Nitrate isotope data from R/V Thomas G. Thompson cruise TN303 in the Eastern Tropical Pacific in 2013 (U.S. GEOTRACES EPZT project)

Website: https://www.bco-dmo.org/dataset/650087
Data Type: Cruise Results
Version: 1
Version Date: 2016-06-24

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
Casciotti, Karen L.	Stanford University	Principal Investigator
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Abstract
Nitrate isotope data from R/V Thomas G. Thompson cruise TN303 in the Eastern Tropical Pacific in 2013 (U.S. GEOTRACES EPZT project).

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Coverage

Spatial Extent: **N**:-10.25 **E**:-77.3761 **S**:-16.0006 **W**:-152.0006
Temporal Extent: 2013-10-29 - 2013-12-18

Dataset Description

Nitrate isotope data from the US GEOTRACES EPZT cruise.

Methods & Sampling

Sampling: Full depth and super station samples were collected from the ship's rosette. Samples were filtered through 0.8/0.45 um acropak5 00 filter cartridges into triple-rinsed 60 mL HDPE bottles. Demi station samples were collected from the GETORACES Go-Flo rosette. Samples were filtered through 0.2 um acropak capsule filters into triple-rinsed 60 mL HDPE bottles. Each sample was collected in triplicate. Samples were frozen at -20 C immediately and stored frozen until analysis.

Analysis: Samples were analyzed for nitrate d15N using the denitrifier method (Sigman et al., 2001; Casciotti, et al., 2001, with technical updates described by McIlvin and Casciotti, 2011). In the Casciotti Lab, Nitrate isotope reference materials USGS32 and USGS34 were used to calibrate d15N. Each sample was analyzed 2-6 times. Mean and standard deviations are reported for each sample. Samples were analyzed either on a DeltaPLUS XP or DeltaV PLUS isotope ratio mass spectrometer (IRMS), both with custom-built inlets described in McIlvin and Casciotti, 2011. Where possible (concentrations exceeded 2 uM), samples and standards were analyzed in 20 nanomole aliquots. When NO3- concentrations were below 2 uM, samples were injected in maximum volume (10 mL) and calibrated using interpolations between standard curves of 5 and 20 nano moles NO3-. Samples containing nitrate concentrations lower than 0.3 uM were not analyzed. Samples containing measurable NO2- concentrations were treated with sulfuric acid prior to analysis (Granger and Sigman, 2009).

Data Processing Description

Data Processing: Raw data were calibrated to USGS standards analyzed 6x with each batch of samples. The measured values of these reference materials were used to calibrated the measured d15N values to the atmospheric N2 reference scale (McIlvin and Casciotti, 2011).

BCO-DMO Processing:
- modified parameter names to conform with BCO-DMO naming conventions;
- replaced blanks (no data) with 'nd';
- replaced -999 with 'nd';
- joined to EPZT master file (details below).

Additional GEOTRACES Processing by BCO-DMO:
As was done for the GEOTRACES-NAT data, BCO-DMO added standard US GEOTRACES information, such as the US GEOTRACES event number, to each submitted dataset lacking this information. To accomplish this, BCO-DMO compiled a 'master' dataset composed of the following parameters:
cruise_id, EXPOCODE,SECT_ID, STNNBR, CASTNO, GEOTRC_EVENTNO, GEOTRC_SAMPNO, GEOTRC_INSTR, SAMPNO, GF_NO, BTLNBR, BTLNBR_FLAG_W, DATE_START_EVENT, TIME_START_EVENT, ISO_DATETIME_UTC_START_EVENT, EVENT_LAT, EVENT_LON, DEPTH_MIN, DEPTH_MAX, BTL_DATE, BTL_TIME, BTL_ISO_DATETIME_UTC, BTL_LAT, BTL_LON, ODF_CTDPRS, SMDEPTH, FMDEPTH, BTMDEPTH, CTDPRS, CTDDEPTH.

This added information will facilitate subsequent analysis and inter-comparison of the datasets.

Bottle parameters in the master file were taken from the GT-C_Bottle and ODF_Bottle datasets. Non-bottle parameters, including those from GeoFish tows, Aerosol sampling, and McLane Pumps, were taken from the TN303 Event Log (version 30 Oct 2014). Where applicable, pump information was taken from the PUMP_Nuts_Sals dataset.

