Nitrate (NO3-) and Nitrite (NO2-) d15N and d18O from R/V Atlantis cruise AT15-61 in Jan-Feb 2010 and R/V Melville cruise MV1104 in Mar-Apr 2011 in the Eastern Tropical South Pacific (ETSP)

Website: https://www.bco-dmo.org/dataset/903891
Data Type: Cruise Results
Version: 1
Version Date: 2023-07-10

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

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Abstract
This dataset includes nitrate (NO3-) and nitrite (NO2-) d15N and d18O from R/V Atlantis cruise AT15-61 in January-February 2010 and R/V Melville cruise MV1104 in March-April 2011 in the Eastern Tropical South Pacific (ETSP). Accompanying physiochemical data can be found in a related BCO-DMO dataset, https://www.bco-dmo.org/dataset/821268.

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Coverage

Spatial Extent: **N**:-9.973 **E**:-79.997 **S**:-20.01 **W**:-100
Temporal Extent: 2010-02-01 - 2011-04-16

Dataset Description

Nitrous oxide (N2O) data from the samples are available in the related dataset "ETSP N2O" (https://www.bco-dmo.org/dataset/821268).

Methods & Sampling

Seawater samples were obtained during the R/V Atlantis (AT15-61) and R/V Melville (MV1104) cruises from January to February 2010 and March to April 2011. Water samples were collected at discrete depths using Niskin bottle type rosette samplers equipped with either 24 bottles (10L) or 12 bottles (20L), and an SBE9plus conductivity-temperature-depth (CTD) sensor package (SeaBird Electronics, Bellevue, WA).

The d15N and d18O of NO3- was determined using the "denitrifier" method (Casciotti et al., 2002; Sigman et al., 2001) with updated techniques (McIlvin & Casciotti, 2011). Samples were treated with sulfamic acid to remove NO2-, if present (Granger & Sigman, 2009).

The d15N and d18O of NO2- was determined using the chemical reduction of NO2- to nitrous oxide (N2O) using the "azide method" (McIlvin & Altabet, 2005).

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° South and between 80° and 100° West, with station locations and sample depths, salinities, sigma theta, oxygen concentrations values, etc. reported in the 'ETSP N2O' dataset. Water column samples were collected by Niskin bottles deployed on a rosette equipped with conductivity-temperature-depth (CTD) sensors. All samples were collected into sample-rinsed HDPE bottles and passed through a 0.2 micrometer (um) filter before collection, and were stored at -20° Celsius until analysis on land.

Data Processing Description

BCO-DMO Processing:
- Imported original file named "ETSP_ENSO_no3_no2_isotope_BCODMO_230227.xlsx" sheet 1 into the BCO-DMO data system.
- Replaced missing data identifier of 'NaN' with blank/empty values, which is the default for csv files.
- Added columns ISO_DateTime_Local, Latitude, and Longitude from related N2O dataset (https://www.bco-dmo.org/dataset/821268) by joining on key comprised of Year+Station+Depth.
- Named the final file "903891_v1_etsp_no3_and_no2_isotopes.csv".

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Data Files

File
903891_v1_etsp_no3_and_no2_isotopes.csv (Comma Separated Values (.csv), 20.20 KB) MD5:e2c133ecda693c84d69a0bfd7ca7f92a Primary data file for dataset ID 903891, version 1.

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Related Publications

Buchwald, C., Santoro, A. E., McIlvin, M. R., & Casciotti, K. L. (2012). Oxygen isotopic composition of nitrate and nitrite produced by nitrifying cocultures and natural marine assemblages. Limnology and Oceanography, 57(5), 1361–1375. Portico. https://doi.org/10.4319/lo.2012.57.5.1361
Results

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

Granger, J., & Sigman, D. M. (2009). Removal of nitrite with sulfamic acid for nitrate N and O isotope analysis with the denitrifier method. Rapid Communications in Mass Spectrometry, 23(23), 3753–3762.

doi:10.1002/rcm.4307
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

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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Related Datasets

IsRelatedTo

Casciotti, K. L., Gluschankoff, N., Santoro, A. E., McIlvin, M. R., Forbes, M. (2023) **Nitrous oxide (N2O) concentrations and associated physicochemical parameters from R/V Atlantis cruise AT15-61 in Jan-Feb 2010 and R/V Melville cruise MV1104 in Mar-Apr 2011 in the Eastern Tropical South Pacific (ETSP).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2) Version Date 2023-07-28 doi:10.26008/1912/bco-dmo.821268.2 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Year	Year sampled	unitless
Station	Station	unitless
Depth	Sample Depth	meters (m)
del15N_NO3	Delta 15N of nitrate; expressed in permille notation in reference to atmospheric N2	permille
del15N_NO3_sd	Delta 15N of nitrate; 1 standard deviation expressed in permille notation in reference to atmospheric N2	permille
del18O_NO3	Delta 18O of nitrate; expressed in permille notation in reference to VSMOW (vienna standard mean ocean water)	permille
del18O_NO3_sd	Delta 18O of nitrate; 1 standard deviation expressed in permille notation in reference to VSMOW (vienna standard mean ocean water)	permille
del15N_NO2	Delta 15N of nitrate expressed in permille notation in reference to atmospheric N2	permille
del15N_NO2_sd	Delta 15N of nitrite; 1 standard deviation expressed in permille notation in reference to atmospheric N2	permille
del18O_NO2	Delta 18O of nitrite; 1 standard deviation expressed in permille notation in reference to VSMOW (vienna standard mean ocean water)	permille
del18O_NO2_sd	Delta 18O of nitrite; 1 standard deviation expressed in permille notation in reference to VSMOW (vienna standard mean ocean water)	permille
ISO_Date_Local	Date of sampling in ISO 8601 format. Timezone was GMT-5 in 2010, GMT-4 in 2011	unitless
Latitude	Latitude of sample collection, South is negative	decimal degrees
Longitude	Longitude of sample collection, West is negative	decimal degrees

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Instruments

Dataset-specific Instrument Name	CTD - profiler
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	Thermo Delta Plus XP isotope ratio mass spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Used to analyze NO3- and NO2- d15N and d18O.
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 bottle
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

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-0961098

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