

# Nitrite (NO<sub>2</sub><sup>-</sup>) isotopes and concentrations from the U.S. GEOTRACES EPZT cruise (GP16, TN303) on R/V Thomas G. Thompson in the tropical Pacific from October to December 2013

Website: <https://www.bco-dmo.org/dataset/933707>

Data Type: Cruise Results

Version: 1

Version Date: 2024-07-30

## Project

- » [U.S. GEOTRACES East Pacific Zonal Transect \(GP16\)](#) (U.S. GEOTRACES EPZT)
- » [GEOTRACES Peru-Tahiti Nitrogen Isotope Measurements](#) (EPZT Nitrogen Isotopes)

## Program

- » [U.S. GEOTRACES](#) (U.S. GEOTRACES)

Contributors	Affiliation	Role
<a href="#">Casciotti, Karen L.</a>	Stanford University	Principal Investigator
<a href="#">Gluschkoff, Noah</a>	Stanford University	Student
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## Abstract

This dataset includes nitrite (NO<sub>2</sub><sup>-</sup>) isotopes and concentration measurements with accompanying physiochemical data from the 2013 U.S. GEOTRACES East Pacific Zonal Transect cruise (GP16). The cruise sailed from October 25, 2013 to December 18, 2013 aboard the R/V Thompson.

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## Coverage

**Spatial Extent:** N:-10.25 E:-77.3761 S:-16.0006 W:-151.9996  
**Temporal Extent:** 2013-10-29 - 2013-12-16

## Methods & Sampling

Seawater samples were collected at sea from Niskin bottles and were immediately analyzed for nitrite concentration. If sufficient nitrite concentrations (>0.1 micromoles per liter (umol/L)) were observed, samples were preserved as nitrous oxide (N<sub>2</sub>O) using sodium azide and acetic acid to selectively convert nitrite to nitrous oxide (McIlvin and Altabet, 2005). In the laboratory, the resultant N<sub>2</sub>O was analyzed using a custom purge and trap gas bench connected to an isotope ratio mass spectrometer. Nitrite isotope standards RSIL-N23, -N7373, and -N10219 were analyzed alongside the seawater samples to normalize nitrite d15N and d18O values to reference scales (Casciotti et al. 2007).

## Data Processing Description

Nitrite d15N and d18O analyses were calibrated against aliquots of the nitrite isotope standards RSIL-N23, RSIL-N7373, and RSIL-N10219 (Casciotti et al., 2007) prepared and analyzed in parallel with each batch of samples. These standards are used to correct for blanks, drift, and to report nitrite isotope data on VSMOW and Air reference scales for d18O and d15N, respectively (Casciotti et al., 2007).

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>:

- 1 = good value;
- 2 = probably good value;
- 3 = probably bad value;
- 4 = bad value;
- 6 = value below detection;
- 9 = missing value.

## BCO-DMO Processing Description

- Imported original file "gp16\_no2\_bcodmo\_240619.xlsx" into the BCO-DMO system
- Flagged "NaN" as a missing data value (missing data are empty/blank in the final CSV file).
- Converted DATE field to YYYY-MM-DD format.
- Renamed fields to comply with BCO-DMO naming conventions.
- Rounded the LATITUDE, LONGITUDE, CTDTMP, and CTDSAL columns to 2 decimal places as requested by the data provider.
- Saved the final file as "933707\_v1\_gp16\_nitrite\_isotopes\_and\_concentrations.csv".

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## Data Files

File
<b>933707_v1_gp16_nitrite_isotopes_and_concentrations.csv</b> (Comma Separated Values (.csv), 19.24 KB) <small>MD5:39c7a50807a1a9e04023964270dd7e8e</small>
Primary data file for dataset ID 933707, version 1

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## Related Publications

Casciotti, K. L., & McIlvin, M. R. (2007). Isotopic analyses of nitrate and nitrite from reference mixtures and application to Eastern Tropical North Pacific waters. *Marine Chemistry*, 107(2), 184–201. doi:[10.1016/j.marchem.2007.06.021](https://doi.org/10.1016/j.marchem.2007.06.021)  
*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](https://doi.org/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](https://doi.org/10.1021/ac1028984)  
*Methods*

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## Related Datasets

### IsRelatedTo

Casciotti, K. L., Gluschkoff, N. (2024) **Nitrous oxide (N2O) isotopes and concentrations from the U.S. GEOTRACES EPZT cruise (GP16, TN303) on R/V Thomas G. Thompson in the tropical Pacific from October to December 2013**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-07-24 doi:[10.26008/1912/bco-dmo.933645.1](https://doi.org/10.26008/1912/bco-dmo.933645.1) [[view at BCO-DMO](#)]

