Calibration of the Isotope Ratio Mass Spectrometer vs. aliquots of 15N2 gas diluted in air then helium

Website: https://www.bco-dmo.org/dataset/778000
Data Type: experimental
Version: 1
Version Date: 2019-10-02

Project
» EAGER: Collaborative Research: Detection limit in marine nitrogen fixation measurements - Constraints of rates from the mesopelagic ocean (EAGER NitFix)

Contributors	Affiliation	Role
Granger, Julie	University of Connecticut (UConn)	Principal Investigator
Bourbonnais, Annie	University of Massachusetts Dartmouth (UMass Dartmouth)	Co-Principal Investigator
Wilson, Samuel	University of Hawaii (UH)	Co-Principal Investigator
Biddle, Mathew	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
In order to verify that measurements of the 15N2 atom% of dissolved N2 gas samples effectuated by Membrane Inlet Mass Spectrometry are accurate, we compared these to corresponding measurements of parallel samples on a Delta V Isotope Ratio Mass Spectrometer (IRMS). To this end, we first ensured that the IRMS returns accurate 15N2 atom% values, by measuring the 15N2 atom% of a serial dilutions of a 15N2 gas stock in air and helium. This calibration is documented herein, showing that IRMS measurements in the experimental range were accurate, as expected

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Dataset Description

Measurements of the 15N2 atom % in prepared standards and solutions.

Methods & Sampling

A serial dilution of 98-99% 15N2 gas stock (Cambridge Isotope Laboratories, Lot #I-21065) in air and helium returned the expected signal (i.e., a slope not significantly different than unity) on a continuous flow Delta V Advantage Plus IRMS (Smith et al. 2015), demonstrating the accuracy of the IRMS over a wide range of 15N2 abundances.

Data Processing Description

BCO-DMO Processing Notes:
- table was extracted from original spreadsheet.

- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions

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Data Files

File
cal_iso.csv (Comma Separated Values (.csv), 121 bytes) MD5:99d30eb086b4f8d16be291013b0442eb Primary data file for dataset ID 778000

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Related Publications

White, A. E., Granger, J., Selden, C., Gradoville, M. R., Potts, L., Bourbonnais, A., Fulweiler, R. W., Knapp, A. N., Mohr, W., Moisander, P. H., Tobias, C. R., Caffin, M., Wilson, S. T., Benavides, M., Bonnet, S., Mulholland, M. R., & Chang, B. X. (2020). A critical review of the 15N2 tracer method to measure diazotrophic production in pelagic ecosystems. Limnology and Oceanography: Methods, 18(4), 129–147. Wiley. https://doi.org/10.1002/lom3.10353
Results

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Parameters

Parameter	Description	Units
comment	sample type	unitless
expected	Expceted 15N2 air He dil (m/z 30/28 ratio x 100)	unitless
measured	measured m/z 30/28 ratio x 100 on GC-IRMS	unitless

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Instruments

Dataset-specific Instrument Name	Isotope Ratio Mass Spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	continuous flow Delta V Isotope Ratio Mass Spectrometer (Smith et al. 2015), and continuous flow-GV Isoprime IRMS (Charoenpong et al., 2014)
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	Membrane Inlet Mass Spectrometer
Generic Instrument Name	Membrane Inlet Mass Spectrometer
Dataset-specific Description	Membrane Inlet Mass Spectrometer (Bay Instruments)
Generic Instrument Description	Membrane-introduction mass spectrometry (MIMS) is a method of introducing analytes into the mass spectrometer's vacuum chamber via a semipermeable membrane.

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Project Information

EAGER: Collaborative Research: Detection limit in marine nitrogen fixation measurements - Constraints of rates from the mesopelagic ocean (EAGER NitFix)

Coverage: North Atlantic Ocean, Pacific Ocean

NSF Award Abstract:
The availability of nitrogen is required to support the growth and production of organisms living in the surface of our global ocean. This element can be scarce. To alleviate this scarcity, a special class of bacteria and archaea, called nitrogen fixers, can derive the nitrogen needed for growth from nitrogen gas. This project would carefully examine one specific method for measuring nitrogen fixation that has been used recently to suggest the occurrence of small amounts of nitrogen fixation in subsurface ocean waters. If these reports are verified, then a revision of our understanding of the marine nitrogen cycle may be needed. The Ocean Carbon and Biogeochemistry program will be used as a platform to develop community consensus for best practices in nitrogen fixation measurements and detection of diversity, activity, and abundances of the organisms responsible. In addition, a session will be organized in a future national/international conference to communicate with the broader scientific community while developing these best practices.

The goal of this study is to conduct a thorough examination of potential experimental and analytical errors inherent to the 15N2-tracer nitrogen fixation method, in tandem with comprehensive molecular measurements, in mesopelagic ocean waters. Samples will be collected and experimental work conducted on a cruise transect in the North Atlantic Ocean, followed by analytical work in the laboratory. The specific aims of this study are to (1) determine the minimum quantifiable rates of 15N2 fixation based on incubations of mesopelagic waters via characterization of sources of experimental and analytical error, and (2) seek evidence of presence and expression of nitrogen fixation genes via comprehensive molecular approaches on corresponding samples. The range of detectable rates and diazotroph activity from the measurements made in this study will be informative for the understanding of the importance of nitrogen fixation in the oceanic nitrogen budget.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1732246

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