Nitrate d15N and d18O from Niskin bottle samples collected on Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1815) on R/V Roger Revelle from October to November 2018

Website: https://www.bco-dmo.org/dataset/928099
Data Type: Cruise Results
Version: 1
Version Date: 2024-05-21

Project
» US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)
» Collaborative Research: US GEOTRACES PMT: Investigating geochemical tracers of the Pacific nitrogen cycle and budget (PMT Nitrate)

Program
» U.S. GEOTRACES (U.S. GEOTRACES)

Contributors	Affiliation	Role
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Abstract
These data include nitrate δ15N and δ18O along US GEOTRACES GP15, a meridional transect at ~152°W in the Pacific Ocean. The Pacific hosts significant rates of all the fluxes that are relevant to the global N cycle: the N budget fluxes (those that either generate or consume fixed N; N2 fixation and denitrification) as well as the N fluxes from the internal N cycle (those that generate or consume nitrate but leave the fixed N pool unaltered; nitrate regeneration and assimilation). The nitrate δ15N and δ18O provide a useful tool to separate and possibly quantify the overlapping impacts of all these co-occurring processes. GP15 was a 60-day research cruise that took place in 2018 along a transect form Alaska to Tahiti at 152° W on board of the R/V Revelle. The cruise was completed in two legs (RR1814 and RR1815), which started on the 18th of September and on the 24th of October 2018, respectively. This dataset includes data from Leg 2 (RR1815). Leg 1 data (RR1814) are provided in a separate, related dataset.

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Coverage

Location: GP15 Pacific Meridional Transect along 152W
Spatial Extent: **N**:18.9065 **E**:-151.9861 **S**:-20 **W**:-155.2581
Temporal Extent: 2018-10-25 - 2018-11-23

Methods & Sampling

Seawater samples were collected using a 36-bottle ODF (Ocean Data Facility) conventional rosette equipped with 10.4-liter (L) Niskin bottles.

HDPE nalgene bottles were acid washed (10% HCl) and rinsed three times (3X) with high-purity water (HPW) before being shipped at sea. Sampling at sea followed the GEOTRACES cookbook indications for nitrate isotopes. Bottles and caps were rinsed three times (3X) with seawater samples from the Niskin before being filled up to shoulder. Samples were then stored kept upright and frozen at -20 degrees Celsius (°C).

Seawater samples were processed in accordance with the published Denitrifier Method (Casciotti et al., 2002). All isotope analyses were performed on a MAT253 Thermo IRMS equipped with a custom-sample preparation system. With this system, we were able to achieve an overall standard deviation of 0.04 per mil for d15N-NO3 analyses and 0.11 per mil for d18O-NO3 analyses. Individual data points have been averaged with standard deviations reported. Please see the papers cited under Related Publications for equations applied to derive final data.

Data Processing Description

Raw data (for mass 45/44 and 46/44) are generated by the MAT253 Thermo IRMS and are calibrated into nitrate d15N and d18O using a correction scheme developed in Excel.

Quality Flags:
All data are of good quality and have thus been assigned a flag of '1'.

BCO-DMO Processing Description

- Imported original file "RR1815_data_Sigman.xlsx" into the BCO-DMO system.
- Marked "NaN" as a missing data value (missing data are empty/blank in the final CSV file).
- Renamed fields to comply with BCO-DMO naming conventions.
- Created date-time fields in ISO 8601 format.
- Removed empty fields (Gear_ID and Rosette_Position).
- Saved final file as "928099_v1_gp15_nitrate_d15n_d18o_leg2.csv".

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Data Files

File	
928099_v1_gp15_nitrate_d15n_d18o_leg2.csv	(Comma Separated Values (.csv), 60.26 KB) MD5:4fca2d2801134bcdfc4c28f8b8d952cf
Primary data file for dataset ID 928099, version 1	

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Related Datasets

Continues

Sigman, D. M., Casciotti, K. L., Marconi, D., Lawrence, R., Wang, W., Oleynik, S., Karolewski, J., Martinez Garcia, A. (2024) **Nitrate d15N and d18O from Niskin bottle samples collected on Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from September to October 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-05-28 doi:10.26008/1912/bco-dmo.928002.1 [view at BCO-DMO]
Relationship Description: GP15 was made up of two cruise legs, RR1814 (Leg 1) and RR1815 (Leg 2)

