Volume effects on blanks originating from the bacterial concentrates, equilibration with atmospheric N2O, and NO3- contamination of the water into which the standards were diluted from 2017-2020 (Biological Nitrogen Isotope Fractionation project)

Website: https://www.bco-dmo.org/dataset/865089
Data Type: experimental
Version: 1
Version Date: 2021-11-16

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

Contributors	Affiliation	Role
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Abstract
Volume-dependent N2O blanks originating from the bacterial concentrates, equilibration with atmospheric N2O, and NO3- contamination of the water into which the standards were diluted.

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Coverage

Temporal Extent: 2017-08-01 - 2020-06-08

Acquisition Description

Methodology:

Sampling and analytical procedures:

☐Effects of sample volume on the size of bacterial blanks

Following sparging with N2 gas, bacterial concentrates (2 mL) in 20 mL vials were injected with incremental volumes of DIW or NO3--deplete surface Sargasso seawater. Solutions included air-equilibrated DIW (for ≥ 1 day) and helium-sparged DIW (for 30 minutes), as well as air-equilibrated vs. helium-sparged seawater. N2O yields were estimated from peak areas recovered by mass spectrometric analysis, calibrated with standard additions.

Processing Description

Processing notes from submitting researcher:

- Data were processed in 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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Parameters

Parameter	Description	Units
Strain	The two denitrifying bacteria strains used in the laboratory experiment: P. aureofaciens and P. chlororaphis	unitless
Date	Date of the experiments; yyyy-mm-dd	unitless
Trial	Trial name	unitless
Solution	Type of aliquot. DIW or nitrate-deplete surface Sargasso seawater	unitless
Sample_processiong	Solutions were equilibrated in the air for ≥ 1 day, or sparged with helium or N2 gas for 30 minutes	unitless
Sample_volume	Volume of solution addition	mL
Blank_N2O	The amount of blank N2O recovered with a Thermo Delta V GC-IRMS with modified Gas Bench II and a PAL autosampler	nmol of N

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Instruments

Dataset-specific Instrument Name	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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