Five-years seasonal variations of nitrogen and triple oxygen isotopic compositions of atmospheric nitrate at Noto Peninsula, Japan

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Anthropogenic nitrogen oxides (NO_x) emission from land to the atmosphere have been accelerated in East Asia. By increase of the anthropogenic pollutants in the atmosphere, atmospheric oxidizing capacity can be changed in East Asia. Moreover, the biological cycle can be changed because the atmospheric nitrate deposition is a source of nitrogen. Thus, the understanding of sources and formation pathways of atmospheric nitrate is important.

The nitrogen and triple oxygen isotopic compositions ($\delta^{15}N$ and $\Delta^{17}O = \delta^{17}O - 0.52 \times \delta^{18}O$) of atmospheric nitrate can be a tracer of the sources and formation pathways of atmospheric nitrate. The $\delta^{15}N$ of atmospheric nitrate can be used to estimate the sources and sinks of atmospheric nitrate. The $\Delta^{17}O$ of atmospheric nitrate can be a tracer of the relative importance of mass-independent oxygen-bearing species (e.g. O_3, BrO; $\Delta^{17}O \neq 0$ ‰) and mass-dependent oxygen-bearing species (e.g. OH radical; $\Delta^{17}O \approx 0$ ‰) during the conversion of NO_x to atmospheric HNO_3. In this study, we present five-years data of $\delta^{15}N$ and $\Delta^{17}O$ values in atmospheric nitrate collected at NOTO Ground-based Research Observatory (NOTOGRO) (37.5˚N, 137.4˚E) located at the north coast of Noto Peninsula, Japan.

The atmospheric nitrate concentrations did not show a clear trend, while the $\delta^{15}N$ and $\Delta^{17}O$ showed a clear seasonal variation with summer minimum and winter maximum. The trend of $\Delta^{17}O$ is caused by the seasonal changes in the O_3 / HO_x ratios decreasing in summer by ozone destruction and HO_X production (e.g. OH, HO_2 radicals) via UV irradiance. Although the correlation between $\delta^{18}O$ and $\Delta^{17}O$ values was observed throughout the year, the slope between $\delta^{18}O$ and $\Delta^{17}O$ values for coarse particles for the winter-spring period is only different from other seasons and fine particles. We will discuss possible explanations of this different isotope pattern for the winter and spring periods.

Keywords: Nitrate, Aerosol, Triple oxygen isotopes, Nitrogen isotope ratio

