Comparison of Membrane Inlet Mass Spectrometry (MIMS) to Isotope Ratio Mass Spectrometer (IRMS)

Website: https://www.bco-dmo.org/dataset/778065
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
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Abstract
In order to ensure that 15N2 atom% effectuated by Membrane Inlet Mass Spectrometry, we tested whether the mass-specific signal ratios returned by MIMS are equivalent with parallel measurements on a Isotope Ratio Mass Spectrometer, on the basis that the latter returns accurate ratios (see 778000 cal_iso). MIMS and IRMS returned identical values for parallel samples.

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Dataset Description

Comparison of MIMS to IRMS

Methods & Sampling

We tested whether the mass-specific signal ratios returned by MIMS accurately quantitate the relative isotopic abundance of 15N2 in the range typically used for N2 fixation incubations. Incremental 15N2 gas aliquots were equilibrated in seawater, and respective solutions were then dispensed into replicate gas-tight vials. 15N atom % of dissolved N2 values were measured in parallel by continuous flow IRMS on a GV Isoprime IRMS (Charoenpong et al., 2014) and by MIMS (Bay Instruments), on the assumption that values returned by IRMS are accurate.

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
mims_2_irms.csv (Comma Separated Values (.csv), 465 bytes) MD5:7b8dbeb0ef6ce3be753fead18af7c9e9 Primary data file for dataset ID 778065

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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
Subsample	subsample identification	unitless
MIMS_at_pcnt	MIMS at%	unitless
stdev_MIMS_at_pcnt	stdev MIMS at%	unitless
IRMS_15N_at_pcnt	IRMS 15N at%	unitless
stdev_IRMS_15N_at_pcnt	stdev IRMS 15N at%	unitless
IRMS_at_pcnt_no_furnace	IRMS at% no furnace	unitless
stdev_IRMS_at_pcnt_no_furnace	stdev IRMS at% no furnace	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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