Analyses of nitrate reference solutions in 18O-labeled water with the denitrifier method (Biological Nitrogen Isotope Fractionation project)

Website: https://www.bco-dmo.org/dataset/865519
Data Type: experimental
Version: 1
Version Date: 2021-11-29

Project
» CAREER: The biological nitrogen isotope systematics of ammonium consumption and production (Biological Nitrogen Isotope Fractionation)

Contributors	Affiliation	Role
Granger, Julie	University of Connecticut (UConn)	Principal Investigator
Zhou, Mengyang	University of Connecticut (UConn)	Student, Contact
Chang, Bonnie X	University of Washington (UW)	Analyst
Newman, Sawyer	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
IAEA-NO3 and USGS-34 reference solutions were supplemented with 18O-labeled water and analyzed for N and O isotope ratios.

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Coverage

Temporal Extent: 2020-06-16 - 2020-08-19

Acquisition Description

Sampling and analytical procedures:

☐Effects of sample volume and salinity on O atom exchange with water

NO3- reference materials (IAEA-NO3 and USGS-34) were diluted with mixtures of DIW and NO3--deplete Sargasso ranging in salinity from 0 to 35 ppt to achieve NO3- concentrations of 1, 3, 5 and 20 µmol L-1 – corresponding to respective injection volumes of 10, 3.3, 2 and 0.5 mL – in order to attain 10 nmoles of N analyte. Reference materials at corresponding salinity and NO3- concentrations were supplemented with 18O-labled water, resulting in δ18OH2O values ranging from -6.8 to 335‰ vs. VSMOW.

Processing Description

Processing notes from researcher:

- Data were processed using Microsoft Excel

BCO-DMO processing notes

- Date formats were changed from mm/dd/yy to yyyy-mm-dd
- Spaces and units removed from column headers

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Related Publications

Casciotti, K. L., Sigman, D. M., Hastings, M. G., Böhlke, J. K., & Hilkert, A. (2002). Measurement of the Oxygen Isotopic Composition of Nitrate in Seawater and Freshwater Using the Denitrifier Method. Analytical Chemistry, 74(19), 4905–4912. doi:10.1021/ac020113w
Methods

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Related Datasets

IsSourceOf

Zhou, M., Granger, J., Chang, B. X. (2021) **O exchange with water during denitrification with the denitrifier method (Biological Nitrogen Isotope Fractionation project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-12-01 http://lod.bco-dmo.org/id/dataset/865666 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Strain	The denitrifying bacteria strains used in the laboratory experiment: P. aureofaciens	unitless
Date	Date of the experiments; yyyy-mm-dd	unitless
Trial	Trial name	unitless
Solution	Nitrate reference materials IAEA-NO3 and USGS-34	unitless
Salinity_in_vial	Nitrate reference materials (IAEA-NO3 and USGS-34) were diluted with a mixture of DIW and nitrate-deplete surface Sargasso seawater to difference salinity	ppt
Concentration	Concentrations of nitrate reference solutions	umol L-1
Sample_volume	Sample volume injected to aliquot 10 nmol of nitrate	mL
delta_18OH2O	Reference materials were supplemented with 18O-labaled water. Delta 18OH2O values (‰ vs. VSMOW) were calculated from dilution	‰ vs. VSMOW
delta_18ON2O	O isotopic composition of nitrate measured with the denitrifier method using a Thermo Delta V GC-IRMS with modified Gas Bench II and a PAL autosampler	‰ vs. N2Otank
stdev_of_delta_18ON2O	Standard deviation of delta 18O replicates in each trial	unitless

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Instruments

Dataset-specific Instrument Name	Delta V Advantage continuous flow gas chromatograph isotope ratio mass spectrometer (Thermo Fisher Scientific, Waltham, MA, USA)
Generic Instrument Name	Gas Chromatograph Mass Spectrometer
Dataset-specific Description	Delta V Advantage continuous flow gas chromatograph isotope ratio mass spectrometer (Thermo Fisher Scientific, Waltham, MA, USA) interfaced with a modified Thermo Fisher Scientific Gas Bench sample preparation device fronted by dual cold traps (Casciotti et al., 2002) and a GC Pal autosampler (CTC Analytics, Zwingen, Switzerland) - to measure N and O isotope ratio of nitrate using the denitrified method.
Generic Instrument Description	Instruments separating gases, volatile substances or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay by a mass spectrometer.

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Project Information

CAREER: The biological nitrogen isotope systematics of ammonium consumption and production (Biological Nitrogen Isotope Fractionation)

NSF Award Abstract:
The nitrogen (N) cycle in the marine environment is controlled by biological processes. Unfortunately, quantifying these processes and assessing their effect on the N cycle is difficult by direct measurements because of large spatial and temporal differences. Isotopic composition measurements of N provide a means to constrain these processes indirectly; however, there is still a great deal to be understood about isotope fractionation of recycled nitrogen through biological processes, which has made interpretation of novel nitrogen isotope data difficult. A researcher from the University of Connecticut plans to determine the influence of biological consumption and production on the isotope fractionation in ammonium. By helping to understand the processes surrounding fractionation of recycled ammonium at the organism level, this research will create a basis for which future researchers can better interpret isotope composition data to infer nitrogen cycle dynamics. A graduate student, a postdoctoral fellow, and two or more undergraduate students will be involved in the research. The researcher plans to integrate science with community-engaged learning by developing an undergraduate field and laboratory course that will require the students to present their research to stakeholders in the community. There will be a manual created for this course that will be disseminated in open-access forums for teachers hoping to develop similar courses.

Biological nitrogen isotope fractionation associated with nitrogen recycling remains poorly constrained despite the advent of a variety of new techniques to analyze nitrogen isotopes in recent years. The use of isotopic composition data can be incredibly useful to interpreting nitrogen cycle processes in the ocean that are difficult to measure directly, which makes it crucial to further understand the processes behind fractionation to catch up with the advancement of the datasets available to researchers. This research will characterize the isotope fractionation dynamics of ammonium during biological consumption and production. The researchers will investigate whether the characteristic low concentrations of ammonium in the surface ocean affect isotope fractionation when the ammonium is recycled and whether there is a trophic isotope effect associated with ammonium recycling by protozoan grazers. With this research, there will be a baseline from which researchers can interpret recycled nitrogen dynamics from ammonium isotope datasets. The methods of comparing nitrogen cycling studies will become significantly clearer with such a standard making interpretation uniform by removing significant uncertainties.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1554474

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