Analysis of solid microparticles and metal components contained in snow at EGRIP, Greenland

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Mineral particles are one of the major components in solid microparticles in snow on the Greenland ice sheet. The mineral particle supply to the ice sheet can be increased by changes in ground surface environments such as aridification and increase in soil area. It is important to understand source areas of the mineral particles for evaluating the relationship between changes in the mineral particle supply and ground surface environments. Several areas in the northern hemisphere (e.g., desert areas in Asia) are suggested as source areas of mineral particles deposited on the Greenland ice sheet, although, the source areas are still unclear. Information on metal composition and size distribution of the mineral particles in snow on the ice sheet are needed for investigation of the source areas.

In 2016-2018, we conducted snow pit observations at EGRIP (East Greenland Ice Core Project) camp to reveal recent temporal variations of solid microparticles and metal components in this area. We dug two pits in 2016 (Pit 1 and 2), three pits in 2017 (Pit 3-5), and one pit in 2018 (Pit 6), respectively. Depths of those pits are 4.01 m for Pit 1, 3.18 m for Pit 2, 2.01 m for Pit 3 and 4, 2.22 m for Pit 5, and 2.01 m for Pit 6, respectively. Snow samples were collected at 0.03 m intervals from the snow surface to the bottom of the pits. Snow samples were melted, and concentrations of solid microparticles for diameters between 0.52 and 12 μm were analyzed by a Coulter counter (Beckman Coulter: Multisizer 4e). In this study, we used concentration data obtained from the Coulter counter. Additionally, particulates in samples of Pit 4 were decomposed by microwave acid digestion method. Then, total concentrations (dissolved + particulate) of Al, Fe, Na, Ca, and Mg in those samples were measured by inductively coupled plasma mass spectrometry.

Ranges of solid microparticle concentrations were 4854-116085 grains/mL for Pit 1, 4338-91989 grains/mL for Pit 2, 4557-59746 grains/mL for Pit 3, 3035-80577 grains/mL for Pit 4, and 7582-110506 grains/mL for Pit 6. In all pits, solid microparticle concentrations shown higher values in the winter-spring layers than in the other layers. We defined the period from one summer to the next as a year, and estimated annual fluxes of solid microparticles for each pit. Additionally, using the annual flux data in all pits, we calculated multiple-site averaged annual fluxes of solid microparticles. The averaged annual fluxes of solid microparticles tended to be higher in higher surface mass balance years. This result suggests that atmospheric deposition of solid microparticles in the EGRIP area was dominated mainly by wet deposition, or that the supply of solid microparticles and water vapor to this area varied synchronously. In presentation, we will also report analysis results of total concentration of metal components and size distribution of solid microparticles.