Casciotti, K., Altabet, M. (2020) **Nitrate isotope data from R/V Thomas G. Thompson cruise TN303 in the Eastern Tropical Pacific in 2013 (U.S. GEOTRACES EPZT project)**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2016-06-24 doi:[10.26008/1912/bco-dmo.650087.1](https://doi.org/10.26008/1912/bco-dmo.650087.1) [[view at BCO-DMO](#)]

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## Parameters

Parameter	Description	Units
STNNBR	Station number	unitless
GEOTRC_EVENTNO	GEOTRACES event number	unitless
GEOTRC_SAMPNO	GEOTRACES sample number	unitless
DATE	Date of sampling	unitless
LATITUDE	Latitude; South is negative	decimal degrees
LONGITUDE	Longitude; West is negative	decimal degrees
CTDPRS	Pressure	decibars
DEPTH	Depth	meters (m)
CTDTMP	Temperature	degrees Celsius
CTDSAL	Salinity	PSU
NITRITE	Nitrite concentration	micromoles per liter (umol/L)
NITRITE_15_14_D_DELTA_BOTTLE_x5fmqg	Average d15N of nitrite measurements in reference to atmospheric nitrogen gas, expressed in permille notation. (Code at the end of column name is GEOTRACES DOoR identifier.)	permille
SD1_NITRITE_15_14_D_DELTA_BOTTLE_x5fmqg	Standard deviation d15N of nitrite measurements in reference to atmospheric nitrogen gas, expressed in permille notation. (Code at the end of column name is GEOTRACES DOoR identifier.)	permille
Flag_NITRITE_15_14_D_DELTA_BOTTLE_x5fmqg	Data quality control flag from Data quality control flag from SeaDataNet: 1 = good value; 2 = probably good value; 3 = probably bad value; 4 = bad value; 9 = missing value.	unitless
NITRITE_18_16_D_DELTA_BOTTLE_iqunnm	Average d18O of nitrite measurements in reference to atmospheric nitrogen gas, expressed in permille notation. (Code at the end of column name is GEOTRACES DOoR identifier.)	permille
SD1_NITRITE_18_16_D_DELTA_BOTTLE_iqunnm	Standard deviation d18O of nitrite measurements in reference to atmospheric nitrogen gas, expressed in permille notation. (Code at the end of column name is GEOTRACES DOoR identifier.)	permille
Flag_NITRITE_18_16_D_DELTA_BOTTLE_iqunnm	Data quality control flag from Data quality control flag from SeaDataNet: 1 = good value; 2 = probably good value; 3 = probably bad value; 4 = bad value; 9 = missing value.	unitless

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## Instruments

<b>Dataset-specific Instrument Name</b>	custom purge and trap gas bench connected to an isotope ratio mass spectrometer
<b>Generic Instrument Name</b>	Automated Purge and Trap System
<b>Dataset-specific Description</b>	This equipment extracts dissolved gases from the water samples, traps the extracted compounds under liquid nitrogen temperature, and then releases the trapped gases into the gas chromatograph and then to the Isotope Ratio Mass Spectrometer via an open split (McIlvin and Casciotti, 2011). It is automated and controlled by a desktop computer and ISODAT 3.0 software.
<b>Generic Instrument Description</b>	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.

<b>Dataset-specific Instrument Name</b>	Thermo Fisher DeltaPLUS XP Isotope Ratio Mass Spectrometer
<b>Generic Instrument Name</b>	Isotope-ratio Mass Spectrometer
<b>Dataset-specific Description</b>	The Isotope-ratio Mass Spectrometer is used to measure the relative abundance of isotopes in a given sample. The instrument is equipped with faraday cup collectors for determining the ratios of m/z 44, 45, and 46 in N <sub>2</sub> O generated from samples using the azide method (McIlvin and Altabet, 2005).
<b>Generic Instrument Description</b>	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).

<b>Dataset-specific Instrument Name</b>	Niskin bottle
<b>Generic Instrument Name</b>	Niskin bottle
<b>Dataset-specific Description</b>	A Niskin bottle is a cylindrical, non-metallic water collection device with stoppers at both ends. On GP16, the 12-place 30-liter (L) Niskin rosette was used to collect discrete water samples for nitrite isotope analyses.
<b>Generic Instrument Description</b>	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

