Factors promoting growth of cryoconite granule formation and glacial/ice sheet melting

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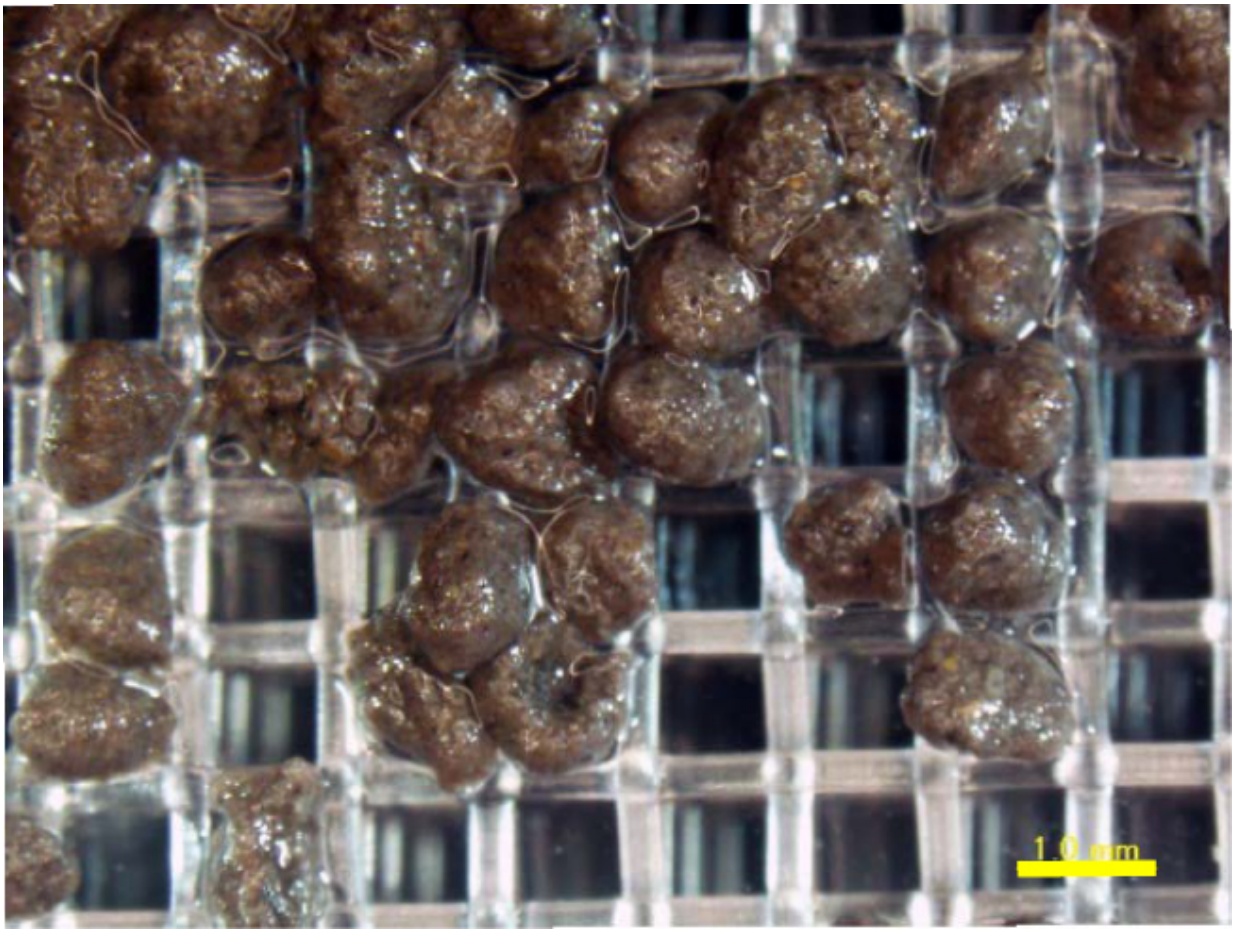

Cryoconite granules (Scale: yellow line = 1mm). Credit: NIPR

Cryoconite granules (see Figure 1) are dark, millimeter-sized aggregations of bacteria and algae, mineral particles and organic matter that form on the surface of glaciers. They are also known to be a significant factor responsible for the acceleration in glacial and ice sheet melting. Research on Greenland's glaciers has revealed that cryoconite granule formation increases in areas on the glacier surface containing higher amounts of fine (250 μm or smaller) mineral particle sediment. Research findings were recently published in the journal *FEMS Microbiology Ecology*.

Cryoconite granules - these tiny aggregation of cold-loving microbes (also known as cryophiles or psychrophiles) and mineral particles - are very dark in color. Because they are dark, they easily absorb heat and light energy from the sun. This additional heat energy in turn leads to accelerated melting of ice sheets and glaciers (see Figure 2).

The accelerated melting of the lower Greenland ice sheet in recent years is reportedly due in large part to the increasing abundance of cryoconite granules and pigmented algae. However, how many types of microbe inhabiting in this tiny granule and what kind of environment factors promoting the activities of cold-loving microbes are still unclear.

Dr. Jun Uetake and his team at the National Institute of Polar Research, Japan employed a variety of analytical methods including microscopic observation, genetic analysis and nutrients analysis to study samples of cryoconite granules taken from five different locations on Qaanaaq Glacier in Greenland.

Results of his analysis show that cryoconite granules were most highly concentrated in the middle area of the glacier. Also, notably, particularly large amounts of filamentous cyanobacteria were found from same sampling area.

Darkened glacial surface. Credit: NIPR

Thorough review of the environmental factors, including data taken such as altitude of and inclination at the sampling location, nutrient (phosphate, nitrate and ammonium ion) concentration, amount and composition of mineral particles, revealed a singular correlation between the amount of fine mineral particles (diameter of 250μm or smaller) and the presence of cryoconite granules in the area. Dr. Uetake says "higher concentrations of fine mineral particles are conducive to cyanobacterial growth and ultimately, cryoconite granule formation."

Ribosomal RNA analysis confirmed that filamentous cyanobacteria *Phormidesmis priestleyi*, also found in Antarctic lakes and marshes, is the predominant species contributing to granule formation and growth. Analysis also showed that granule diameter surpassing 250μm due to growth of *P. priestleyi* leads to change of bacterium species inhabiting cryoconite granules.

Dr. Uetake concludes "As cryoconite granule formation is spreading throughout Greenland, our continuing research must be required."

More information: Jun Uetake et al, Microbial community variation in cryoconite granules on Qaanaaq Glacier, NW Greenland, *FEMS Microbiology Ecology* (2016). DOI: 10.1093/femsec/fiw127

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