A standardized BCO-DMO method (called "join") was then used to merge the missing parameters to each US GEOTRACES dataset, most often by matching on sample_GEOTRC or on some unique combination of other parameters.

If the master parameters were included in the original data file and the values did not differ from the master file, the original data columns were retained and the names of the parameters were changed from the PI-submitted names to the standardized master names. If there were differences between the PI-supplied parameter values and those in the master file, both columns were retained. If the original data submission included all of the master parameters, no additional columns were added, but parameter names were modified to match the naming conventions of the master file.

See the dataset parameters documentation for a description of which parameters were supplied by the PI and which were added via the join method.

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Data Files

File
d15N_NO3_joined.csv (Comma Separated Values (.csv), 148.08 KB) MD5:c57f9a9313c1785caa550d37f8476897 Primary data file for dataset ID 650087

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Related Publications

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., & 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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Parameters

Parameter	Description	Units
cruise_id	Cruise identification	unitless
STNNBR	Station number; values added from the EPZT master file.	unitless
GEOTRC_EVENTNO	GEOTRACES event number; values added from the EPZT master file.	unitless
CASTNO	Cast number; values added from the EPZT master file.	unitless
ISO_DATETIME_UTC_START_EVENT	Date and time, formatted to the ISO 8601 standard, at the start of the sampling event, according to the event log. In the format YYYY-MM-DDTHH:MM:SS[.xx]Z	unitless
EVENT_LAT	Latitude at the start of the event (according to the event log); north is positive; values added from the EPZT master file.	decimal degrees
EVENT_LON	Longitude at the start of the event (according to the event log); east is positive; values added from the EPZT master file.	decimal degrees
GEOTRC_INSTR	Sampling instrument; values added from the EPZT master file.	unitless
GEOTRC_SAMPNO	Unique GEOTRACES sample number	unitless
DEPTH_PI	Sampling depth, provided by the PI.	meters
NO3_15_D_DELTA_BOTTLE	Average nitrate delta 15N, reported in units of permil vs. atmospheric N2.	permil
NO3_15_D_DELTA_BOTTLE_STDEV	Standard deviation of nitrate delta 15N analysis, reported in units of permil vs. atmospheric N2.	permil
num_of_analyses	The number of replicates analyzed for a given sample.	dimensionless
NO3_15_D_DELTA_BOTTLE_FLAG	NO3_15_D_DELTA_BOTTLE quality flag. 1 indicates that the sample was treated with sulfamic acid ; 2 indicates that the nitrate concentration of the sample was too low for delta 15N analysis ; 3 indicates that no sample was collected.	dimensionless
SAMPNO	Sequential sample number within the cast (usually corresponds to bottle number); values added from the EPZT master file.	unitless
BTLNBR	Bottle number; typically 1-24; values added from the EPZT master file.	unitless
BTLNBR_FLAG_W	Bottle number quality flag; follows WOCE conventions. 2 = good; 3 = questionable; 4 = bad; 9 = missing data; values added from the EPZT master file.	unitless
BTL_ISO_DATETIME_UTC	Date and time, formatted to the ISO 8601 standard, at the time of bottle firing; values added from the EPZT master file.	YYYY-MM-DDTHH:MM:SS[.xx]Z
BTL_LAT	Latitude of bottle firing; north is positive; values added from the EPZT master file.	decimal degrees
BTL_LON	Lonitude of bottle firing; east is positive; values added from the EPZT master file.	decimal degrees
ODF_CTDPRS	The ODF software acquisition measurement of pressure; values added from the EPZT master file.	decibars
SMDEPTH	Saunders-Mantyla depth (integrated; uses dynamic height); values added from the EPZT master file.	meters
FMDEPTH	Fofonoff-Millard depth (non-integrated; also used by SBE); values added from the EPZT master file.	meters
BTMDEPTH	Bottom depth; values added from the EPZT master file.	meters
CTDPRS	CTD pressure; values added from the EPZT master file.	decibars
CTDDEPTH	CTD bottle firing depth; values added from the EPZT master file.	meters

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Instruments

Dataset-specific Instrument Name	Go-Flo
Generic Instrument Name	GO-FLO Teflon Trace Metal Bottle
Generic Instrument Description	GO-FLO Teflon-lined Trace Metal free sampling bottles are used for collecting water samples for trace metal, nutrient and pigment analysis. The GO-FLO sampling bottle is designed specifically to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

Dataset-specific Instrument Name	IRMS
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Samples were analyzed either on a DeltaPLUS XP or DeltaV PLUS isotope ratio mass spectrometer (IRMS).
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).

