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

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To reveal regional and temporal variations in the sources and transportation processes of mineral dust that deposited onto the Greenland Ice Sheet, we analysed the morphology and mineralogical composition of dust in an ice core from northeastern Greenland (East Greenland Ice-Core Project, EGRIP) from 1910 to 2013 using scanning electron microscopy and energy-dispersive X-ray spectroscopy, and compared the results with those previously obtained for an ice core from northwestern Greenland (SIGMA-D). The SIGMA-D ice core dust varied on a multi-decadal scale, which was caused by an increasing contribution of minerals that originated from local ice-free areas during the recent warming periods (Nagatsuka et al., 2021). In contrast, the EGRIP ice core dust, which consisted mainly of silicate minerals as did the SIGMA-D core, there was relatively low compositional variation among the samples, suggesting that ice core mineral sources have not dramatically changed during the past 100 years. The subtle compositional variation in the EGRIP ice core dust is likely due to a minor contribution of local dust. The silicate mineral composition differed significantly between the two ice cores; micas and chlorite, which form in cold and dry regions, were abundant in the EGRIP ice core, whereas kaolinite, which forms in warm and humid regions, was abundant in the SIGMA-D ice core, indicating that the EGRIP ice core dust likely originated from different geological sources than those for the SIGMA-D dust. Back-trajectory analysis shows that the minerals were transported from Northern Eurasia and North America to the EGRIP site and that the contribution from each source was likely smaller and larger, respectively, compared to those for the SIGMA-D ice core. Furthermore, the higher illite content in the EGRIP ice core suggests dust transportation from Asian deserts. Although the back-trajectory analysis suggests that most of the air mass that arrived at the EGRIP site came from the Greenland coast, the mineral size and composition results show that local dust contribution was likely small.

References

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