Variations in mineralogy of dust in ice cores obtained from northwestern and northeastern Greenland over the past 100 years

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To reconstruct past variations in the sources and transportation processes of mineral dust in northwestern Greenland, we analysed the morphology and mineralogical composition of dust in the SIGMA-D ice core (77.64N, 59.12W, 2100 m a.s.l) from 1915 to 2013 using scanning electron microscope (SEM) and energy-dispersive X-ray spectroscopy (EDS). The results revealed the ice core dust consisted mainly of silicate minerals and that the composition varied substantially on multi-decadal and inter-decadal scales, suggesting that the ice core minerals originated from different geological sources in different periods during the past 100 years. The multi-decadal variation trend differed among mineral types. Kaolinite, which generally formed in warm and humid climatic zones, was abundant in colder periods (1950–2004), whereas mica, chlorite, feldspars, mafic minerals, and quartz, which formed in arid, high-latitude, and local areas, were abundant in warmer periods (1915–1949 and 2005–2013). Comparison of this information to Greenland surface temperature records indicates that this multi-decadal variation in the relative abundance of these different minerals was likely affected by local temperature changes in Greenland. Trajectory analysis shows that the minerals were transported mainly from its west coast during the two warming periods. This, in turn, was likely due to an increase in dust sourced from ice-free areas due to a shorter duration of snow and ice cover in Greenland's coastal region during the melt season caused by recent global warming. Meanwhile, ancient deposits in northern Canada, which were formed in past warmer climates, seem to be the best candidate during the colder period (1950–2004). Our results suggest that SEM–EDS analysis can detect variations in ice core dust sources during recent periods of low dust concentration (Nagatsuka et al., 2021).

To reveal spatial variation in the sources of minerals on the Greenland ice sheet, we have also analysed mineral dust from northeastern Greenland ice core (EGRIP: 75.62N, 35.96W, 2708 m a.s.l) during the past 100 years. The results showed the particle size, mineral composition, and compositional variations of the EGRIP ice core dust differed significantly than those of the SIGMA-D, indicating that the sources and transportation processes of the minerals were different between the two ice cores. The detailed discussion will be presented at the symposium.

References

Nagatsuka, N., Goto-Azuma, K., Tsushima, A., Fujita, K., Matoba, S., Onuma, Y., Dallmayr, R., Kadota, M., Hirabayashi, M., Ogata, J., Ogawa-Tsukagawa, Y., Kitamura, K., Minowa, M., Komuro, Y., Motoyama, H., and Aoki, T.: Variations in

mineralogy of dust in an ice core obtained from northwestern Greenland over the past 100 years, Clim. Past, 17, 1341–1362, 2021.