Seasonal variations of triple oxygen isotopes of atmospheric nitrate and sulfate at Noto Peninsula, Japan

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Anthropogenic activities have increased emissions of nitrogen and sulfur from land to the atmosphere. By recent increase of the anthropogenic pollutants in the atmosphere, atmospheric oxidative capacity can be changed in the east Asia. An understanding of changes in the oxidizing capacity of the atmosphere is also relevant for air quality managers, but it is not easy because of oxidant’ s unstabilities and multiple competing effects. The magnitude of ^{17}O enrichment (Delta^{17}O) in atmospheric nitrate and sulfate are unique tracers for the apportionment of different oxidation pathways. Thus, based on Delta^{17}O in atmospheric nitrate and sulfate, it is possible to predict oxidizing capacity (i.e. relative importance of oxidants) in the atmosphere. In this study, we present seasonal variations of Delta^{17}O values in atmospheric nitrate and sulfate collected at at NOTO Ground-based Research Observatory (NOTOGRO) (37.5^{o}N, 137.4^{o}E) located at the north coast of Noto Peninsula, Japan.
The $\Delta^{17}O$ values of nitrate showed the clear seasonal variations with summer minimum and winter maximum. This trend is resulted from the seasonal changes in the O_3 / HO_x ratios decreasing in summer by ozone destruction and HOX production (e.g. OH, HO 2 radicals) via UV irradiance. Although correlation between delta^{18}O and Delta^{17}O values were observed throughout the year, slope between delta^{18}O and Delta^{17}O values for coarse particle for winter-spring period is only different from other seasons and fine particles. Possible explanation of this different isotope pattern for winter and spring period are discussed. For the Delta^{17}O values of sulfate, clear seasonal variation is not observed but the Delta^{17}O values of sulfate ranged from 0.7 to 1.9‰, being slightly higher than those observed in previous studies for Wuhan (Li et al., 2013) and haze event in Beijing (He et al., 2017), China. This difference of Delta^{17}O values of sulfate between China and Japan may indicate that there is different thermodynamic state of aerosols (stable or metastable) and its influence to aerosol pH during long-distance transportation of SO_2.

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