Oxygen Isotopic Composition of Nitrate Produced by Freshwater Nitrification

D. BOSHERS[1], J. GRANGER[2], J. K. BÖHLKE[3]

[1]Department of Marine Sciences, University of Connecticut, Groton, CT. 06340; danielle.boshers@uconn.edu
[2]Department of Marine Sciences, University of Connecticut, Groton, CT. 06340; julie.granger@uconn.edu
[3]U.S. Geological Survey, Reston, VA. 20192; jkbohlke@usgs.gov

Measurements of naturally ocurring nitrogen and oxygen stable isotope ratios of nitrate (NO_3^-), $\delta^{15}N$ and $\delta^{18}O$, can be used to determine the source, dispersal, and fate of natural and contaminant NO_3^- in aquatic environments. To this end, it is necessary to know how NO_3^- isotopologues are modified by biological reactions, as heavy and light isotopes have different reaction rates. The purpose of this study was to determine the influence of the $\delta^{18}O$ of ambient water on the isotopic composition of NO_3^- produced by nitrification, the biological oxidation of ammonium (NH_4^+) to nitrite (NO_2^-) then NO_3^-, an influence which is not well understood in freshwater systems. We collected water from two streams in New England during the fall and spring, which we amended with NH_4^+ and with increments of ^{18}O-enriched water, and then monitored the isotopic composition of NO_2^- and NO_3^- produced by natural consortia of nitrifiers. Although oxidation rates differed between the two stream waters, the final $\delta^{18}O$ of NO_3^- produced in both experiments revealed a sensitivity to the $\delta^{18}O$ of water mediated by (a) isotopic equilibration between water and NO_2^- and (b) kinetic isotope fractionation during O-atom incorporation from molecular oxygen and water into NO_2^- and NO_3^-. Our results concur with nitrifying culture experiments that have demonstrated analogous sensitivity of the $\delta^{18}O$ of NO_3^- product to equilibrium and kinetic O isotope effects (Buchwald et al. 2012). These dynamics need to be understood to interpret NO_3^- isotope distribution in freshwater environments.