Variation in chemical form of aerosol deposited around southeastern Greenland in spring season during 1960-2015.

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The Arctic including the Greenland ice sheet is one of the most sensitive areas for future warming. Tendency of cloud condensation nuclei (CCN) formation, which is an important factor of radiative forcing, differs depending on chemical forms of aerosol. However, detailed transportation process of these aerosols in the past from the Northern Hemisphere to the Greenland ice sheet is still unknown. Ice cores are suitable to evaluate changes in aerosol composition because past water-soluble inclusions are preserved. Thus, chemical form of aerosol in ice core samples is important to reveal radiative forcing change in the past and future. Seasonal change of $\delta^{18}O$ is recognized from southeastern dome in Greenland (SE-Dome) ice core samples collected in 2015 due to extremely high accumulation rate (~1 m/yr.; Furukawa et al., 2017). In addition, the decadal trend of NO_3^- flux in these samples differs from the decreasing trend of anthropogenic NOx emissions (Iizuka et al., 2017). In this study, we focused on water-soluble inclusions in the spring samples of SE-Dome core and identified their chemical form by using micro-Raman spectroscopy.

The ice samples were sublimated on Ni sheets in a clean booth under −22 degrees Celsius, and residual inclusions were analyzed. We analyzed 100 particles from spring samples. We identified $CaSO_4$, Na_2SO_4, $(NH_4)_2SO_4$, $NaNO_3$, NH_4NO_3 and $CaCO_3$ by Raman spectra. Sulfate/nitrate ratios gradually increase with depth direction. This trend is consistent with the decreasing trend of sulfate ion concentration (Iizuka et al., 2017). Moreover, $(NH_4)_2SO_4$ is the major chemical form in the samples characterized by higher sulfate/nitrate ratios. Our back trajectory analyses using Hysplit suggest the air mass contribution from EU was higher during 60’s and 70’s. This higher contribution is possibly related to negative North Atlantic Oscillation (NAO-; Sodemann et al., 2008). From these results, we suggest that anthropogenic emission in EU before 70’s increased $(NH_4)_2SO_4$ and sulfate depositions in SE Greenland. In contrast, sodium salts (Na_2SO_4 and $NaNO_3$) decrease with depth direction. Atlantic Multidecadal Oscillation (AMO) changed from negative to positive after late 90’s. Sea salt emission in the North Atlantic around Greenland increases with SST during AMO+ (Li et al., 2015). We presumed that constant transportation of $NaNO_3$ under AMO+ after late 90’s possibly maintained higher nitrate ions in the SE samples regardless of decreasing of anthropogenic NOx emissions.

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