Vertical profiles of N2 gas concentrations in excess of equilibrium values along with the isotopic composition of total N2, NO3- and NO2- from R/V New Horizon cruise NH1410 in the Eastern Tropical North Pacific from May to June 2014

Website: https://www.bco-dmo.org/dataset/705567
Data Type: Cruise Results
Version: 1
Version Date: 2017-06-20

Project
» Collaborative Research: Autonomous Lagrangian Floats for Oxygen Minimum Zone Biogeochemistry (OMZ Biogeochemistry Floats)

Contributors	Affiliation	Role
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Abstract
This dataset includes vertical profiles of N2 gas concentrations in excess of equilibrium values along with the isotopic composition of total N2, NO3- and NO2- from R/V New Horizon cruise NH1410 in the Eastern Tropical North Pacific from May to June 2014.

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Coverage

Spatial Extent: **N**:25.2 **E**:-104.2 **S**:18.19 **W**:-116.53
Temporal Extent: 2014-05-13 - 2014-06-07

Dataset Description

Vertical profiles from the Mexican OMZ of N2 gas concentrations in excess of equilibrium values along with the isotopic composition of total N2, NO3- and NO2-.

Acquisition Description

Sampling at sea was done using a standard SeaBird CTD/Rosette system. Hydrographic data was processed using SeaBird software and standard procedures. O2 was measured by an SBE43 sensor and final data were calibrated against Winkler O2 determinations

NO3- and NO2- concentrations were measured in the laboratory on frozen samples using a SmartChem autoanalyzer using standard chemical methods

N2 excess were determined from N2/Ar ratios measured using the procedures described by Charoenpong et al. (2014) with the exception that the measurements were made at sea using a Pfieffer 400 series quadrupole mass spectrometer system. Data acquisition and initial data processing used custom LabView software. Biogenic N2 concentrations were determined by subtraction of estimated background excess N2 as described in Chang et al. (2012). The d15N of N2 was determined in the laboratory using similar methodology but using an IsoPrime Isotope Ratio Mass Spectrometer (IRMS) as described by Charoenpong et al. (2014) using IonVantage software.

The isotopic composition of nitrate and nitrite was determined on samples returned to the laboratory using procedures described by McIlvin and Casciotti (2011) and McIlvin and Altabet (2005). Samples for nitrate isotope analysis were preserved by mild acidification and addition of sulfamic acid to remove nitrite. Nitrite samples were preserved at high pH with NaOH to retain its d18O signature. An IsoPrime IRMS running IonVantage was used to make these measurements.

Final data reduction and organization was done using Microsoft Excel.

Processing Description

See above for data processing.

BCO-DMO processing:
- modified parameter names to conform with BCO-DMO naming conventions (replaced # with "num", replaced hyphens with underscores);
- re-formatted date to mm/dd/yyyy;
- re-formatted time to HH:MM:SS;
- added ISO date/time field using original date and time fields;
- replaced "#N/A" and blanks (missing data) with "nd";
- there were 12 rows where lon values were degrees and decimal mins (CTD 11F02; 107 53.218). Converted those to decimal degrees.

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Related Publications

Chang, B. X., Devol, A. H., & Emerson, S. R. (2012). Fixed nitrogen loss from the eastern tropical North Pacific and Arabian Sea oxygen deficient zones determined from measurements of N2:Ar. Global Biogeochemical Cycles, 26(3). doi:10.1029/2011gb004207 https://doi.org/10.1029/2011GB004207
Methods

Charoenpong, C. N., Bristow, L. A., & Altabet, M. A. (2014). A continuous flow isotope ratio mass spectrometry method for high precision determination of dissolved gas ratios and isotopic composition. Limnology and Oceanography: Methods, 12(5), 323–337. doi:10.4319/lom.2014.12.323
Methods

McIlvin, M. R., & Altabet, M. A. (2005). Chemical Conversion of Nitrate and Nitrite to Nitrous Oxide for Nitrogen and Oxygen Isotopic Analysis in Freshwater and Seawater. Analytical Chemistry, 77(17), 5589–5595. doi:10.1021/ac050528s
Methods

McIlvin, M. R., & Casciotti, K. L. (2011). Technical Updates to the Bacterial Method for Nitrate Isotopic Analyses. Analytical Chemistry, 83(5), 1850–1856. doi:10.1021/ac1028984
Methods

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Parameters

Parameter	Description	Units
cruise	Cruise identifier	unitless
ctd_num	CTD cast identifier	unitless
date	Date formatted as dd/mm/yyyy	unitless
btl_num	Niskin bottle number	unitless
lat	Latitude	decimal degrees
lon	Longitude	decimal degrees
time_local	Local ship time formatted as HH:MM:SS	unitless
ISO_DateTime_Local	Date and time formatted to ISO 8601 standard: yyyy-mm-ddTHH:MM:SS	unitless
depth_ctd	CTD depth	meters
pressure_ctd	CTD pressure	decibars (dB)
in_situ_temp_ctd	CTD in situ temperature	degrees Celsius
salinity_ctd	CTD salinity	unitless
calibrated_ctd_O2	Winkler calibrated CTD oxygen	micromoles per kilogram (umol/kg)
sigma_theta	Density anomaly	kilograms per cubic meter - 1000 (kg/m3 - 1000)
NO3	Nitrate concentration	micromoles per kilogram (umol/kg)
NO2	Nitrite concentration	micromoles per kilogram (umol/kg)
N2_excess	N2 concentration in excess of equilibrium with atmosphere	micromoles per kilogram (umol/kg)
stdev_N2_excess	Precision of above	micromoles per kilogram (umol/kg)
bio_N2	biogenic N2 concentration	micromoles per kilogram (umol/kg)
d15N2	Difference in d15N of total N2 relative to equilibrium values	per mil (‰)
stdev_d15N2_anomaly	Precision of above	per mil (‰)
d15NO3	d15N of nitrate	per mil (‰)
d18O_NO3	d18O of nitrate	per mil (‰)
d15NO2	d15N of nitrite	per mil (‰)
d18O_NO2	d18O of nitrite	per mil (‰)