### TN303

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/499719">https://www.bco-dmo.org/deployment/499719</a>
<b>Platform</b>	R/V Thomas G. Thompson
<b>Report</b>	<a href="http://dmoserv3.whoi.edu/data_docs/GEOTRACES/EPZT/GT13_EPZT_ODFReport_All.pdf">http://dmoserv3.whoi.edu/data_docs/GEOTRACES/EPZT/GT13_EPZT_ODFReport_All.pdf</a>
<b>Start Date</b>	2013-10-25
<b>End Date</b>	2013-12-20
<b>Description</b>	A zonal transect in the eastern tropical South Pacific (ETSP) from Peru to Tahiti as the second cruise of the U.S. GEOTRACES Program. This Pacific section includes a large area characterized by high rates of primary production and particle export in the eastern boundary associated with the Peru Upwelling, a large oxygen minimum zone that is a major global sink for fixed nitrogen, and a large hydrothermal plume arising from the East Pacific Rise. This particular section was selected as a result of open planning workshops in 2007 and 2008, with a final recommendation made by the U.S. GEOTRACES Steering Committee in 2009. It is the first part of a two-stage plan that will include a meridional section of the Pacific from Tahiti to Alaska as a subsequent expedition. Figure 1. The 2013 GEOTRACES EPZT Cruise Track. [click on the image to view a larger version] Additional cruise information is available from the Rolling Deck to Repository (R2R): <a href="http://www.rvdata.us/catalog/TN303">http://www.rvdata.us/catalog/TN303</a>

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## Project Information

### U.S. GEOTRACES East Pacific Zonal Transect (GP16) (U.S. GEOTRACES EPZT)

**Website:** <http://www.geotraces.org/>

**Coverage:** Eastern Tropical Pacific - Transect from Peru to Tahiti (GP16)

#### From the NSF Award Abstract

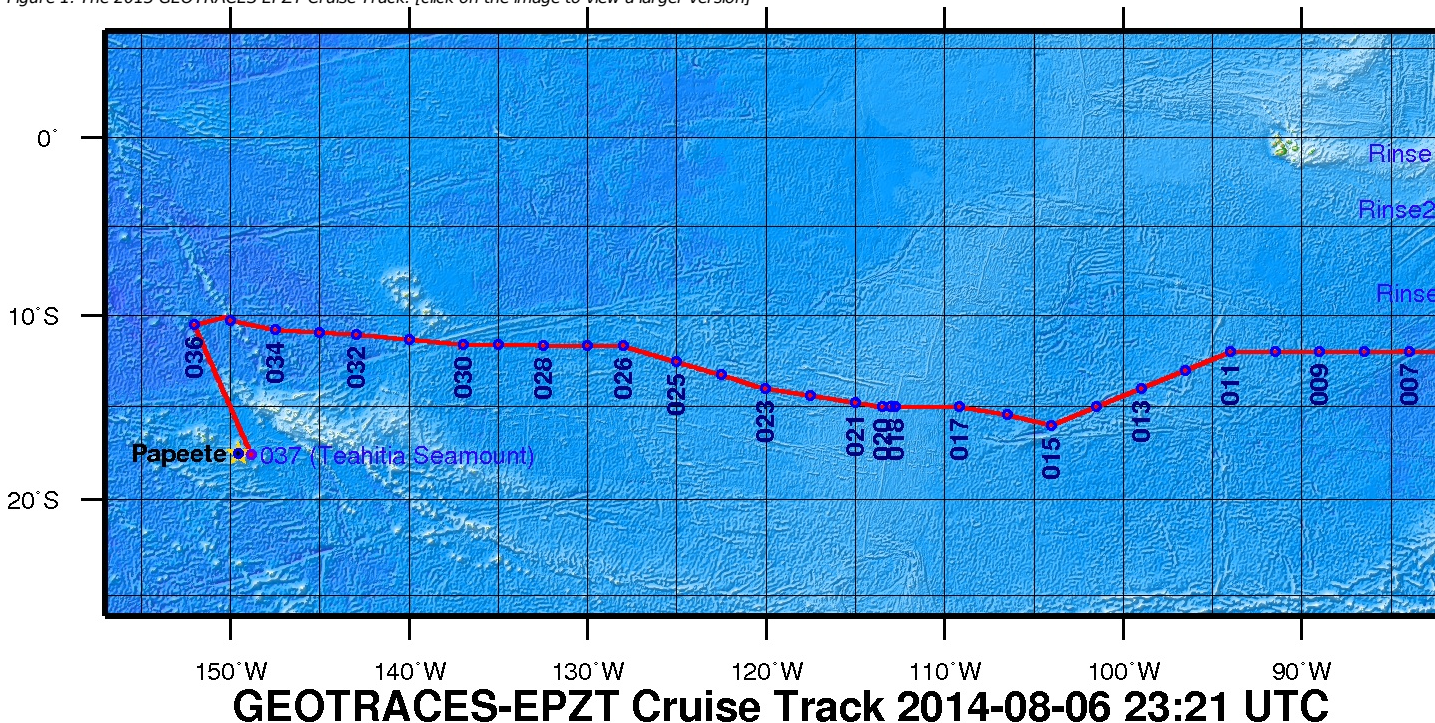
The mission of the International GEOTRACES Program (<https://www.geotraces.org/>), of which the U.S. chemical oceanography research community is a founding member, is "to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions" (GEOTRACES Science Plan, 2006). In the United States, ocean chemists are currently in the process of organizing a zonal transect in the eastern tropical South Pacific (ETSP) from Peru to Tahiti as the second cruise of the U.S. GEOTRACES Program. This Pacific section includes a large area characterized by high rates of primary production and particle export in the eastern boundary associated with the Peru Upwelling, a large oxygen minimum zone that is a major global sink for fixed nitrogen, and a large hydrothermal plume arising from the East Pacific Rise. This particular section was selected as a result of open planning workshops in 2007 and 2008, with a final recommendation made by the U.S. GEOTRACES Steering Committee in 2009. It is the first part of a two-stage plan that will include a meridional section of the Pacific from Tahiti to Alaska as a subsequent expedition.

