Measurements of dissolved organic nitrogen concentration and d15N from R/V Atlantis and R/V Melville cruises in the Eastern Tropical South Pacific from 2010 to 2011.

Website: https://www.bco-dmo.org/dataset/729480
Data Type: Cruise Results
Version: 1
Version Date: 2018-03-06

Project
» Collaborative Research: Documenting N2 fixation in N deficient waters of the Eastern Tropical South Pacific (N2 fixation ETSP)
» Expression of Microbial Nitrification in the Stable Isotopic Systematics of Oceanic Nitrite and Nitrate (Microbial Nitrification)

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Abstract
Measurements of dissolved organic nitrogen concentration and d15N from R/V Atlantis and R/V Melville cruises in the Eastern Tropical South Pacific from 2010 to 2011.

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Coverage

Spatial Extent: **N**:-9.3059 **E**:-80 **S**:-20 **W**:-101.3576
Temporal Extent: 2010-02-01 - 2011-04-18

Dataset Description

Measurements of dissolved organic nitrogen concentration and d15N.

Methods & Sampling

NO3- + NO2- concentration and isotopic composition analysis

The NO3- + NO2- concentration of samples was determined using chemiluminescent analysis (Braman & Hendrix, 1989) in a configuration with a detection limit of 0.05 uM, and +/- 0.1 uM for 1 standard deviation

(S.D.). The d15N of NO3- + NO2- was determined using the “denitrifier” method (K. L. Casciotti, Sigman, Hastings, Bohlke, & Hilkert, 2002; Sigman et al., 2001) with modifications (McIlvin & Casciotti, 2011) on samples with NO3- + NO2- concentration >0.3 uM (typically <0.2‰ 1 S.D.) (Supp. Table 1) (Knapp, Casciotti, Berelson, Prokopenko, & Capone, 2016).

DON concentration and isotopic analysis

The DON concentration of samples was determined using persulfate oxidation to convert DON to NO3- (Solorzano & Sharp, 1980), adapted according to (Knapp et al., 2005). The resulting NO3- concentration was then measured using chemiluminescence as described above. In cases where NO3- + NO2- (and/or ammonium, NH4+) was above the detection limit, DON was determined by subtracting the concentration of NO3- + NO2-+NH4+ from the concentration of total dissolved N (TDN). The average standard deviation for duplicate DON concentration analyses of individual samples that have undetectable levels of NO3- in the sample was +/- 0.30 uM, and the propagated error for DON concentration in the presence of detectable NO3- was +/- 0.32 uM.

The d15N of DON was determined according to (Knapp et al., 2005), where DON samples were oxidized to NO3- by persulfate oxidation (as described above in section 2.2), acidified to a pH range of 3 to 4, and measured as NO3- by the denitrifier method. In samples with measurable NO3- + NO2-, the d15N of DON is calculated by mass balance by subtracting the NO3- + NO2- concentration and d15N of NO3- + NO2- from the TDN concentration and TDN d15N measurements. In surface samples with undetectable NO3- + NO2- concentration, the standard deviation of duplicate analyses of DON d15N in a sample is +/- 0.3‰. For subsurface samples with NO3- + NO2- concentration approximately equal to the DON concentration, the propagated error for the calculation of DON d15N using a Monte Carlo method (Press, Teukolsky, Vetterling, & Flannery, 1992), and assuming duplicate analysis of a single sample and the standard deviations for TN concentration, NO3- + NO2- concentration and d15N of NO3- + NO2- given above, is +/- 0.6 0/00. The 15N of DON in samples with NO3- + NO2- concentration exceeding DON concentration, and/or with NH4+ concentration > 0.2 uM, was not determined (i.e., Stations 9, 10, 11, and 12 from the 2010 cruise).

Sampling

Samples were collected on the R/V Atlantis in January through February 2010, and the R/V Melville in March through April 2011 between 10 and 20 ºS and 80º W and 100º W (Fig. 1), with station locations and sample depths, salinities, sigma theta values, chlorophyll a concentrations, nitrate+nitrite concentration, NO3-+ NO2- d15N, DON concentrations, and DON d15N reported in Supplementary Information Table 1. Water column samples were collected by Niskin bottles deployed on a rosette equipped with conductivity-temperature-depth (CTD) sensors. All samples were collected into acid-washed, sample-rinsed HDPE bottles, and samples from the upper 400 m passed a 0.2 um filter before collection, and were stored at -20º C until analysis on land.

