

d15N of size-fractionated particulate organic nitrogen (PON) from net tows in the Sargasso Sea at BATS and Hydro Station S

Website: <https://www.bco-dmo.org/dataset/746854>

Data Type: Cruise Results

Version: 1

Version Date: 2018-10-01

Project

» [Understanding the nitrogen isotopes of planktonic foraminifera: A modern Sargasso Sea study](#) (N Isotopes Foraminifera)

Contributors	Affiliation	Role
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Abstract

d15N of size-fractionated particulate organic nitrogen (PON) from net tows in the Sargasso Sea (off Bermuda) in the western subtropical North Atlantic. Net tow samples from 0-200 m at BATS (31°40'N, 64°10'W) and Hydro Station S (32°10'N, 64°34'W).

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Coverage

Spatial Extent: N:32.167 E:-64.167 S:31.667 W:-64.567

Temporal Extent: 2011-07 - 2013-11

Dataset Description

d15N of size-fractionated particulate organic nitrogen (PON) from net tows in the Sargasso Sea (off Bermuda) in the western subtropical North Atlantic. Net tow samples from 0-200 m at BATS (31°40'N, 64°10'W) and Hydro Station S (32°10'N, 64°34'W).

Data published in:

Smart, S.M., H. Ren, S.E. Fawcett, R. Schiebel, M. Conte, P.A. Rafter, K.K. Ellis, M.A. Weigand, S. Oleynik, G.H. Haug, D.M. Sigman (2018). Ground-truthing the planktic foraminifer-bound nitrogen isotope paleo-proxy in the Sargasso Sea, *Geochimica et Cosmochimica Acta*, doi: <https://doi.org/10.1016/j.gca.2018.05.023>

Methods & Sampling

PON samples were collected from the upper 200 m of the water column using a 1-m², 200-um-mesh plankton net aboard the R/V Atlantic Explorer during ten cruises between July 2011 and November 2013. Approximately

10% of the tow material was size-fractionated and freeze-dried for elemental and isotopic analysis of PON. See methods section of Smart et al. (2018) for more details of sample collection, isotope analysis, and data quality.

The d15N of tow-collected, size-fractionated PON was determined by elemental analyzer-isotope ratio mass spectrometry (an Elementar Vario Isotope Cube online to an Elementar Isoprime visION), referencing to atmospheric N2 using USGS-40 and an in-house aminocaproic acid standard.

Data Processing Description

Data processing: After correcting for drift (when necessary) and non-linearity in the data, isotope ratio measurements were calibrated to N2 in air using international reference materials that were included in every run.

Missing data identifier = -999

BCO-DMO Processing: modified parameter names (replaced spaces w/ underscores; replaced # with "num").

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Data Files

File
d15N_NetTows.csv (Comma Separated Values (.csv), 3.80 KB) MD5:57fda63f01f76234613d273c22dc0f26 Primary data file for dataset ID 746854

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Related Publications

Smart, S. M., Ren, H., Fawcett, S. E., Schiebel, R., Conte, M., Rafter, P. A., ... Sigman, D. M. (2018). Ground-truthing the planktic foraminifer-bound nitrogen isotope paleo-proxy in the Sargasso Sea. *Geochimica et Cosmochimica Acta*, 235, 463–482. doi:[10.1016/j.gca.2018.05.023](https://doi.org/10.1016/j.gca.2018.05.023)
Results

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Parameters

Parameter	Description	Units
cruise	Cruise identifier	unitless
date	Date of collection (month and 2-digit year)	unitless
depth	Sample depth	meters
size_fraction	Size fraction	micrometers (um)
d15N_AVG	Average d15N (per mil vs. AIR). d15N is the nitrogen isotopic composition of a sample expressed in delta notation (d15N in units of per mil, ‰) relative to atmospheric N2, where $d15N = \left\{ \left(\frac{15N}{14N} \right)_{\text{sample}} / \left(\frac{15N}{14N} \right)_{\text{atmN2}} - 1 \right\} \times 1000$.	per mil
d15N_stdev	Standard deviation of d15N_AVG	per mil
num_measurements	Number of measurements	unitless

