Centre sequenced

the genome of Phormidesmis priestleyi, which belongs to the cyanobacteria, an ancient group of photosynthetic microorganisms capable of transforming energy from sunlight into sugars using carbon dioxide and water.

Their research was published this week in the open access journal *BMC Genomics*.

Recent studies have shown that cold extreme habitats thrive with microbial life. In the Arctic, Antarctic and high altitude places where plants cannot survive, cyanobacteria serve as major primary producers and represent the base of the microbial food chain.

In the Greenland ice sheet, Phormidesmis priestleyi helps to form cryoconite holes - dark, dust-filled puddles on the ice sheet surface. Cryoconite holes can be found covering vast areas of ice, making these microbes important ecosystem engineers on glaciers and ice sheets. Explaining how these organisms are capable of survival in these environments is key to understanding the ecology of Polar Regions.

Lead author Nathan Chrismas a PhD student from the Bristol Glaciology Centre, said: "Many cold adapted organisms, or psychrophiles, have distinct signatures in their genomes related to how they are adapted to survival in the cold. By isolating and sequencing its genome of Phormidesmis priestleyi, we could look for distinctive signatures at the genome level. We found its genome is similar to related organisms from much warmer environments. This new genome suggests that Phormidesmis priestleyi mainly survives in cold environments by producing a special protective coating made from sugars."

Dr Patricia Sánchez-Baracaldo, Royal Society Research Fellow at the School of Geographical Sciences said: "I am delighted that my lab was able to sequence the first genome of a key cyanobacteria in the Arctic.

Our work shows that by wrapping itself in a protective layer made out of a complex arrangement of sugars, this microbe uses this sticky layer to protect its cells from freezing, allowing it to survive through the Arctic winter.

"Interestingly, other cyanobacteria species use similar strategies in order to survive in other extreme habitats. Such strategies have allowed cyanobacteria to colonise some of the most inhospitable places on our planet."

More information: Nathan A. M. Chrismas et al. Genomic mechanisms for cold tolerance and production of exopolysaccharides in the Arctic cyanobacterium Phormidesmis priestleyi BC1401, *BMC Genomics* (2016). DOI: 10.1186/s12864-016-2846-4

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