Dissolved and sinking particulate organic nitrogen data from a large volume mesocosm experiment in the Noumea Lagoon, New Caledonia, measured from January to February 2013

Website: https://www.bco-dmo.org/dataset/739646
Data Type: Other Field Results
Version: 1
Version Date: 2018-07-10

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

Contributors	Affiliation	Role
Knapp, Angela N.	Florida State University (FSU)	Principal Investigator, Contact
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset includes water column dissolved organic nitrogen (DON) concentration and d15N data, as well as sinking particulate nitrogen d15N ("PNsink d15N") data. These samples were collected inside triplicate ("M1", "M2", and "M3") large volume (i.e., 2.3 m diameter, 15 m deep) mesocosm experiments deployed in a lagoon off of Noumea, New Caledonia. DON samples were collected at 6 m depth daily by a Teflon pump and PVC tubing. PNsink d15N samples were collected daily by SCUBA divers who removed a screw-top plastic bottle from the bottom of the plastic mesocosm. "Swimmers" were removed from the PNsink d15N samples prior to analysis. These measurements were made as part of project "VAriability of vertical and tropHIc transfer of diazotroph derived N in the south wEst Pacific" (VAHINE) to study the fate of fixed nitrogen in the oceanic pelagic food web and its potential impact on carbon export. The field campaign of VAHINE took place in the South West Pacific (New Caledonia) in January and February of 2013 and involved 16 scientists from France, Israel, Germany and the USA.

Table of Contents

Coverage

Spatial Extent: **Lat**:-22.48092 **Lon**:166.4454
Temporal Extent: 2013-01-14 - 2013-02-06

Dataset Description

These data were published in Knapp et al., 2016, Biogeosciences, Supplementary Table 1.

Methods & Sampling

Sampling and analytical procedures:

The concentration of total nitrogen (TN) for samples was determined by persulfate oxidation (Solorzano and Sharp, 1980) with adaptations (Knapp et al., 2005), and the resulting NO3- was measured by chemiluminescence (Braman and Hendrix, 1989). DON concentration was determined by subtracting the concentrations of PNsusp, NH4+, and NO3-+NO2- (reported in Berthelot et al., 2015, Biogeosciences) from the measured TN concentration of each sample with a propagated error of +/- 0.5 µM. The d15N of the resulting NO3- was measured using the denitrifier method (Casciotti et al., 2002; McIlvin and Casciotti, 2011; Sigman et al., 2001).

The d15N of PNsink was measured using a Thermo Scientific Flash 2000 Elemental Analyzer coupled with a Delta Plus Thermo Scientific mass spectrometer.

The average standard deviation for individual DON concentration measurements was +/- 0.3 µM. DON concentration was determined by subtracting the concentrations of PNsusp, NH4+, and NO3-+NO2- (reported in Berthelot et al., 2015, Biogeosciences) from the measured TN concentration of each sample with a propagated error of +/- 0.5 µM.

The d15N of TN was determined via persulfate oxidation of TN to NO3- (Knapp et al., 2005) and subsequent analysis of NO3- d15N by the denitrifier method, with a propagated error for DON d15N calculated using a Monte Carlo method (Press et al., 1992) of +/- 0.6‰. Samples were calibrated with IAEA N3 and USGS 34 NO3- d15N isotopic reference materials as described in McIlvin and Casciotti, 2011.

The d15N of PNsink was measured using a Thermo Scientific Flash 2000 Elemental Analyzer coupled with a Delta Plus Thermo Scientific mass spectrometer. The average standard deviation for standards was +/- 0.06‰.

Data Processing Description

BCO-DMO Data Manager Processing Notes:
* 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.