Data Processing Description

BCO-DMO Processing:

- dates reformatted to yyyy/mm/dd
- no data replaced with nd
- N/A replaced with NA
- blanks replaced with nd
- converted from wide to long format

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Data Files

File
biogeochemical.csv (Comma Separated Values (.csv), 5.50 KB) MD5:989bbd3922e086a09d65748003667a95 Primary data file for dataset ID 729480

Related Publications

Berelson, W. M., Haskell, W. Z., Prokopenko, M., Knapp, A. N., Hammond, D. E., Rollins, N., & Capone, D. G. (2015). Biogenic particle flux and benthic remineralization in the Eastern Tropical South Pacific. Deep Sea Research Part I: Oceanographic Research Papers, 99, 23–34. doi:10.1016/j.dsr.2014.12.006
Related Research

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

Haskell, W. Z., Berelson, W. M., Hammond, D. E., & Capone, D. G. (2013). Particle sinking dynamics and POC fluxes in the Eastern Tropical South Pacific based on 234Th budgets and sediment trap deployments. Deep Sea Research Part I: Oceanographic Research Papers, 81, 1–13. doi:10.1016/j.dsr.2013.07.001
Related Research

Haskell, W. Z., Kadko, D., Hammond, D. E., Knapp, A. N., Prokopenko, M. G., Berelson, W. M., & Capone, D. G. (2015). Upwelling velocity and eddy diffusivity from 7Be measurements used to compare vertical nutrient flux to export POC flux in the Eastern Tropical South Pacific. Marine Chemistry, 168, 140–150. doi:10.1016/j.marchem.2014.10.004
Related Research

Haskell, W. Z., Prokopenko, M. G., Stanley, R. H. R., & Knapp, A. N. (2016). Estimates of vertical turbulent mixing used to determine a vertical gradient in net and gross oxygen production in the oligotrophic South Pacific Gyre. Geophysical Research Letters, 43(14), 7590–7599. doi:10.1002/2016gl069523 https://doi.org/10.1002/2016GL069523
Related Research

Jacquot, J. E., Kondo, Y., Knapp, A. N., & Moffett, J. W. (2013). The speciation of copper across active gradients in nitrogen-cycle processes in the eastern tropical South Pacific. Limnology and Oceanography, 58(4), 1387–1394. doi:10.4319/lo.2013.58.4.1387
Related Research

Johnston, D. T., Gill, B. C., Masterson, A., Beirne, E., Casciotti, K. L., Knapp, A. N., & Berelson, W. (2014). Placing an upper limit on cryptic marine sulphur cycling. Nature, 513(7519), 530–533. doi:10.1038/nature13698
Related Research

Knapp, A. N., Casciotti, K. L., Berelson, W. M., Prokopenko, M. G., & Capone, D. G. (2016). Low rates of nitrogen fixation in eastern tropical South Pacific surface waters. Proceedings of the National Academy of Sciences, 113(16), 4398–4403. doi:10.1073/pnas.1515641113
Methods

Letscher, R. T., Knapp, A. N., James, A. K., Carlson, C. A., Santoro, A. E., & Hansell, D. A. (2015). Microbial community composition and nitrogen availability influence DOC remineralization in the South Pacific Gyre. Marine Chemistry, 177, 325–334. doi:10.1016/j.marchem.2015.06.024
Related Research

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

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Parameters

Parameter	Description	Units
deployment	Deployment name	unitless
cruise_year	Year of cruise; yyyy	unitless
date	Date of sampling; yyyy/mm/dd	unitless
station	Station where sampling occurred	unitless
lat	Latitude	decimal degrees
lon	Longitude	decimal degrees
depth	Depth of sampling	meters
NO3_NO2	NO3- + NO2- values	uM
NO3_NO2_d15N	No3- + NO2- d15N values	ppm vs air
DON	Dissolved organic nitrogen	uM
DON_stdev	Standard deviation of dissolved organic nitrogen	uM
DON_d15N	Dissolved organic nitrogen d15N	ppm vs air
DON_d15N_stdev	Standard deviation of dissolved organic nitrogen d15N	ppm vs air

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Instruments

Dataset-specific Instrument Name	CTD
Generic Instrument Name	CTD - profiler
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	Sievers 280i Nitric Oxide Analyzer
Generic Instrument Name	Gas Analyzer
Dataset-specific Description	Used to collect the NO3- + NO2- concentration and DON concentration data
Generic Instrument Description	Gas Analyzers - Instruments for determining the qualitative and quantitative composition of gas mixtures.

Dataset-specific Instrument Name	Teledyne API Model 200EU Chemiluminescence NO/NOx/NOX analyzer
Generic Instrument Name	Gas Analyzer
Dataset-specific Description	Used to collect the NO3- + NO2- concentration and DON concentration data
Generic Instrument Description	Gas Analyzers - Instruments for determining the qualitative and quantitative composition of gas mixtures.

