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)

Website: https://www.bco-dmo.org/dataset/821268
Data Type: Cruise Results, experimental
Version: 2
Version Date: 2023-07-28

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

Contributors	Affiliation	Role
Casciotti, Karen L.	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
Gluschankoff, Noah	Stanford University	Student
Santoro, Alyson E.	Woods Hole Oceanographic Institution (WHOI)	Contact
Forbes, Matthew	Stanford University	Analyst
McIlvin, Matthew R.	Woods Hole Oceanographic Institution (WHOI)	Analyst
Gerlach, Dana Stuart	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset includes nitrous oxide (N2O) concentrations and associated physicochemical parameters from the CTD sensor package collected on 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). These data were published as Figure 5 in Santoro et al., 2020 (doi:10.1002/essoar.10503499.1).

Table of Contents

Coverage

Spatial Extent: **N**:-9.973 **E**:-79.997 **S**:-20.01 **W**:-100
Temporal Extent: 2010-02-01 - 2011-04-19

Dataset Description

These data were published as Figure 5 in Santoro et al. (2020).

Nitrate (NO3-) and Nitrite (NO2-) d15N and d18O data from the samples are available in the related dataset "ETSP NO3 and NO2 isotopes" (https://www.bco-dmo.org/dataset/903891).

Description of changes/updates contained in version 2 of this dataset:
Most depths were analyzed in duplicates from two bottles (i.e. one measurement of all isotopic variables and a concentration per bottle). This version (v2) contains each measurement in a unique column (i.e. d15n_alpha1, d15n_alpha2, etc.). A quality control (QC) flag was also added for each measurement using the SeaDataNet QC guidelines available at https://www.seadatanet.org/Standards/Data-Quality-Control.

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). This dataset's samples were collected from Niskin bottles into 160-milliliter (mL) glass serum vials, killed with saturated mercuric chloride, and crimp sealed with gray butyl stoppers. Prior to sealing, ~1 mL of sample was removed to allow room for sample expansion and to prevent the sample vessel from shattering upon warming.

In all cases, samples were extracted and analyzed using a custom automated purge and trap inlet system and normalized to an injection of calibrated pure N2O reference gas introduced prior to the elution of each sample peak (McIlvin & Casciotti, 2010). Isotope ratios were referenced initially to the calibrated N2O reference tank to create a set of 'ratio of ratios' (^{31}Rsample/^{31}Rreference, ^{45}Rsample/^{45}Rreference, ^{46}Rsample/^{46}Rreference). Next, the data were size corrected in reference to a calibrated 20 volt-second (Vs) peak area for a mass-to-charge ratio of 44 (m/z 44). Finally, 'scrambling coefficients' were applied to the isotopomer data to correct the measured 15Ra and 15Rb for the rearrangement of nitrogen atoms in N2O when the gas is ionized in the mass spectrometer ion source (Frame et al., 2014; Frame & Casciotti, 2010; Kelly et al., 2021). The isotope ratios of N and O atoms in N2O, ^{15}Rsample or ^{18}Rsample, respectively, are expressed in delta notation (δ), where the δ15N and δ18O are defined relative to the isotope ratios of certified standards: δ15N or δ18O = (Rsample/Rstandard - 1) x1000. The Rstandard values used for δ15N and δ18O are the ratios of 15N/14N and 18O/16O in atmospheric N2 and Vienna Standard Mean Ocean Water (VSMOW), respectively.

Data Processing Description

Data Processing:
CTD sensor data were processed using Seabird Electronics (SBE) Data Processing software using SBE recommended parameters, including the tau oxygen correction and oxygen hysteresis correction. Processing commands were applied in the following order: filter, alignctd, celltm, loopedit, wildedit.

Derived parameters (pottemp, aou, sigma_theta) were calculated in MATLAB using the CSIRO SEAWATER function library for MATLAB, ver 3.3 (22-Sept-2010).

Version 1:
(Version Date: 2020-08-18)
v1 BCO-DMO Processing:
- Added a conventional header with dataset name, PI name, version date.
- Adjusted parameter names to comply with database requirements.
- Combined year, month, day fields and adjusted timezone to create ISO date field.
- Units in parentheses removed and added to Parameter Description metadata section.
- Missing data identifier of 'NaN' replaced with 'nd'.

Version 2:
(Version Date: 2023-07-28)
Description of v2: This includes a further QC'ed version of the v1 data with six additional isotopic variables: d15n_alpha, d15n_beta, Site_preference (SP), d17O, and d18O. N2O samples were analyzed in duplicates, thus each analysis has an associated QC flag.
v2 BCO-DMO Processing:
- Imported original file named "ETSP_ENSO_N2Oisotope_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.
- Renamed "Presure" column to "Pressure".
- Filled in a value of "1" in the "flag_1" column per request of data submitter.
- Named the final file "821268_v2_etsp_n2o.csv".

[table of contents | back to top]

Data Files

File
821268_v2_etsp_n2o.csv (Comma Separated Values (.csv), 63.96 KB) MD5:11ede7de3f1ca7b23368cf7b88c48243 Primary data file for dataset ID 821268, version 2.

