Dynamics of N2O production pathways analyzed by 15N18O isotope labeling

Jensen, Marlene Mark; Ma, Chun; Lavik, Gaute; Smets, Barth F.; Thamdrup, Bo

Publication date:
2017

Document Version
Peer reviewed version

Dynamics of N_2O production pathways analysed by $^{15}N/^{18}O$ dual isotope labelling – data from a full-scale wastewater treatment plant

M. M. Jensen**, **C. Ma***, **G. Lavik*****, **B. F. Smets****, **B. Thamdrup***

* Department of Biology, University of Southern Denmark (SDU), Odense, Denmark, chun@biology.sdu.dk; bot@biology.sdu.dk
** Department of Environmental Engineering, Technical University of Denmark, Kongens Lyngby, Denmark, mmaj@env.dtu.dk; bfsm@env.dtu.dk
*** Max Planck Institute for Marine Microbiology, Bremen, Germany, glavik@mpi-bremen.de

Nitrous oxide production associated with biological nitrogen transformations can contribute substantially to the CO_2 footprint of both man-made and natural systems, but the pathways and regulation of N_2O production are poorly understood. We developed a $^{15}N/^{18}O$ dual isotope labelling technique to distinguish and quantify these pathways in mixed communities. The use of ^{18}O-O_2 permits differentiation of hydroxylamine oxidation and nitrifier-denitrification driven N_2O production by ammonium oxidizing bacteria. We analysed N_2O production pathways during biological nitrogen removal at Lynetten wastewater treatment plant. Under anoxia, N_2O accumulated due to denitrification, but N_2O accumulation was ~3 and 1.7 times higher at 30 and 100 µM O_2, respectively. Oxic N_2O production was dominated by nitrifier-denitrification, reaching 73% of the total with the remainder due to hydroxylamine oxidation. Our results demonstrate three active pathways of N_2O production, each with different environmental controls. The dual $^{15}N/^{18}O$ isotope labelling approach can contribute to the development of strategies to minimise N_2O emissions from man-made and natural systems.