Variations in composition of mineral dust in an ice core obtained from Northwestern Greenland Ice Sheet

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Snow and ice on glaciers and the ice sheet in the Arctic contain windblown mineral dust derived from local sediments as well as distant deserts. Dust deposited on the ice sheet in the past can be obtained by ice core drilling, and the variations in its sources and transportation processes can be reconstructed by particle analysis of ice cores. In this study, we analyzed morphology and surface chemistry of mineral dust particles in an ice core drilled in Northwest Greenland with Scanning Electron Microscope (SEM, QUANTA FEG 450) and Energy Dispersive X-ray Spectrometer (EDS).

The ice core was drilled at the SIGMA-D site (N77°64’, W59°12’) of 2100 m a.s.l. in 2014. The length is 222.72 m and the estimated age at 113 m depth is 350 years before present . The ice samples were collected every five years in plastic bottles and freeze dried on a polycarbonate filter to concentrate micro-particles. Then, the filter was coated with platinum (Pt) for SEM analysis.

The SEM observation revealed that the mean size of mineral dust in the SIGMA-D ice core ranged from 1-3μm, which is similar to that of the other Greenland ice core dust that seems to be derived from distant deserts. This suggests that the SIGMA-D ice core contained mainly long–range transported wind-blown mineral dust. The EDS alalysis also revealed the ice core contained mainly silicate minerals, especially clay minerals, that showed compositional variation among the samples. For example, Quartz and Feldspar contents were three times higher in 1935-1950 compared with the other periods. Furthermore, the variation trend also differed among the minerals. The trend of micas/illite, chlorite, and feldspar were similar to each other, but different from kaolinite. The two type of minerals were formed by different weathering processes. These results indicate that the ice core dust was likely derived from different sources in different period.

Keywords: ice core, Greenland, Scanning Electron Microscope (SEM), mineral composition

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