3.089 Seasonal variation in the triple oxygen isotopic compositions of atmospheric nitrate in the Asian monsoon area.

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Abstract:

The ^{17}O excesses ($\Delta^{17}O$) of nitrate in wet deposition (n = 196) were determined for three years at Sado-seki in Japan (38°14′59′′N, 138°24′00′′E). The deposited nitrate showed large $\Delta^{17}O$ similar to those already reported for mid-latitudes: the $\Delta^{17}O$ ranged from +18.6‰ to +32.4‰ with a three-year average of +26.3‰. Both the annual average and the seasonal variation range of $\Delta^{17}O$ correlated strongly with those determined at Rishiri (45°07′11′′N, 141°12′33′′E) in past. Moreover, the values also coincided with those reported for mid-latitudes. We concluded that the observed temporal variations in $\Delta^{17}O$ reflect variations in the atmospheric formation channels of atmospheric nitrate from NO.
Moreover, a clear normal correlation between $\Delta^{17}O$ and $\delta^{18}O$ was shown (r^2 = 0.878). A similar trend had been obtained in other areas of the world, implying that the linear correlation corresponds to the mixing line between ozone and H_2O, and thus OH radicals, with $\Delta^{17}O$ = 0‰ and $\delta^{18}O$ = –5‰. However, the NO_3^- in Sado-seki showed a somewhat different trend in the $\Delta^{17}O$–$\delta^{18}O$ plot between summer and winter. Although the line fitted to the summer showed a slope of 2.21±0.22 and an intercept of +19.7±5.1‰ in the $\Delta^{17}O$–$\delta^{18}O$ plot, that of the winter showed a statistically significant larger slope of 2.89±0.38 and a smaller intercept of +3.0±9.2‰. Although the winter data included an intercept of −5‰ as the end-member $\delta^{18}O$ value of the OH radical within the possible error range, the intercept of summer deviated strongly from the value. Because the monitoring station is located in the Asian monsoon area, the major air mass that arrived at the station was different seasonally. The present results imply regional changes in the $\delta^{18}O/\Delta^{17}O$ ratios of ozone and the OH radical in the Asian monsoon area.