[table of contents | back to top]

Data Files

File
VAHINE_nitrogen.csv (Comma Separated Values (.csv), 1.12 KB) MD5:cbdc93f0fbb4dd699e3574b235b7ba2f Primary data file for dataset ID 739646

[table of contents | back to top]

Related Publications

Berthelot, H., Moutin, T., L'Helguen, S., Leblanc, K., Hélias, S., Grosso, O., … Bonnet, S. (2015). Dinitrogen fixation and dissolved organic nitrogen fueled primary production and particulate export during the VAHINE mesocosm experiment (New Caledonia lagoon). Biogeosciences, 12(13), 4099–4112. doi:10.5194/bg-12-4099-2015
Methods

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

Knapp, A. N., Fawcett, S. E., Martínez-Garcia, A., Leblond, N., Moutin, T., & Bonnet, S. (2016). Nitrogen isotopic evidence for a shift from nitrate- to diazotroph-fueled export production in the VAHINE mesocosm experiments. Biogeosciences, 13(16), 4645–4657. doi:10.5194/bg-13-4645-2016
Results

Knapp, A. N., Sigman, D. M., & Lipschultz, F. (2005). N isotopic composition of dissolved organic nitrogen and nitrate at the Bermuda Atlantic Time-series Study site. Global Biogeochemical Cycles, 19(1). doi:10.1029/2004gb002320
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

Press, W. H., Teukolsky, S. A., Vetterling, W. T., and Flannery, B. P. (1992) Numerical Recipes in C: The art of scientific computing, 2nd Edn., Cambridge University Press. https://isbnsearch.org/isbn/9780521430647
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

Solórzano, L., & Sharp, J. H. (1980). Determination of total dissolved nitrogen in natural waters1. Limnology and Oceanography, 25(4), 751–754. doi:10.4319/lo.1980.25.4.0751
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
Sampling_Date	Sample date in format "dd-mmm-yyyy"	unitless
M1_DON	Dissolved organic nitrogen (replicate "M1")	micromolar (uM)
M1_DONd15N	Dissolved organic nitrogen isotopic composition (replicate "M1")	per mil (0/00)
M2_DON	Dissolved organic nitrogen (replicate "M2")	micromolar (uM)
M2_DONd15N	Dissolved organic nitrogen isotopic composition (replicate "M2")	per mil (0/00)
M3_DON	Dissolved organic nitrogen (replicate "M3")	micromolar (uM)
M3_DONd15N	Dissolved organic nitrogen isotopic composition (replicate "M3")	per mil (0/00)
M1_d15NPNsink	Sinking particulate nitrogen isotopic composition (replicate "M1")	per mil (0/00)
M2_d15NPNsink	Sinking particulate nitrogen isotopic composition (replicate "M2")	per mil (0/00)
M3_d15NPNsink	Sinking particulate nitrogen isotopic composition (replicate "M3")	per mil (0/00)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Thermo Scientific 42i chemiluminescent NOx
Generic Instrument Name	Chemiluminescence NOx Analyzer
Dataset-specific Description	DON concentration was measured on a Thermo Scientific 42i chemiluminescent NOx box.
Generic Instrument Description	The chemiluminescence method for gas analysis of oxides of nitrogen relies on the measurement of light produced by the gas-phase titration of nitric oxide and ozone. A chemiluminescence analyzer can measure the concentration of NO/NO2/NOX. One example is the Teledyne Model T200: https://www.teledyne-api.com/products/nitrogen-compound-instruments/t200

Dataset-specific Instrument Name	Thermo Scientific Flash 2000 Elemental Analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	The d15N of PNsink was measured using a Thermo Scientific Flash 2000 Elemental Analyzer coupled with a Delta Plus Thermo Scientific mass spectrometer.
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	Thermo Delta V isotope ratio mass spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	DON d15N was measured on a Thermo Delta V isotope ratio mass spectrometer.
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).

[table of contents | back to top]

Deployments

VAHINE

Website	https://www.bco-dmo.org/deployment/739688
Platform	shoreside New Caledonia
Report	http://mio.pytheas.univ-amu.fr/?VAHINE-Project
Start Date	2013-01-13
End Date	2013-02-06

[table of contents | back to top]

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

[table of contents | back to top]

Funding

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

[table of contents | back to top]