Abstract ID : **130**

Did Nitrification or Denitrification Cause the Deglacial N2O Rise?

Content

We used an archive of large-volume ice samples from Taylor Glacier (McMurdo Dry Valleys, Antarctica) to measure the position-dependent isotopic composition or “site preference” of atmospheric nitrous oxide (N2O) across the last deglaciation (21-11 thousand years ago).

N2O, an important greenhouse gas and ozone-destroying substance, increased by ~ 70 ppb during the last glacial-interglacial transition due to increased production rates in source regions. Previous measurements of the bulk isotopic composition of N2O (δ15N-N2O and δ18O-N2O) constrained the production increases to roughly equal parts contribution from marine and terrestrial environments. The “site preference” (SP), or the difference in δ15N at the center and terminal positions of the N2O molecule, may indicate whether N2O was produced by microbial nitrification or denitrification, adding a novel piece of information to understanding the natural response of the nitrogen cycle in a warming climate.

We measured position-dependent N2O isotopes and N2O concentration in air extracted from 28 ice core samples ranging in size from 0.8-1.5 kg, with an additional 32 replicate measurements. The 1-sigma pooled standard deviation of replicates was: N¬2O = 3.09 ppb, δ15N-N2O = 0.30 ‰, δ18O-N2O = 0.38 ‰, δ15Nα-N2O = 0.71 ‰, and SP = 1.41 ‰. Spurious outliers prevent a clear determination of the change in SP signal during the fast N¬2O rise, but spline fits to the data combined with a Monte-Carlo “bootstrapping” method for outlier identification hint at a possible 2.5 ‰ rise in SP. The data also suggest a ~ 2.5 ‰ decrease in SP during the Younger Dryas cold interval (12.9-11.7 thousand years ago).

We used a Monte-Carlo box model inversion to reconstruct possible changes in nitrification versus denitrification considering the combination of uncertainties in source SP and data errors. We find that both nitrification and denitrification increases were important for causing increased N2O concentration across the deglaciation. Decreases in both processes were also responsible for decreased N2O concentration during the Younger Dryas. Nitrification may have changed faster and by ~ 50% more than denitrification during both the deglaciation and the Younger Dryas.

Our study highlights the necessity of (1) improvements in the precision of the SP measurement and (2) improvements in our understanding of the isotopic composition of N2O sources to make progress in interpreting ice core N2O isotope data.

Primary author: MENKING, Andy (University of Tasmania) **Co-author:** BROOK, Ed (Oregon State University) **Presenter:** MENKING, Andy (University of Tasmania)

Track Classification: Biogeochemical Cycles in the Earth system – data and models