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Parameters

Parameter	Description	Units
Station_ID	Station number	unitless
Event_ID	GEOTRACES event number	unitless
Start_Date_UTC	Date of sampling (start)	unitless
Start_Time_UTC	Time of sampling (start) (UTC)	unitless
Start_ISO_DateTime_UTC	Date and time of sampling in ISO 8601 format (start) (UTC)	unitless
End_Date_UTC	Date of sampling (end)	unitless
End_Time_UTC	Time of sampling (end) (UTC)	unitless
End_ISO_DateTime_UTC	Date and time of sampling in ISO 8601 format (end) (UTC)	unitless
Start_Latitude	Latitude of sampling (start); positive values = North	decimal degrees
Start_Longitude	Longitude of sampling (start); negative values = West	decimal degrees
End_Latitude	Latitude of sampling (end); positive values = North	decimal degrees
End_Longitude	Longitude of sampling (end); negative values = West	decimal degrees
Sample_ID	GEOTRACES sample ID	unitless
Sample_Depth	Depth in meters (calculated from pressure and latitude)	meters (m)
NITRATE_15_14_D_DELTA_BOTTLE_w2kmnp	Nitrate d15N in per mil versus air	per mil versus air
SD1_NITRATE_15_14_D_DELTA_BOTTLE_w2kmnp	Standard deviation of NITRATE_15_14_D_DELTA_BOTTLE_w2kmnp	per mil versus air

Flag_NITRATE_15_14_D_DELTA_BOTTLE_w2kmnp	Quality flag for NITRATE_15_14_D_DELTA_BOTTLE_w2kmnp	unitless
NITRATE_18_16_D_DELTA_BOTTLE_dksgvb	Nitrate d18O in per mil versus VSMOW	per mil versus VSMOW
SD1_NITRATE_18_16_D_DELTA_BOTTLE_dksgvb	Standard deviation of NITRATE_18_16_D_DELTA_BOTTLE_dksgvb	per mil versus VSMOW
Flag_NITRATE_18_16_D_DELTA_BOTTLE_dksgvb	Quality flag for NITRATE_18_16_D_DELTA_BOTTLE_dksgvb	unitless
Comment	Indicates for which samples we performed nitrite removal	unitless

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Instruments

Dataset-specific Instrument Name	MAT253 Thermo IRMS equipped with a custom-sample preparation system
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	10.4L Niskin bottles deployed on the ODF 36-bottle 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.

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Deployments

RR1815

Website	https://www.bco-dmo.org/deployment/776917
Platform	R/V Roger Revelle
Report	https://datadocs.bco-dmo.org/docs/geotraces/GEOTRACES_PMT/casciotti/data_docs/GP15_Cruise_Report_with_ODF_Report.pdf
Start Date	2018-10-24
End Date	2018-11-24
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RR1815

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Project Information

US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)

Website: http://www.geotraces.org/

Coverage: Pacific Meridional Transect along 152W (GP15)

A 60-day research cruise took place in 2018 along a transect form Alaska to Tahiti at 152° W. A description of the project titled "*Collaborative Research: Management and implementation of the US GEOTRACES Pacific Meridional Transect*", funded by NSF, is below. Further project information is available on the US GEOTRACES website and on the cruise blog. A detailed cruise report is also available as a PDF.

Description from NSF award abstract:
GEOTRACES is a global effort in the field of Chemical Oceanography in which the United States plays a major role. The goal of the GEOTRACES program is to understand the distributions of many elements and their isotopes in the ocean. Until quite recently, these elements could not be measured at a global scale. Understanding the distributions of these elements and isotopes will increase the understanding of processes that shape their distributions and also the processes that depend on these elements. For example, many "trace elements" (elements that are present in very low amounts) are also important for life, and their presence or absence can play a vital role in the population of marine ecosystems. This project will launch the next major U.S. GEOTRACES expedition in the Pacific Ocean between Alaska and Tahiti. The award made here would support all of the major infrastructure for this expedition, including the research vessel, the sampling equipment, and some of the core oceanographic measurements. This project will also support the personnel needed to lead the expedition and collect the samples.

This project would support the essential sampling operations and infrastructure for the U.S. GEOTRACES Pacific Meridional Transect along 152° W to support a large variety of individual science projects on trace element and isotope (TEI) biogeochemistry that will follow. Thus, the major objectives of this management proposal are: (1) plan and coordinate a 60 day research cruise in 2018; (2) obtain representative samples for a wide variety of TEIs using a conventional CTD/rosette, GEOTRACES Trace Element Sampling Systems, and in situ pumps; (3) acquire conventional CTD hydrographic data along with discrete samples for salinity, dissolved oxygen, algal pigments, and dissolved nutrients at micro- and nanomolar levels; (4) ensure that proper QA/QC protocols are followed and reported, as well as fulfilling all GEOTRACES intercalibration protocols; (5) prepare and deliver all hydrographic data to the GEOTRACES Data Assembly Centre (via the US BCO-DMO data center); and (6) coordinate all cruise communications between investigators, including preparation of a hydrographic report/publication. This project would also provide baseline measurements of TEIs in the Clarion-Clipperton fracture zone (~7.5°N-17°N, ~155°W-115°W) where large-scale deep sea mining is planned. Environmental impact assessments are underway in partnership with the mining industry, but the effect of mining activities on TEIs in the water column is one that could be uniquely assessed by the GEOTRACES community. In support of efforts to communicate the science to a wide audience the investigators will recruit an early career freelance science journalist with interests in marine science and oceanography to participate on the cruise and do public outreach, photography and/or videography, and social media from the ship, as well as to submit articles about the research to national media. The project would also support several graduate students.