[table of contents | back to top]

Related Publications

Frame, C. H., & Casciotti, K. L. (2010). Biogeochemical controls and isotopic signatures of nitrous oxide production by a marine ammonia-oxidizing bacterium. Biogeosciences, 7(9), 2695–2709. https://doi.org/10.5194/bg-7-2695-2010
Methods

Frame, C. H., Deal, E., Nevison, C. D., & Casciotti, K. L. (2014). N2O production in the eastern South Atlantic: Analysis of N2O stable isotopic and concentration data. Global Biogeochemical Cycles, 28(11), 1262–1278. doi:10.1002/2013gb004790 https://doi.org/10.1002/2013GB004790
Methods

Kelly, C. L., Travis, N. M., Baya, P. A., & Casciotti, K. L. (2020). Quantifying nitrous oxide cycling regimes in the eastern tropical North Pacific Ocean with isotopomer analysis. Global Biogeochemical Cycles. doi:10.1029/2020gb006637 https://doi.org/10.1029/2020GB006637
Results

McIlvin, M. R., & Casciotti, K. L. (2010). Fully automated system for stable isotopic analyses of dissolved nitrous oxide at natural abundance levels. Limnology and Oceanography: Methods, 8(2), 54–66. doi:10.4319/lom.2010.8.54
Methods

Santoro, A. E., Buchwald, C., Knapp, A. N., Berelson, W. M., Capone, D. G., & Casciotti, K. L. (2020). Nitrification and nitrous oxide production in the offshore waters of the Eastern Tropical South Pacific. doi:10.1002/essoar.10503499.1
Results

[table of contents | back to top]

Related Datasets

IsRelatedTo

Casciotti, K. L., Buchwald, C., Gluschankoff, N., McIlvin, M. R., Forbes, M. (2023) **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).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-07-10 doi:10.26008/1912/bco-dmo.903891.1 [view at BCO-DMO]

[table of contents | back to top]

Parameters

Parameter	Description	Units
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
Station	Station number	unitless
Cast	Cast number	unitless
Depth	Sample collection depth	meters (m)
Salinity	Salinity	practical salinity units (psu)
Temperature	Temperature	degrees Celsius
Density	Seawater density	kilograms per cubic meter (kg/m^3)
Oxygen	Dissolved oxygen	micromoles per kilogram (umol/kg)
Pressure	Pressure	decibars
Potential_Temp	Potential temperature	degrees Celsius
AOU	Apparent oxygen utilization	micromoles per kilogram (umol/kg)
sigma_theta	sigma-theta, Potential density anomaly	kilograms per cubic meter (kg/m^3)
sigma_T	sigma-T, Density anomaly	kilograms per cubic meter (kg/m^3)
d15n_alpha_1	First measurement of d15N alpha (inner nitrogen atom) in N2O in reference to atmospheric nitrogen gas, expressed in permille notation	permille
d15n_beta_1	First measurement of d15N beta (outer nitrogen atom) in N2O in reference to atmospheric nitrogen gas, expressed in permille notation	permille
SP_1	First measurement of N2O SP (site preference) in N2O in reference to atmospheric nitrogen gas, expressed in permille notation	permille
d15n_bulk_1	First measurement of d15N bulk in N2O in reference to atmospheric nitrogen gas, expressed in permille notation	permille
d17O_1	First measurement of d17O in N2O in reference to VSMOW, expressed in permille notation	permille
d18O_1	First measurement of d18O in N2O in reference to VSMOW, expressed in permille notation	permille
N2O_nM_1	First N2O concentration measurement in nanomolar (nM)	nanomoles per liter (nM)

flag_1	Data quality control flag from SeaDataNet: https://www.seadatanet.org/Standards/Data-Quality-Control. 1 = good value; 2 = probably good value; 3 = probably bad value, 4 = bad value, 9 = missing value	unitless
d15n_alpha_2	Second measurement of d15N alpha (inner nitrogen atom) in N2O in reference to atmospheric nitrogen gas, expressed in permille notation	permille
d15n_beta_2	Second measurement of d15N beta (outer nitrogen atom) in N2O in reference to atmospheric nitrogen gas, expressed in permille notation	permille
SP_2	Second measurement of N2O SP (site preference) in N2O in reference to atmospheric nitrogen gas, expressed in permille notation	permille
d15n_bulk_2	Second measurement of d15N bulk in N2O in reference to atmospheric nitrogen gas, expressed in permille notation	permille
d17O_2	Second measurement of d17O in N2O in reference to VSMOW, expressed in permille notation	permille
d18O_2	Second measurement of d18O in N2O in reference to VSMOW, expressed in permille notation	permille
N2O_nM_2	Second N2O concentration measurement in nanomolar (nM)	nanomoles per liter (nM)
flag_2	Data quality control flag from SeaDataNet: https://www.seadatanet.org/Standards/Data-Quality-Control. 1 = good value; 2 = probably good value; 3 = probably bad value, 4 = bad value, 9 = missing value	unitless
Year	Deployment year	unitless
Month	Deployment month (local)	unitless
Day	Deployment day (local)	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	custom automated purge and trap inlet system
Generic Instrument Name	Automated Purge and Trap System
Generic Instrument Description	This equipment removes dissolved gases from the water samples, traps the extracted compounds on a cold trap and then heats the trap and injects the trapped gases into the gas chromatograph. It is automated and controlled by a laptop computer.

Dataset-specific Instrument Name	SBE9plus
Generic Instrument Name	CTD Sea-Bird
Generic Instrument Description	Conductivity, Temperature, Depth (CTD) sensor package from SeaBird Electronics, no specific unit identified. This instrument designation is used when specific make and model are not known. See also other SeaBird instruments listed under CTD. More information from Sea-Bird Electronics.

Dataset-specific Instrument Name	Thermo Fisher Delta V Plus
Generic Instrument Name	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).

Dataset-specific Instrument Name	Niskin bottle type rosette
Generic Instrument Name	Niskin bottle
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.

[table of contents | back to top]

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

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

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

[table of contents | back to top]