Seasonality in sulfur isotopic compositions of atmospheric sulfate and its implications for atmospheric sulfur cycles in East Antarctica

*Sakiko Ishino[1], Shohei Hattori[1], Joel Savarino[2], Michel Legrand[2], Susanne Preunkert[2], Bruno Jourdain[2], Francis Albarede[3], Emmanuelle Albalat[3], Naohiro Yoshida[1,4]

1. Department of Chemical Science and Engineering, School of Materials and Chemical Technology, Tokyo Institute of Technology, 2. Institut des Geoscience de l' Environnement, Université Grenoble Alpes/CNRS, 3. Ecole Normale Supérieure (LGL-TPE), 4. Earth-Life Science Institute, Tokyo Institute of Technology

Atmospheric sulfate in Antarctica is produced mainly from a marine biogenic sulfur compound, dimethyl sulfide. They are therefore a subject of study related to the linkage between marine biogenic activity and climate. We investigate year-round observations of sulfur isotopic compositions of atmospheric sulfate (SO_4^{2-}) at inland (Dome C) and coastal (Dumont d' Urville) sites in East Antarctica to quantify the relative importance of marine biogenic (mb) and non-marine biogenic (nmb) SO_4^{2-} for the Antarctic atmospheric sulfur cycle. The $\delta^{34}S$ values of non-sea salt sulfate showed clear seasonal variations with summer maxima and winter minima, and showed homogeneity between inland and coastal sites throughout the year. This result suggests that the isotopic fractionation through chemical reactions during transportation from coastal to inland areas insignificantly affects the observed $\delta^{34}S_{nss}$ values. The observed $\delta^{34}S_{nss}$ values are controlled mainly by the relative importance of mb-SO_4^{2-} and nmb-SO_4^{2-}. This finding, in conjunction with the SO_4^{2-} records in Antarctic ice cores, will open a perspective implying the increased relative importance of nmb-SO_4^{2-} during glacial periods. We also found a significant increase in nmb-SO_4^{2-} concentrations in November, especially for the inland site. This nmb-SO_4^{2-} increase is correlated with the ^{210}Pb concentration, suggesting the existence of long-range transport of continental nmb-SO_4^{2-} from lower latitudes to the Antarctic inland. Identification of the sources of those nmb-SO_4^{2-} will be a key step for elucidation of the linkage between Antarctic atmosphere/climate and environmental changes at lower latitudes from the past through the future.

Keywords: Sulfur isotope analysis, Sulfate aerosols, Antarctica