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Deployments

TN303

Website	https://www.bco-dmo.org/deployment/499719
Platform	R/V Thomas G. Thompson
Report	http://dmoserv3.whoi.edu/data_docs/GEOTRACES/EPZT/GT13_EPZT_ODFReport_All.pdf
Start Date	2013-10-25
End Date	2013-12-20
Description	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): http://www.rvdata.us/catalog/TN303

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Project Information

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

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

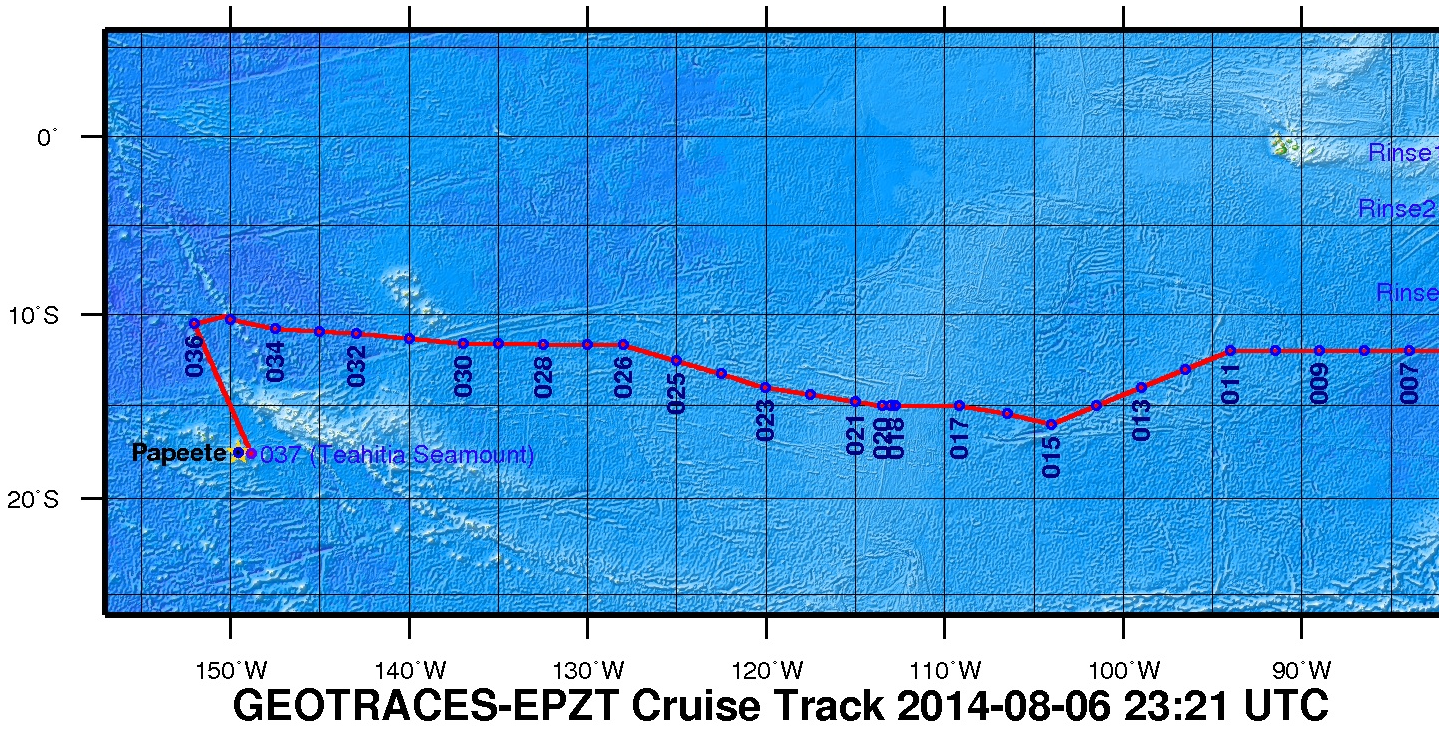
Coverage: Eastern Tropical Pacific - Transect from Peru to Tahiti (GP16)

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 uM 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 N2O 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 N2O 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, N2/Ar and N2 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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1233339

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