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Instruments

Dataset-specific Instrument Name	SeaBird CTD/Rosette
Generic Instrument Name	CTD Sea-Bird
Dataset-specific Description	Sampling at sea was done using a standard SeaBird CTD/Rosette system.
Generic Instrument Description	Conductivity, Temperature, Depth (CTD) sensor package from SeaBird Electronics, no specific unit identified. This instrument designation is used when specific make and model are not known. See also other SeaBird instruments listed under CTD. More information from Sea-Bird Electronics.

Dataset-specific Instrument Name	IsoPrime Isotope Ratio Mass Spectrometer (IRMS)
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	The d15N of N2 was determined in the laboratory using an IsoPrime Isotope Ratio Mass Spectrometer (IRMS) as described by Charoenpong et al. (2014) using IonVantage software. An IsoPrime IRMS running IonVantage was also used to make measurements of the isotopic composition of nitrate and nitrite.
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	SBE43 sensor
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Dataset-specific Description	O2 was measured by an SBE43 sensor and final data were calibrated against Winkler O2 determinations
Generic Instrument Description	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. more information from Sea-Bird Electronics

Dataset-specific Instrument Name	Pfieffer 400 series quadrupole mass spectrometer
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	N2 excess were determined from N2/Ar ratios measured using the procedures described by Charoenpong et al. (2014) with the exception that the measurements were made at sea using a Pfieffer 400 series quadrupole mass spectrometer system.
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

Dataset-specific Instrument Name	SmartChem autoanalyzer
Generic Instrument Name	Discrete Analyzer
Dataset-specific Description	NO3- and NO2- concentrations were measured in the laboratory on frozen samples using a SmartChem autoanalyzer using standard chemical methods
Generic Instrument Description	Discrete analyzers utilize discrete reaction wells to mix and develop the colorimetric reaction, allowing for a wide variety of assays to be performed from one sample. These instruments are ideal for drinking water, wastewater, soil testing, environmental and university or research applications where multiple assays and high throughput are required.

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Deployments

NH1410

Website	https://www.bco-dmo.org/deployment/628491
Platform	R/V New Horizon
Report	http://dmoserv3.whoi.edu/data_docs/OMZ_SulfurCycling/Cruise_Report_NH1410.pdf
Start Date	2014-05-10
End Date	2014-06-08
Description	Oxygen Minimum Zone Microbial Biogeochemistry Expedition 2 (OMZoMBiE 2) Cruise Track Cruise information and original data are available from the NSF R2R data catalog.

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Project Information

Collaborative Research: Autonomous Lagrangian Floats for Oxygen Minimum Zone Biogeochemistry (OMZ Biogeochemistry Floats)

NSF Award Abstract:
Intense oxygen minimum zones (OMZ) of the world's oceans, though constituting a small fraction of total oceanic volume, host critical biogeochemical processes and are central to understanding the ocean's N cycle and its biogeochemical and isotopic signatures. OMZ's are sites for a large portion of marine combined N loss to N2 (25 to 50%) and dominate the ocean N isotope budget through cogeneration of 15N and 18O enriched NO3 -. Major outstanding issues include the magnitude of this N sink, the stoichiometry between NO3 - loss and the production of biogenic N2, the microbial pathways leading to N2 production, as well as the interaction between these OMZ processes and the surface export of organic matter as well as physical circulation.

The PI's request funding to develop a new, in situ, autonomous tool for studying N loss in OMZ's. It will allow observation of variability over a range in temporal and spatial scales that are critical for understanding controlling processes and better estimating the magnitude of N-loss. The sustained deployments possible with autonomous platforms will be critical for detecting any response of OMZ's to climate change.

Broader Impacts: Nitrogen is often the limiting nutrient for biological production in the oceans, and the current global marine nitrogen balance has been in much debate due to a number of uncertainties and questions. A successful development of this proposed sensor-float package may help in resolving some of the important

questions on the spatial and temporal variabilities of the OMZs. In turn, such knowledge is essential in assessing the global nitrogen balance in the current and future oceans. This proposed project would involve active participation of undergraduates, graduates and postdocs, as well as the training of a K-12 science teacher. This project would also foster collaboration with international researchers. The PI's have partnered with Ocean Explorium at New Bedford Seaport to provide an educational outreach component designed to aid teacher development and create a field trip program for teachers in the south coast of Massachusetts. The proposal will support post-doc, graduate and undergraduate students.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1154741
NSF Division of Ocean Sciences (NSF OCE)	OCE-1153295

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