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Seasonal variations of nitrogen and oxygen isotopic signature of atmospheric nitrate in coastal Antarctica

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Nitrate (NO_3^-) is the end-product of oxidation of nitrogen oxides (NO_X=NO+NO_2) in the atmosphere and one of the major ions preserved in Antarctic snow and ice. Therefore, there has been great interest in using concentration and isotopic signature of nitrate in ice cores to reconstruct past atmospheric NO_X sources and their oxidation processes to nitrate. For interpretation of nitrate records in Antarctic ice cores, it is necessary to know the long-term changes of concentration and isotopic compositions ($^{15}N/^{14}N$, $^{17}O/^{16}O$ and $^{18}O/^{16}O$) of nitrate in the atmosphere which deposits on the surface snow. In this study, we present seasonal variation of nitrogen and triple oxygen isotopic composition of nitrate collected at French Antarctic Station Dumont d'Urville (66^{o}40'S, 140^{o}01'E) throughout the year 2011. The significant increase of nitrate concentration during spring and summer period was observed and ^{15}N were depleted in the nitrates, indicating that there was the substantial NO_X input to the atmosphere by photolysis of nitrate in the surface snow. In addition, relatively low ^{17}O excess in summer period suggests that NO_X oxidation to nitrate by OH radicals was increased. On the other hand, high ^{17}O excess with low concentration in fall and winter period suggests that OH oxidation pathway was depleted and other oxidation pathways related to O_3 were dominant. Additionally, the small nitrate increase in winter period might be attributed to the transport of stratospheric nitrate to troposphere due to the formation of polar stratospheric clouds. In the presentation, we will discuss the long-term change of the seasonal trends and compare the result with that of 2001 year-round isotopic analysis using nitrate aerosols at the same station.

Keywords: Antarctic, Aerosol, Nitrate, Stable isotopic analysis