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Continuous measurements of Nitrous Oxide isotopomers during incubation experiments

Malte Nordmann Winther (1), Thomas Blunier (1), David Balslev-Harder (1,2), Bo Elberling (3), Anders Priemé (3,4), and Søren Christensen (5)

(1) University of Copenhagen, Niels Bohr Institute, Center for Ice and Climate, Copenhagen OE., Denmark (malte.winther@nbi.ku.dk), (2) DFM - Danish National Metrology Institute, Kgs. Lyngby, Denmark, (3) Center for Permafrost, Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark, (4) Department of Microbiology, Biological institute, University of Copenhagen, Denmark, (5) Department of Terrestrial Ecology, Biological institute, University of Copenhagen, Denmark

Nitrous oxide (N_2O) is an important and strong trace greenhouse gas in the atmosphere; it is part of a feedback loop with climate. N_2O is produced by microbes during nitrification and denitrification in the terrestrial and oceanic realm where today $1/3$ of the production is estimated to stem from oceanic sources. The position of the isotope ^{15}N in the linear N=N=O molecule can be distinguished between the central or terminal position (the isotopomers of N_2O). It has been demonstrated that nitrification and denitrification have a relative preference for the terminal and central position, respectively. Therefore it is claimed that measuring the site preference in N_2O allows to determine the responsible production process i.e. nitrification or denitrification. Our recent instrument development in collaboration with Picarro Inc. allows for continuous position dependent δ^{15}N measurements. We present continuous results from incubation experiments with denitrifying bacteria, Pseudomonas Fluorescens and Pseudomonas Chlororaphis. We find bulk isotope effects of -11.3‰ to -8.3‰ for P. Chlororaphis. For P. Fluorescens the isotope effect during production of N_2O is in the range -47.7‰ to -35.4‰ and between 1.9‰ and 12.6‰ during N_2O reduction. The values for P. Fluorescens is in line with earlier findings, whereas the values for P. Chlororaphis is larger than previously published $\delta^{15}N^{bulk}$ measurements from production. The calculations of the site preference (SP) isotope effect from the measurements of P. Chlororaphis results in values between 8.6‰ and 1.6‰. For P. Fluorescens the calculations results in SP values between -11.6‰ and -0.8‰ during production of N_2O and between -8.1‰ and 5.0‰ during reduction of N_2O. All measured values of SP are in the range of previously published results for denitrifying bacteria.