This award provides funding for management of the U.S. GEOTRACES Pacific campaign to a team of scientists from the University of Southern California, Old Dominion University, and the Woods Hole Oceanographic Institution. The three co-leaders will provide mission leadership, essential support services, and management structure for acquiring the trace elements and isotopes samples listed as core parameters in the International GEOTRACES Science Plan, plus hydrographic and nutrient data needed by participating investigators. With this support from NSF, the management team will (1) plan and coordinate the 52-day Pacific research cruise described above; (2) obtain representative samples for a wide variety of trace metals of interest using conventional CTD/rosette and GEOTRACES Sampling Systems; (3) acquire conventional JGOFS/WOCE-quality hydrographic data (CTD, transmissometer, fluorometer, oxygen sensor, etc) along with discrete samples for salinity, dissolved oxygen (to 1  $\mu$ M detection limits), plant pigments, redox tracers such as ammonium and nitrite, 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-type data to the GEOTRACES Data Center (and US data centers); and (6) coordinate cruise communications between all participating investigators, including preparation of a hydrographic report/publication.

**Broader Impacts:** The project is part of an international collaborative program that has forged strong partnerships in the intercalibration and implementation phases that are

unprecedented in chemical oceanography. The science product of these collective missions will enhance our ability to understand how to interpret the chemical composition of the ocean, and interpret how climate change will affect ocean chemistry. Partnerships include contributions to the infrastructure of developing nations with overlapping interests in the study area, in this case Peru. There is a strong educational component to the program, with many Ph.D. students carrying out thesis research within the program.

Figure 1. The 2013 GEOTRACES EPZT Cruise Track. [click on the image to view a larger version]



#### GEOTRACES Peru-Tahiti Nitrogen Isotope Measurements (EPZT Nitrogen Isotopes)

**Coverage:** East Pacific Zonal Transect

#### Description from NSF award abstract:

Nitrogen (N) is an essential macronutrient whose availability can limit primary production and the capacity of the biological pump to export carbon from the surface ocean on seasonal, annual, decadal, and millennial timescales. The inventory of fixed (bioavailable) N in the ocean is driven by biological processes such as nitrogen fixation, denitrification, and anaerobic ammonia oxidation (anammox). Water column oxygen deficient zones (ODZs) are important sites for fixed N loss, as well as N<sub>2</sub>O production, and they are projected to expand and intensify in the coming years as global warming increases ocean stratification and decreases ventilation. It is important to understand the distribution of nitrate, nitrite, and N<sub>2</sub>O isotopes in relation to current ocean conditions of oxygen and trace element availability order to interpret past and future changes in nitrate signals.

In this project, a team of researchers from Stanford University, University of Massachusetts at Dartmouth, and Brown University will measure the nitrogen- and oxygen-isotopic composition (del15N and del18O) of nitrate, nitrite, and nitrous oxide in seawater samples collected along the GEOTRACES Pacific Peru-Tahiti Section. Values of del15N and del18O will also be measured in nitrate from aerosol and rain samples to inform our interpretation of the N isotope budget and isotopic gradients within the tropical South Pacific. Finally, N<sub>2</sub>/Ar and N<sub>2</sub> del15N will be determined to close the N mass and isotope budgets. Nitrate del15N is a GEOTRACES "core parameter" that will complement other measurements, such as bioactive trace element concentrations and speciation, Si isotope variations, as well as redox and productivity proxies.

The GEOTRACES Peru-Tahiti section provides a rare opportunity to track the fate of the isotopic signals of N loss from one of the largest water column ODZs. Furthermore, little is known about the effect of N recycling through hydrothermal vents on nitrate isotopes in the deep ocean, and this section will allow quantitative tracking of this input. Together, these measurements will yield insight into the relative rates of modern N cycle processes and will provide background information for paleoceanographic applications.

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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
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1233339</a>

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