

## Geographical variations in formation process of cryoconite granules on Arctic glaciers

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The dark colored impurities deposited on the glacier ice are called cryoconite. Cryoconite is consisted of mineral particles, organic matter and microbes, including snow algae, cyanobacteria and bacteria. They usually form small spherical aggregates known as cryoconite granules. The spherical shape is maintained by filamentous cyanobacteria. The satellite images of Greenland ice sheet revealed that the dark colored bare ice surface has expanded recently and may have a big impact on the melting of ice. The darkening may be due to increase of cryoconite on the surface. Therefore, the understanding of the structure and formation process of the cryoconite granules is important for studies of the influence on the glacier ecosystem and mass balance of glaciers. In this study, we analyzed the structure and characteristics of cryoconite granules on Arctic glaciers and we clarified the differences in the formation process with the glaciers.

We analyzed the cryoconite samples collected on the northwestern part of the Greenland ice sheet, the Longyearbreen glacier of the Svalbard, the Suntar-Khayata glacier of the Siberia, the Gulkana glacier of the Alaska. We observed the cryoconite granules using a microscope in order to clarify the characteristic of the composition, the granule size. Furthermore, to observe inner structures, thin sections of cryoconite granules were made.

Microscopy of cryoconite granules revealed that their size and coloration differed among the glaciers. The size of granules was the largest for Svalbard followed by Siberia, Alaska, and Greenland. The coloration of cryoconite granules was brown for Svalbard, black for Siveria, gray for Alaska, and black to brown for Greenland. Cross section of the granules also showed the disticnt features. The granules from Greenland had mostly subgranules inside. The granules from Svalbard had some concentric layers of dense organic matter. The granules from Siberia had a large mineral particle inside. The granules from Alaska had no specific inner structure. These differences of cryoconite granules may reflect physical and/or chemical conditions of each glacier.