Dataset-specific Instrument Name	Thermo Delta V Plus isotope ratio mass spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Used to collect NO3- + NO2- d15N and DON d15N data
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	Niskin
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Used to collect water samples
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

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Deployments

AT15-61

Website	https://www.bco-dmo.org/deployment/58785
Platform	R/V Atlantis
Start Date	2010-01-29
End Date	2010-03-03
Description	See more information at R2R: https://www.rvdata.us/search/cruise/AT15-61

MV1104

Website	https://www.bco-dmo.org/deployment/555585
Platform	R/V Melville
Start Date	2011-03-23
End Date	2011-04-23
Description	See more information at R2R: https://www.rvdata.us/search/cruise/MV1104

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Project Information

Collaborative Research: Documenting N2 fixation in N deficient waters of the Eastern Tropical South Pacific (N2 fixation ETSP)

Coverage: Eastern Tropical South Pacific

Description from NSF award abstract:
Several independent lines of geochemical and remote sensing evidence suggest that dinitrogen (N2) fixation may be associated with surface waters downstream of major oxygen minimum zones (OMZs) and in particular in the Eastern Tropical South Pacific (ETSP). However, little direct evidence supports these inferences. Besides substantiating these indirect assessments, documenting significant N2 fixation in the ETSP would provide

insight into two longstanding controversies: Is the marine N budget balanced, as implied by modeling and paleoceanographic data, and if so, how are the processes that add and remove N spatially, and thus temporally coupled?

In this project researchers at the University of Southern California and the University of Miami will test the hypothesis that fixation occurs in the ETSP at areal rates that equal or exceed those previously documented in more well-studied regions such as the oligotrophic waters of the sub/tropical North Atlantic. If scaled to the surface area of ETSP waters, this could add an additional 10-50 Tg N per year of inputs to the global marine N budget. They will undertake two cruises in the ETSP during early and late summer in two consecutive years to assess the quantitative significance of N2 fixation as a source of new N to surface waters using complementary biological and geochemical tools. N2 fixation rates will be evaluated on two temporal/spatial scales: daily/local (bottle 15N2 incubations and floating sediment traps); and seasonal/regional (d15N budget using moored sediment traps and water column TDN d15N). These estimates provide detailed observations of potential N2 fixation during station occupation in two summer seasons, when rates are expected to be greatest, as well as prolonged observation over lower expected N2 fixation periods. A combination of these different estimates will aim to determine if N2 fixation in this region can help balance the marine N budget. If all goes as planned, this study will determine the quantitative importance of N2 fixation in the ETSP, and whether these previously undocumented rates can help resolve the marine N budget. Implications include the ability of the marine N cycle to maintain homeostasis, and thus the global C cycle on glacial/interglacial time scales.

Expression of Microbial Nitrification in the Stable Isotopic Systematics of Oceanic Nitrite and Nitrate (Microbial Nitrification)

Coverage: Eastern Tropical South Pacific

Description from NSF award abstract:
Closing the marine budgets of nitrate and nitrous oxide are central goals for researchers interested in nutrient-driven changes in primary productivity and climate change. With the implementation of new methods for oxygen isotopic analysis of seawater nitrate, it will be possible to construct a budget for nitrate based on its oxygen isotopic distribution that is complementary to nitrogen isotope budgets. Before we can effectively use oxygen isotopes in nitrate to inform the current understanding of the marine nitrogen cycle, we must first understand how different processes that produce (nitrification) and consume (assimilation, denitrification) nitrate affect its oxygen isotopic signature.

In this study, researchers at the Woods Hole Oceanographic Institution will provide a quantitative assessment of the oxygen isotopic systematics of nitrification in the field and thus fill a key gap in our understanding of 18O variations in nitrate, nitrite, and nitrous oxide. The primary goal is to develop a quantitative prediction of the oxygen isotopic signatures of nitrite and nitrate produced during nitrification in the sea. The researchers hypothesize that oxygen isotopic fractionation during nitrification is the primary factor setting the 18O values of newly produced nitrate and nitrite. Secondly, they hypothesize that oxygen atom exchange is low where ammonia oxidation and nitrite oxidation are tightly coupled, but may increase in regions with nitrite accumulation, such as in the primary and secondary nitrite maxima. They will test these hypotheses with a series of targeted laboratory and field experiments, as well as with measurements of nitrite and nitrate isotopic distributions extending through the euphotic zone, primary nitrite maximum, and secondary nitrite maximum of the Eastern Tropical South Pacific. The results of these experiments are expected to provide fundamental information required for the interpretation of 18O isotopic signatures in nitrite, nitrate, and N2O in the context of underlying microbial processes. A better understanding of these features and the processes involved is important for quantifying new production, controls on the N budget, and N2O production in the ocean -- which should lead to a better understanding of the direct and indirect interactions among the nitrogen cycle, marine chemistry, and climate.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0850801
NSF Division of Ocean Sciences (NSF OCE)	OCE-0850905
NSF Division of Ocean Sciences (NSF OCE)	OCE-0961207
NSF Division of Ocean Sciences (NSF OCE)	OCE-0961098

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