Water column nitrate+nitrite d15N and d18O from samples collected during R/V Pelican and R/V F.G. Walton Smith cruises in the Gulf of Mexico and Florida Straits between 2011 and 2018

Website: https://www.bco-dmo.org/dataset/782518
Data Type: Other Field Results
Version: 1
Version Date: 2019-11-21

Project
» Quantifying nitrogen fixation along unique geochemical gradients in the southwest Pacific Ocean (SW Pac N2 fixation)

Contributors	Affiliation	Role
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Abstract
This data set includes water column nitrate+nitrite d15N and d18O measurements from the Gulf of Mexico and Florida Straits. These measurements were used to address whether Mississippi River nitrate is entrained in Loop Current waters and potentially exported from the Gulf of Mexico to the North Atlantic. Water samples were collected during R/V Pelican and R/V F.G. Walton Smith cruises in the Gulf of Mexico and Florida Straits between 2011 and 2018.

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Coverage

Spatial Extent: **N**:27 **E**:-79.5 **S**:25.866 **W**:-92.0401
Temporal Extent: 2011-11-22 - 2018-04-20

Dataset Description

This data set includes water column nitrate+nitrite d15N and d18O measurements from the Gulf of Mexico and Florida Straits. These measurements were used to address whether Mississippi River nitrate is entrained in Loop Current waters and potentially exported from the Gulf of Mexico to the North Atlantic. Water samples were collected during R/V Pelican and R/V F.G. Walton Smith cruises in the Gulf of Mexico and Florida Straits between 2011 and 2018.

Methods & Sampling

Water column samples were collected by Niskin bottle on a CTD rosette (“CTD profile”). NO3-+NO2- concentration was measured using a chemiluminescent method described by Braman and Hendrix, 1989, with

a detection limit of 0.1 µM. NO3-+NO2- d15N and d18O analyses were by the “denitrifier method” and followed the methods described by Sigman et al., 2001, Casciotti et al., 2002, McIlvin and Casciotti, 2011, and Weigand et al., 2016. Briefly, NO3-+NO2- was quantitatively reduced to N2O by Pseudomonas aureofaciens and Pseudomonas chlororaphis, which was then cryogenically focused and analyzed on an isotope ratio mass spectrometer. A volume of sample was added to each bacterial vial to achieve a final quantity of 10 or 20 nmols N2O, which was then purged from the vial using a helium carrier gas. The d15N of N2O in samples was calibrated with the international isotopic reference materials.

The average precision of the nitrate+nitrite concentration measurement was <0.2 µM. The average precision of nitrate+nitrite d15N measurements was <0.2 per mil and for d18O was <0.3 per mil, but with the standard deviation for duplicate analyses of each sample reported here. NO3-+NO2- δ15N δ18O analyses were calibrated with IAEA N3 and USGS 34 NO3- d15N isotopic reference materials as described in McIlvin and Casciotti, 2011. NO3-+NO2- d18O were also calibrated with the USGS 35 isotopic reference material as described in McIlvin and Casciotti, 2011.

Data Processing Description

BCO-DMO Data Manager Processing Notes:
* converted xlsx file to csv
* latitude and longitude exported with 4 decimal places
* added a conventional header with dataset name, PI name, version date
* modified parameter names to conform with BCO-DMO naming conventions
* blank values in this dataset are displayed as "nd" for "no data." nd is the default missing data identifier in the BCO-DMO system.
* Date format converted to ISO 8601 format yyyy-mm-dd
* Columns SigmaTheta,NO3_NO2,NO3_NO2_d15N, NO3_NO2_d18O, sal , temp rounded to two decimal places.

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Data Files

File
no3.csv(Comma Separated Values (.csv), 6.33 KB) MD5:8007f05d031a83da8d58b7b72dff6966 Primary data file for dataset ID 782518

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Related Publications

Braman, R. S., & Hendrix, S. A. (1989). Nanogram nitrite and nitrate determination in environmental and biological materials by vanadium(III) reduction with chemiluminescence detection. Analytical Chemistry, 61(24), 2715–2718. doi:10.1021/ac00199a007
Methods

Casciotti, K. L., Sigman, D. M., Hastings, M. G., Böhlke, J. K., & Hilkert, A. (2002). Measurement of the Oxygen Isotopic Composition of Nitrate in Seawater and Freshwater Using the Denitrifier Method. Analytical Chemistry, 74(19), 4905–4912. doi:10.1021/ac020113w
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

Sigman, D. M., Casciotti, K. L., Andreani, M., Barford, C., Galanter, M., & Böhlke, J. K. (2001). A Bacterial Method for the Nitrogen Isotopic Analysis of Nitrate in Seawater and Freshwater. Analytical Chemistry, 73(17), 4145–4153. doi:10.1021/ac010088e

Methods

Weigand, M. A., Foriel, J., Barnett, B., Oleynik, S., & Sigman, D. M. (2016). Updates to instrumentation and protocols for isotopic analysis of nitrate by the denitrifier method. Rapid Communications in Mass Spectrometry, 30(12), 1365–1383. doi:10.1002/rcm.7570
Methods

