Simulation of δ15N and δ18O scale contraction, given the observation of the fraction of O atom exchange with water and blanks (Biological Nitrogen Isotope Fractionation project)

Website: https://www.bco-dmo.org/dataset/865676
Data Type: experimental
Version: 1
Version Date: 2021-12-01

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

Contributors	Affiliation	Role
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Abstract
Simulation of δ15N and δ18O scale contraction, given the observation of the fraction of O atom exchange with water and blanks.

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Methods & Sampling

Sampling and analytical procedures:

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

δ^{15}O and δ^{18}O scale contraction were simulated given the observations of the fraction of O atom exchange with water during denitrification, blanks originating from the bacterial concentrates, from equilibration with atmospheric N_2O, or from NO_3^- contamination of the water into which the standards were diluted.

Data Processing Description

Processing notes from researcher:

- Data were processed using Microsoft Excel

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Data Files

File
zhou_et_al_lab_data-8.csv(Comma Separated Values (.csv), 722 bytes) MD5:7125b3842da512dcef14eb3f2ada52ba Primary data file for dataset ID 865676

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Parameters

Parameter	Description	Units
Aliquot_volume	Sample volume injected to aliquot 10 nmol of nitrate	mL
Observed_delta_15N_scale_contraction_pcnt	Observed mean delta 15N scale contraction of the 3 trials in Datasheet "Scale contraction"	unitless
stdev_of_observed_delta_15N_scale_contraction	The standard deviation of trial means of delta 15N scale contraction	unitless
Observed_delta_18O_scale_contraction_pcnt	Observed mean delta 18O scale contraction of the 3 trials in Datasheet "Scale contraction"	unitless
stdev_of_observed_delta_18O_scale_contraction	The standard deviation of trial means of delta 18O scale contraction	unitless
Observed_delta_18O_delta_15N_scale_contraction_pcnt	Observed mean difference between delta 18O and delta 15N scale contraction of the 3 trials in Datasheet "Scale contraction"	unitless
stdev_of_observed_delta_18O_delta_15N_scale_contraction	The standard deviation of trial means of delta 18O - delta 15N scale contraction	unitless
Model_1_delta_15N_scale_contraction_pcnt	Delta 15N scale contraction in Model 1, which prescribes 10 nmol nitrate aliquots, an O atom exchange fraction of 3%, a mean bacterial blank of 0.06 nmol N, an atomspheric N2O concentration of 0.013 nmol N mL-1, and a contaminant blank of 0.016 nmol N mL-1 in the reference solution	unitless
Model_1_delta_18O_scale_contraction_pcnt	Delta 18O scale contraction in Model 1	unitless

Model_1_delta_18O_delta_15N_scale_contraction_pcnt	The difference between delta 18O and delta 15N scale contraction in Model 1	unitless
Model_2_delta_15N_scale_contraction_pcnt	Delta 15N scale contraction in Model 2. Based on Model 1, Model 2 increased the bacterial blank to the maximum observed values of 0.16 nmol N and a contaminant blank in the reference solution to 0.027 nmol N mL-1	unitless
Model_2_delta_18O_scale_contraction_pcnt	Delta 18O scale contraction in Model 2	unitless
Model_2_delta_18O_delta_15N_scale_contraction_pcnt	The difference between delta 18O and delta 15N scale contraction in Model 2	unitless

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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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