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Instruments

Dataset-specific Instrument Name	Elementar Vario Isotope Cube
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	The d15N of tow-collected, size-fractionated PON was determined by elemental analyzer-isotope ratio mass spectrometry (an Elementar Vario Isotope Cube online to an Elementar Isoprime visION), referencing to atmospheric N2 using USGS-40 and an in-house aminocaproic acid standard.
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	Elementar Isoprime visION
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	The d15N of tow-collected, size-fractionated PON was determined by elemental analyzer-isotope ratio mass spectrometry (an Elementar Vario Isotope Cube online to an Elementar Isoprime visION), referencing to atmospheric N2 using USGS-40 and an in-house aminocaproic acid standard.
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	mesh plankton net
Generic Instrument Name	Plankton Net
Dataset-specific Description	PON samples were collected from the upper 200 m of the water column using a 1-m ² , 200-µm-mesh plankton net.
Generic Instrument Description	A Plankton Net is a generic term for a sampling net that is used to collect plankton. It is used only when detailed instrument documentation is not available.

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Project Information

Understanding the nitrogen isotopes of planktonic foraminifera: A modern Sargasso Sea study (N Isotopes Foraminifera)

Coverage: Sargasso Sea

NSF Award Abstract:

Nitrogen (N) and phosphorus are the two nutrients required in large quantity by phytoplankton in the ocean, and together they limit productivity throughout most of the tropical, subtropical, and temperate ocean. Both the cycling of N and its input/output budget have been argued to control the fertility of the ocean and the ocean's role in setting atmospheric CO₂. The CaCO₃ tests of foraminifera can represent a substantial fraction of marine sediments and have been used extensively in paleoceanography; they are an obvious target for isotopic analysis of microfossil-bound organic matter.

In recent years, researchers at Princeton have developed a protocol for the isotopic analysis of foraminiferal shell-bound N. The current protocol is at least 100 times more sensitive than typical on-line combustion, allowing for rapid progress with a N isotope archive that was previously not feasible to measure. Measurements on surface sediments and a downcore record from the Caribbean show the promise of foraminifera-bound δ¹⁵N (fb-δ¹⁵N) to provide both a robust N isotope archive for paleoceanography, and one with a unique potential of richness, given the existence of multiple foraminiferal species with different depth habitats and behaviors. Moreover, the finding from the Caribbean Sea record -- reduced N fixation in ice age Atlantic -- has changed the scientific conversation about the nature of the input/output budget of oceanic fixed N and its potential to change ocean fertility and atmospheric CO₂. However, the controls on fb-δ¹⁵N have not yet been adequately studied.

In this project, as a first major step in developing a foundation for the paleoceanographic application of fb-δ¹⁵N, the same Princeton University team will study its genesis in the water column, transport to the seafloor, and early diagenesis. They will undertake this study in the Sargasso Sea south of Bermuda. This is

one of the best studied regions of the ocean, in general and with respect to foraminifera, and a region that has been a focus of the N isotope research of the PI for the last decade and others previously. Moreover, its significant seasonality -- in physical oceanography, biogeochemistry, and foraminiferal species abundance -- will facilitate the effort to understand the controls on fb- $\delta^{15}\text{N}$ at a mechanistic level. The research team will participate in six Bermuda Atlantic Time-series Study (BATS) cruises over two years, collecting foraminifera and other N forms likely to provide insight into the controls on fb- $\delta^{15}\text{N}$. From the nearby Oceanic Flux Program (OFP) moored sediment traps and from shallow sediments collected in the region, they will pick foraminifera shells and again make relevant ancillary measurements. This work will establish the relationship of foraminiferal biomass to shell-bound $\delta^{15}\text{N}$ for different species, and comparison of the foraminiferal isotope data with the upper ocean N pools will yield empirical isotopic relationships and work toward a mechanistic insight of fb- $\delta^{15}\text{N}$ (e.g., the importance of different N pools to the diets of different foraminifera; the role of algal symbionts). The sediment trap and surface sediment data will support the plankton tow data by integrating over longer time scales and will also address questions regarding late stage (e.g., gametogenic) calcification and the early diagenesis of fb- $\delta^{15}\text{N}$ and fb-N content.

Broader Impacts: This study will yield an improved understanding of the nutrient dynamics of foraminifera, a class of organisms whose shells are a central tool in micropaleontology and paleoclimatology. The project will also build on the principal investigator's involvement in the Bermuda Institute of Ocean Sciences as an asset for integrating ocean-related education and research at both the undergraduate and graduate levels.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0960802
NSF Division of Ocean Sciences (NSF OCE)	OCE-1136345
NSF Division of Ocean Sciences (NSF OCE)	OCE-1060947

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