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Parameters

Parameter	Description	Units
Cruise_ID	Rolling Deck Repository or other cruise identifier	unitless
Sampling_Date	Date on which the sample was collected	unitless
Latitude	latitude at which the sample was collected	decimal degrees
Longitude	longitude at which the sample was collected	decimal degrees
Depth	Depth at which the sample was collected	meters (m)
SigmaTheta	Potential Density of depth at which sample was collected	unitless
NO3_NO2	Concentration of nitrate+nitrite in a sample	micro molar (µM)
NO3_NO2_d15N	Nitrogen isotopic composition of nitrate+nitrite in a sample	per mil (0/00) vs. N2 in air
NO3_NO2_d18O	Oxygen isotopic composition of nitrate+nitrite in a sample	per mil (0/00) vs. VSMOW
sal	salinity of the sample	Practical Salinity Units (PSU)
temp	temperature of the sample	degrees Celsius

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Instruments

Dataset-specific Instrument Name	Thermo 42i NOx analyzer
Generic Instrument Name	Gas Analyzer
Dataset-specific Description	Nitrate+nitrite concentration was measured on a Thermo 42i NOx analyzer.
Generic Instrument Description	Gas Analyzers - Instruments for determining the qualitative and quantitative composition of gas mixtures.

Dataset-specific Instrument Name	Thermo Finnigan Delta V isotope ratio mass spectrometer
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Nitrate+nitrite d15N was measured using a Thermo Finnigan Delta V isotope ratio mass spectrometer.
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.

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Deployments

WS1114

Website	https://www.bco-dmo.org/deployment/782521
Platform	R/V F.G. Walton Smith
Start Date	2011-09-21
End Date	2011-09-22
Description	https://www.rvdata.us/search/cruise/WS1114 doi: 10.7284/901055

PE17-24

Website	https://www.bco-dmo.org/deployment/782553
Platform	R/V Pelican
Start Date	2017-06-23
End Date	2017-06-26
Description	Additional information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/PE17-24 Cruise DOI: 10.7284/907751

PE18-23

Website	https://www.bco-dmo.org/deployment/782580
Platform	R/V Pelican
Start Date	2018-04-06
End Date	2018-04-21
Description	https://www.rvdata.us/search/cruise/PE18-23 doi: 10.7284/908171

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Project Information

Quantifying nitrogen fixation along unique geochemical gradients in the southwest Pacific Ocean (SW Pac N2 fixation)

Website: http://scope.soest.hawaii.edu/data/lava/lava.html

Coverage: Southwest Pacific Ocean between New Caledonia and Tahiti along ~18 deg S

NSF Award Abstract:
The availability of nitrogen in the surface ocean plays a critical role regulating rates of primary productivity in the ocean, and thus through modification of the carbon cycle, nitrogen has the capacity to influence climate. The dominant source of biologically available nitrogen to the ocean is through a process known as di-nitrogen (N2) fixation, which involves the reduction of N2 gas dissolved in seawater to ammonium by microbes referred to as diazotrophs. While significant progress has been made identifying a diversity of marine diazotrophs in recent years using molecular tools, quantifying global rates of N2 fixation, and identifying which ocean basin supports the highest fluxes, has remained a vexing question. This research will quantify rates of N2 fixation as

well as its importance for supporting production in the southwest Pacific Ocean. Results from this research will shed light on the sensitivities of N2 fixation (temperature, iron concentrations) as well as the extent of spatial and temporal coupling of nitrogen sources and sinks in the ocean. The work will be carried out by an early career scientist, and involve mentoring of young women, middle school girls and minorities, training of undergraduate and graduate researchers, and international collaborations.

Identifying the spatial distribution of the largest di-nitrogen (N2) fixation fluxes to the ocean remains a critical goal of chemical oceanography. The spatial distribution can inform our understanding of the environmental sensitivities of N2 fixation and the capacity for the dominant marine nitrogen (N) source and sink processes to respond to each other and thus influence the global carbon cycle and climate. In addition to temperature, two factors are at the heart of the current debate over what influences the spatial distribution of N2 fixation in the ocean: 1) the presence of adequate iron to meet the needs of N2 fixing microbes, and, 2) the absolute concentrations as well as ratios of surface ocean nitrate and phosphate concentrations that are low relative to the "Redfield" ratio, which are thought to favor N2 fixing microbes. This project will test the effects of gradients in atmospheric dust deposition on N2 fixation rates when surface waters have relatively constant but favorable nitrate to phosphate concentrations. The work will be carried out in the southwest Pacific, a region highlighted by new modeling work for its unique geochemical characteristics that are expected to favor significant N2 fixation fluxes. Nitrate+nitrite d15N as well as total dissolved nitrogen (TDN) concentration and d15N will be measured in water column samples collected on a French cruise and sediment traps were deployed to capture the sinking particulate N flux. The results will be compared with published work to evaluate which ocean regions support the largest N2 fixation fluxes.

More information:

This project was part of the Oligotrophy to UlTra-oligotrophy PACific Experiment (OUTPACE) cruise in the Southwest Pacific between New Caledonia (166°28' E; 22°14' S) and Tahiti (149°36' W; 17°34' S) 0-2000 m
* OUTPACE cruise (doi: http://dx.doi.org/10.17600/15000900)
* OUTPACE website: https://outpace.mio.univ-amu.fr/?lang=en

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1537314

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