Analysis of dissolved 15N2 gas standards by Membrane Inlet Mass Spectrometry

Website: https://www.bco-dmo.org/dataset/778021
Data Type: experimental
Version: 1
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Project
» EAGER: Collaborative Research: Detection limit in marine nitrogen fixation measurements - Constraints of rates from the mesopelagic ocean (EAGER NitFix)

Contributors	Affiliation	Role
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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 developed a specific protocol to prepare dissolved 15N2 gas standards. We detail the protocol herein, and report representative MIMS measurements of the prepared standards.

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Dataset Description

Analysis of dissolved 15N2 gas standards by Membrane Inlet Mass Spectrometry

Acquisition Description

We determined that the most reliable way to prepare dissolved 15N2 gas standards involves equilibration of the liquid phase with a headspace, rather than injection of a 15N2 gas aliquot into a sealed bottle without a headspace. Standards were prepared in a room with a relatively constant ambient temperature. Serial aliquots of 15N2 gas were each injected into the headspace of crimp-sealed 120 mL serum bottles containing 80 mL of air-equilibrated seawater (at room temperature) and a stir bar with an unpressurized air headspace. The vials were equilibrated for 72 hours on a stir plate (at low rpm) prior to analysis on the MIMS or IRMS.

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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Related Publications

White, Granger and others. In Review. A Review of the 15N2 Tracer Method to Measure Diazotrophic Production in Pelagic Ecosystems. Limnology and Oceanography Methods.

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Parameters

Parameter	Description	Units
Bottle_vol	volume of the bottle	mililiters (mL)
Sample	type of sample	unitless
Injection_15N2	amount of Injection of 15N2	mililiters (mL)
Expected_15N_At_pcnt	expected 15N At %	unitless
Time_of_analysis	time of analysis in 24 hour format	unitless
m_z_28	mass-to-charge	unitless
m_z_29	mass-to-charge	unitless
m_z_30	mass-to-charge	unitless
m_z_32	mass-to-charge	unitless
m_z_40	mass-to-charge	unitless
N2_Ar	N2/Ar ratio	unitless
ratio_28_29	28/29 ratio	unitless
ratio_28_30	28/30 ratio	unitless
At_15N_pcnt	15N At%	unitless
At_15N_pcnt_avg	15N At% average	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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