Collaborative Research: US GEOTRACES PMT: Investigating geochemical tracers of the Pacific nitrogen cycle and budget (PMT Nitrate)

NSF Award Abstract:
Nitrate is an important nutrient that marine plants and algae need for growth. It is abundant in deep ocean waters, but scarce in most sunlit surface waters. The purpose of this project is to better understand what controls the availability of nitrate in the deep ocean and its delivery to surface waters. Researchers from Stanford University, Princeton University, and Brown University will analyze the stable isotopes of seawater nitrate collected between Alaska and Tahiti in the Pacific Ocean. The data will provide information about the supply of nitrate to a large section of the Pacific Ocean and allow informed decisions on past and future changes in marine photosynthesis. This collaborative project will be carried under the GEOTRACES program, an international effort to understand the distribution of elements in the global ocean. This study will include undergraduate, graduate, and postdoctoral researchers at all three academic institutions. The investigators will develop a 1-day workshop for the Teachers as Scholars program, for middle and high school teachers at Princeton University. The workshop will focus on accessing and visualizing ocean data sets and other content available on the internet for project-based learning in the classroom. Investigators will also participate in teacher workshops offered each summer at Stanford University. Data from this project will be made available to the public through the Biological and Chemical Oceanography-Data Management Office (bco-dmo.org). The data will also be compiled in GEOTRACES data products that will be freely available.

The isotopic composition of nitrate in the ocean interior records biogeochemical and physical processes on the time scales of years, decades, centuries, and millennia, with the shallow subsurface and deep ocean recording shorter and longer time scales, respectively. These are meaningful time scales in the efforts to (1) understand the feedbacks that structure the biogeochemistry of N in the ocean, ocean productivity, and the global carbon cycle, (2) reconstruct past changes in ocean biogeochemistry and carbon cycling, and (3) perhaps predict future changes. This proposal seeks to analyze the nitrate isotopes during the upcoming US GEOTRACES Pacific Meridional Transect (GP15) between Alaska and Tahiti. Nitrate isotopes provide critical constraints on the ocean N cycle and budget, especially in the Pacific Ocean where a variety of processes affect the distribution of nitrate and its supply to surface waters. This largely meridional section of nitrate isotope data will be broadly useful as part of the growing nitrate isotope dataset for the global ocean and for comparison to the many complementary geochemical data sets that will be generated as part of this GEOTRACES effort. In addition, nitrate isotopes in aerosols will be measured to support interpretations of nitrate isotopes in surface waters along the section. The proposed measurements will contribute to the investigation of three overarching questions: 1) What are the similarities and differences in N biogeochemistry among the different nutrient-rich regions in the Pacific basin: the Southern Ocean, equatorial Pacific, and subarctic North Pacific, and how do they affect nitrate supply to low-latitude surface waters? 2) What sources of nitrogen fuel export production in surface waters across the Pacific? 3) What are the roles in surface and subsurface processes in the distribution of nitrate isotopes in the ocean interior?

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Program Information

U.S. GEOTRACES (U.S. GEOTRACES)

Website: http://www.geotraces.org/

Coverage: Global

GEOTRACES is a SCOR sponsored program; and funding for program infrastructure development is provided by the U.S. National Science Foundation.

GEOTRACES gained momentum following a special symposium, S02: Biogeochemical cycling of trace elements and isotopes in the ocean and applications to constrain contemporary marine processes (GEOSECS II), at a 2003 Goldschmidt meeting convened in Japan. The GEOSECS II acronym referred to the Geochemical Ocean Section Studies To determine full water column distributions of selected trace elements and isotopes, including their concentration, chemical speciation, and physical form, along a sufficient number of sections in each ocean basin to establish the principal relationships between these distributions and with more traditional hydrographic parameters;

* To evaluate the sources, sinks, and internal cycling of these species and thereby characterize more completely the physical, chemical and biological processes regulating their distributions, and the sensitivity of these processes to global change; and

* To understand the processes that control the concentrations of geochemical species used for proxies of the past environment, both in the water column and in the substrates that reflect the water column.

GEOTRACES will be global in scope, consisting of ocean sections complemented by regional process studies. Sections and process studies will combine fieldwork, laboratory experiments and modelling. Beyond realizing the scientific

objectives identified above, a natural outcome of this work will be to build a community of marine scientists who understand the processes regulating trace element cycles sufficiently well to exploit this knowledge reliably in future interdisciplinary studies.

Expand "Projects" below for information about and data resulting from individual US GEOTRACES research projects.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1736652

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