Nitrate + nitrite concentration and d15N from the Eastern Tropical South Pacific collected on the R/V Atlantis (AT15-61) and R/V Melville (MV1104) in 2010-2011 (N2 fixation ETSP project, Microbial Nitrification project)

Website: https://www.bco-dmo.org/dataset/555691
Version: 2015-04-09

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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Methods & Sampling

Water column sample collection: Samples were collected on the R/V Atlantis in January through February 2010, and the R/V Melville in March through April 2011 on a zonal transect along 20º S between 80º W and 100º W, with exact station locations and sample depths, nutrient concentrations and isotopic compositions reported below. 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 µm filter before collection. All samples were stored at -20º C until analysis on land.

Nitrate plus nitrite (NO3-+NO2-) concentration: The concentration of NO3-+NO2- ([NO3-+NO2-]) was determined using chemiluminescent analysis (in a configuration with a detection limit of 0.05 µM, + 0.1 µM 1 S.D.).

Reference: Braman, R. S. & Hendrix, S. A. Nanogram Nitrite and Nitrate Determination in Environmental and

Biological-Materials by Vanadium(Iii) Reduction with Chemi-Luminescence Detection. Analytical Chemistry 61, 2715-2718 (1989).

NO3+NO2 d15N: The d15N of NO3+NO2 was determined using the denitrified method on samples with >0.3 µM NO3+NO2 with a standard deviation <0.2 per mil.

References:

Sigman, D. M. et al. A bacterial method for the nitrogen isotopic analysis of nitrate in seawater and freshwater. Analytical Chemistry 73, 4145-4153 (2001).

Casciotti, K. L., Sigman, D. M., Hastings, M. G., Bohlke, J. K. & Hilkert, A. Measurement of the oxygen isotopic composition of nitrate in seawater and freshwater using the denitrifier method. Analytical Chemistry 74, 4905-4912 (2002).

McIlvin, M. R. & Casciotti, K. L. Technical Updates to the Bacterial Method for Nitrate Isotopic Analyses. Analytical Chemistry 83, 1850-1856 (2011).

Data Processing Description

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date
- renamed parameters to BCO-DMO standard
- added cruise id column
- replaced blank cells with nd

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Data Files

File
nitrates.csv (Comma Separated Values (.csv), 5.78 KB) MD5:35012890ae948d448526bf6c043bfdcb Primary data file for dataset ID 555691

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Parameters

Parameter	Description	Units
date	sample collection date (local) in yyyy-mm-dd format	unitless
station	station	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
depth	sample depth	meters
sigma_theta	seawater density	unitless
NO3_NO2	nitrate + nitrite concentration	micro mols N per liter
NO3_NO2_sd	nitrate + nitrite concentration standard deviation	micro mols N per liter
del15N_NO3NO2	delta 15N of nitrate + nitrite, reported in units of permil vs. atmospheric N2	per mil versus air
del15N_NO3NO2_sd	delta 15N of nitrate + nitrite; 1 standard deviation, reported in units of permil vs. atmospheric N2	per mil versus air
cruise_id	cruise_id	unitless

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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.

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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-0961098

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