

Darkening glaciers and ice caps in Greenland by cryoconite

Nozomu Takeuchi^{1*}, Jun Uetake², Naoko Nagatsuka², Rigen Shimada¹

¹Chiba University, ²National Institute of Polar Research

Studies have revealed that a part of the bare ice surface of the Greenland Icesheet appeared to be dark coloration compared with those in the surrounding surface. The area, dark region, is likely to melt greater because the dark-colored surface can absorb more solar radiation compared with the white clean ice. The possible causes of the darkening are impurities on the ice, such as mineral dust, black carbon, and organic matter. In particular, organic component derived from snow algae, cyanobacteria, and bacteria, may have significant effect of darkening since they usually contain substantial amounts of dark-colored humic substances. However, it is still unknown that where the impurities came from and how they appear and distribute on the surface. To understand dynamics of impurities and formation process of organic matter on the glacier, we investigated characteristics of impurities on Qaanaaq Ice cap located in the north-western part of the Greenland in melting season of 2012.

Substantial amounts of impurities were found on both snow and ice surfaces. Microscopy revealed that the impurities consisted of mineral dust, snow algae, and other organic matter. In the ice area, they formed granular aggregates: cryoconite granules. The amount of impurities (dry weight) was greatest on the bare ice surface at the middle part of the ice cap, while that was smallest at the lowest site close to the terminus. In the snow area, red snow algae were blooming and visibly recognized. The red algal blooms were confirmed from the snow line to the top of the ice cap, indicating that the algae appeared on the entire surface of the ice cap. Results suggest that organic matter derived from snow algae plays a substantial role to darken the surface of the glacier.

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