
Abstract ID : **114**

# New joint isotopic analyses of N2O and NO3- in Antarctic ice cores for investigating the processes of N2O in situ production

## Content

Nitrous oxide (N<sub>2</sub>O) is a trace gas in the atmosphere involved in the destruction of stratospheric ozone through its photodissociation products. It is also a greenhouse gas whose concentration has varied substantially in the past. Direct reconstruction of these past variations is only possible by analyzing the air bubbles archived in ice cores. However, some sections of Antarctic ice cores are affected by *in situ* production of N<sub>2</sub>O. As this artifact is not yet quantified, there is no continuous record of atmospheric N<sub>2</sub>O so far. Furthermore, ice core information on atmospheric N<sub>2</sub>O concentration and its nitrogen and oxygen isotopic composition can be used to reconstruct changes in the terrestrial and marine sources. Existing isotopic data show that the isotopic composition of *in situ* produced N<sub>2</sub>O can be very different from that of atmospheric N<sub>2</sub>O. The measured isotopic signal and concentration must therefore be systematically corrected for the *in situ* contribution, even if minor, to avoid wrong interpretations regarding the N<sub>2</sub>O source attribution.

With the use of isotopic analyses, this study aims at understanding the processes leading to N<sub>2</sub>O production in Antarctic ice. The *in situ* production of N<sub>2</sub>O occurs specifically during glacial periods, where the dust content is higher compared to interglacials. In addition to being different from the atmospheric signal, the isotopic signature of *in situ* N<sub>2</sub>O appears to depend on the accumulation rate. An enrichment in <sup>15</sup>N compared to the atmospheric signature is observed for low accumulation sites, with a δ<sup>15</sup>N *in situ* signature in the range of +60‰ for Dome C (EDC) and Vostok, whereas a depletion is observed for higher accumulation sites, with a δ<sup>15</sup>N around -10‰ for Dronning Maud Land (EDML).

Based on these observations, nitrate (NO<sub>3</sub>-) could be a good candidate as a precursor of *in situ* N<sub>2</sub>O in ice. Nitrate concentration in ice cores is higher and more variable during glacial periods, following a similar trend to dust levels, and its isotopic composition is also impacted by the accumulation rate through post-depositional processes. The photolysis of nitrate, accentuated in low accumulation sites, induces a high enrichment in <sup>15</sup>N – up to +300‰ during glacial periods in Vostok.

To test the hypothesis of a potential reaction from nitrate substrate in the ice, we carried out joint measurements of nitrogen and oxygen isotopic compositions of N<sub>2</sub>O and NO<sub>3</sub>- in samples from EDC, EDML, and Talos Dome – a core with low dust content. These new isotopic analyses spanning the Last Glacial Maximum and MIS4 will be used to quantify the N<sub>2</sub>O *in situ* contribution using a mass balance approach, and to investigate the correlation between NO<sub>3</sub>- and *in situ* N<sub>2</sub>O isotopic signatures.

**Primary author:** Ms SOUSSAINTJEAN, Lison (Climate and Environmental Physics, Physics Institute & Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland)

**Co-authors:** SCHMITT, Jochen (Climate and Environmental Physics, Physics Institute & Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland); SAVARINO, Joel (IGE-CNRS, Grenoble, France); SETH, Barbara (Climate and Environmental Physics, Physics Institute & Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland); Mr RÖCKMANN, Thomas (Institute for Marine and Atmospheric Research, Utrecht University, Utrecht, Netherlands); FISCHER, Hubertus (Climate and Environmental Physics, Physics Institute & Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland)

**Presenter:** Ms SOUSSAINTJEAN, Lison (Climate and Environmental Physics, Physics Institute & Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland)

**Track Classi ication:** Biogeochemical Cycles in the Earth system – data and models