



A new analyzer to measure the abundance of $^{14}\text{N}^{15}\text{N}^{16}\text{O}$ and $^{15}\text{N}^{14}\text{N}^{16}\text{O}$ relative to $^{14}\text{N}^{14}\text{N}^{16}\text{O}$ to help elucidate microbial N_2O dynamics in terrestrial ecosystems.

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Nitrous oxide (N_2O) is an atmospheric trace gas that contributes to global warming and stratospheric ozone depletion. The major sources from terrestrial ecosystems are the microbial processes of nitrification and denitrification occurring in soils. Isotopomer ratios of N_2O , i.e. the abundances of $^{14}\text{N}^{15}\text{N}^{16}\text{O}$ and $^{15}\text{N}^{14}\text{N}^{16}\text{O}$ relative to $^{14}\text{N}^{14}\text{N}^{16}\text{O}$, are promising for elucidation of N_2O biogeochemistry(1). Although isotopic signatures of inorganic N species tend to be variable because of the high turnover of N in terrestrial ecosystems, variations in their ^{15}N isotopic and isotopomeric ratios can provide important information about ecosystem functions without disturbing the environment through the addition of inhibitors and tracer-labeled compounds(2). For example, nitrogen isotopic site preference (the difference between the isotope ratios of the central and terminal nitrogen atoms) can be useful to distinguish between N_2O produced via hydroxylamine oxidation versus nitrite reduction.

Picarro, Inc. has developed a Cavity Ring-Down Spectroscopy (CRDS) based analyzer, able to measure the abundance of $^{14}\text{N}^{15}\text{N}^{16}\text{O}$ and $^{15}\text{N}^{14}\text{N}^{16}\text{O}$ relative to $^{14}\text{N}^{14}\text{N}^{16}\text{O}$ in N_2O . The analyzer is easy to use and makes continuous measurements in real time. Unlike with mass spectrometry, the $^{14}\text{N}^{15}\text{N}^{16}\text{O}$ and $^{15}\text{N}^{14}\text{N}^{16}\text{O}$ configurations can be clearly distinguished using optical absorption spectroscopy via CRDS. This unique capability is possible because, in optical absorption spectroscopy, the wavelength location of the $^{14}\text{N}^{15}\text{N}^{16}\text{O}$ and $^{15}\text{N}^{14}\text{N}^{16}\text{O}$ isotopomers are defined by the molecular mass AND the molecular configuration. In isotopic ratio mass spectrometry (IRMS), the charge to mass ratio must be different in order to discriminate different molecules. Therefore distinguishing isotopomers using IRMS requires additional analyses of N_2O mass fragments generated by the ion source.

In this work, measurements of $^{14}\text{N}^{15}\text{N}^{16}\text{O}$ and $^{15}\text{N}^{14}\text{N}^{16}\text{O}$ relative to $^{14}\text{N}^{14}\text{N}^{16}\text{O}$ in N_2O taken from soil gas flux chambers will be shown. This work is a first step in proving the viability of this new technology in terrestrial ecosystem applications.

- (1) K. Koba*, K. Osaka, Y. Tobi, S. Toyoda, N. Ohte, M. Katsuyama, N. Suzuki, M. Itoh, H. Yamagishi, M. Kawasaki, S.J. Kim, N. Yoshida, T. Nakajima (2009) Biogeochemistry of nitrous oxide in groundwater in a forested ecosystem elucidated by nitrous oxide. *Geochimica et Cosmochimica Acta* 73 (2009) 3115–3133.
- (2) Ostrom N. E., Hedin L. O., von Fischer J. C. and Robertson G. P.(2002) Nitrogen transformations and NO_3^- removal at a soil–stream interface: a stable isotope approach. *Ecol. Appl.* 12(4), 1027–1043.