Test of potential mass to charge 30 interferences from O2

Website: https://www.bco-dmo.org/dataset/778083
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
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Abstract
Molecular oxygen (O2) has been documented to ionize partially to NO+ in mass spectrometer sources, generating a signal that overlaps with that of 15N2 (mass-to-charge of 30). Here, we tested whether O2 needs to be specifically removed from the sample streams of the Membrane Inlet Mass Spectrometer and the Isotope Ratio Mass Spectrometer in order to properly quantitate 15N2 atom% at pertinent concentrations. Sample streams with and without O2 yielded similar signals, suggesting that O2 does not interfere with the 15N2 atom% measurements in the experimental range with the given instruments.

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Dataset Description

Test of potential m/z 30 interferences from O2

Methods & Sampling

The measurements presented here were conducted with a MIMS and an IRMS each equipped with high-temperature copper reduction columns to scrub O2 from the gas stream entering the source. However, samples measured in parallel on the IRMS and on the MIMS without the O2 scrubbing column yielded similar 15N atom % values, indicating that any NO+ generated in the respective IRMS and MIMS sources was insufficient to alter the 15N atom % significantly in the range pertinent to 15N2 tracer incubations.

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
mz_30_int_from_o2.csv (Comma Separated Values (.csv), 4.11 KB) MD5:5eea994368a25b2fb14d33d9c1b2a749 Primary data file for dataset ID 778083

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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
Sample	sample	unitless
Time_of_analysis	time the analysis was conducted 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
atom_pcnt_15n	15 N atom %	unitless
Notes	additional comments	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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