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Nitrogen and triple oxygen isotopic composition of surface snow in Antarctica

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The interplay between the chemical state of the atmosphere and the climate is poorly documented and constitutes a weakness in the current understanding of past climate change. The main reason is that we are lacking a suitable set of proxies for the past oxidizing capacity of the atmosphere, which controls the chemical lifetime of greenhouse gases such as methane or ozone.

For example the relationship of nitrate (NO_3^-) preserved in Antarctic snow and firn to atmospheric nitrogen oxides ($NO_x \equiv NO + NO_2$), which are key in modulating the atmospheric oxidation capacity, is so far not well understood. Post-depositional processes in the snow pack alter concentrations significantly and thereby complicate the quantitative interpretation of ice core records. However, the stable isotopic composition of NO_3^- potentially provides a powerful quantitative tool to not only gain insight into post-depositional processes but also to determine prevalent atmospheric oxidation pathways and major sinks and sources, as recent aerosol measurements in the Arctic and Antarctic have shown.

Here we report results from the first simultaneous determination ofthe nitrate $^{15}N/^{14}N$, $^{18}O/^{16}N$ and $^{17}O/^{16}O$ isotopic ratios in Antarctic surface snow samples collected on a summer traverse between Dome Concordia (75ºS) and Dumont d'Urville (DDU) (66ºS). Analysis involved conversion of nitrate into N_2O using the denitrifier method followed by on-line decomposition into O_2 and N_2 on a gold furnace at 900 ºC and measurement in a mass spectrometer. A minimum sample size of 50 nmol NO_3^- assured good reproducibility. We compare the isotopic values to available observations from South Pole and DDU and discuss implications for the nitrate budget in snow and

atmosphere.