Nitrate (NO3) aerosol isotopes from the U.S. GEOTRACES EPZT cruise TN303 on R/V Thomas G. Thompson in the Eastern Tropical Pacific from October to December 2013

Website: https://www.bco-dmo.org/dataset/709845
Data Type: Cruise Results
Version: 25 July 2017
Version Date: 2017-07-25

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
Hastings, Meredith	Brown University	Principal Investigator
Casciotti, Karen L.	Stanford University	Co-Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Table of Contents

Coverage

Spatial Extent: **N**:-4.0701 **E**:-77.657 **S**:-16.0003 **W**:-152.0003
Temporal Extent: 2013-10-26 - 2013-12-16

Dataset Description

Nitrate (NO3) aerosol isotopes from the U.S. GEOTRACES EPZT cruise

Methods & Sampling

Samples were collected using Florida State University's high volume aerosol sampler (Tisch Environmental TSP TE5170V), during the US GEOTRACES EZPT cruise, R/V Thomas G. Thompson (TGT303), which took place from 25 October 2013 - 20 December 2013. Samples were collected at the rate of 1 cubic meter per minute on Whatman 41, 47 mm discs (glass fiber; GF) and were pre-combusted before deployment.

Methods for collection of filter and extraction of nitrate are described in Morton et al. (2013).

Filters were stored frozen until processing. Filters were soaked in ultrapure (18 Megaohm) water, sonicated, and then filtered via syringe filters. Concentration analysis of samples was completed using an automated colorimetric system (WestCo SmartChem 200); the pooled standard deviation of control standards run within each sample set run was 0.1 micromoles per liter (6.2 ppb nitrate); detection limit was 0.09 micromoles per liter. Based upon nitrate concentration, 10 nmol of N were injected into vials containing denitrifying bacteria to convert nitrate to nitrous oxide for isotopic analysis on a ThermoFisher Delta V isotope ratio mass spectrometer. Analysis for d15N and d18O of nitrate are described in Sigman et al. (2001), Casciotti et al. (2002), McIlvin and Casciotti (2011). Kaiser et al. (2007) describes similar methodology for the determination of D17O of nitrate.

Data Processing Description

As described in Kaiser et al. (2007), isotopic data is corrected and standardized to international reference materials IAEA-N3, USGS34, and USGS35, which are run 3-9 times with each sample run. For d15N, samples are corrected for isobaric interferences and a blank associated with the bacteria. For d18O, samples are corrected for isobaric interferences, blank, and exchange between sample nitrate and background water that takes place during denitrification to nitrous oxide. The pooled standard deviation for the reference materials are (n=51): 0.3 per mil for d15N and 0.4 per mil for d18O of IAEA-N3; 0.2 per mil for d15N and 0.6 per mil for d18O of USGS34; and 0.8 per mil for d18O of USGS35 (sample d15N is not corrected for d15N of USGS35, this is used as an internal quality check and pooled standard deviation across all runs in 0.3 per mil). 30 samples were run in duplicate or triplicate and the paired pooled standard deviation (n=30) is 0.3 per mil for d15N and 0.7 per mil for d18O. Pooled standard deviation for USGS34 and USGS35 run for D17O is 0.3 per mil each (n=18), and replicate samples were the same (0.3 per mil, n=6).

BCO-DMO Processing:
- modified parameter names to conform with BCO-DMO and GEOTRACES naming conventions;
- created separate columns for date_start and date_end;
- added cruise_id column;
- joined to BCO-DMO GEOTRACES EPZT master data file.

Additional GEOTRACES Processing:
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.

[table of contents | back to top]

Data Files

File
NO3_aerosol_isotopes_joined.csv (Comma Separated Values (.csv), 3.60 KB) MD5:a9c2bb23c49667b951f3027ca8ec8136 Primary data file for dataset ID 709845

[table of contents | back to top]

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

Kaiser, J., Hastings, M. G., Houlton, B. Z., Röckmann, T., & Sigman, D. M. (2007). Triple Oxygen Isotope Analysis of Nitrate Using the Denitrifier Method and Thermal Decomposition of N2O. Analytical Chemistry, 79(2), 599–607. doi:10.1021/ac061022s
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

Morton, P. L., Landing, W. M., Hsu, S.-C., Milne, A., Aguilar-Islas, A. M., Baker, A. R., ... Zamora, L. M. (2013). Methods for the sampling and analysis of marine aerosols: results from the 2008 GEOTRACES aerosol intercalibration experiment. Limnology and Oceanography: Methods, 11(2), 62–78. doi:10.4319/lom.2013.11.62
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

[table of contents | back to top]

Parameters

Parameter	Description	Units
cruise_id	Cruise identification	unitless
GEOTRC_INSTR	Sampling instrument; added from BCO-DMO EPZT master file	unitless
GEOTRC_SAMPNO	Unique GEOTRACES sample number	unitless
STNNBR	Station number; added from BCO-DMO EPZT master file	unitless
GEOTRC_EVENTNO	GEOTRACES event number	unitless
filter_group	Filter group; designated as A or B by filter collection team (FSU)	unitless
date_start	Date at start of sample collection; formatted as yyyymmdd	unitless
date_end	Date at end of sample collection; formatted as yyyymmdd	unitless
lat_start	Latitude at start of air collection through filter (negative is west)	decimal degrees
lon_start	Longitude at start of air collection through filter (negative is south)	decimal degrees
lat_end	Latitude at end of air collection through filter (negative is west)	decimal degrees
lon_end	Longitude at end of air collection through filter (negative is south)	decimal degrees
extraction_volume	Volume of ultra pure water used to extract filter nitrate	milliliters (mL)
filter_type	Designated by filter collection team (FSU), GF = glass fiber	unitless
run_time_hrs	Total time of air collection	hours
air_volume	Total volume of air collection per sample	cubic meters (m^3)
NO3_15_14_A_SML_DELTA_HIVOL	delta 15N of aerosol nitrate	permil vs. atmospheric N2
NO3_18_16_A_SML_DELTA_HIVOL	delta 18O of aerosol nitrate	permil vs. VSMOW
NO3_17_16_A_SML_DELTA_HIVOL	capital delta 17O (D17O = d17O-0.5*d18O) of aerosol nitrate	permil vs. VSMOW
NO3_A_SML_CONC_HIVOL	Nitrate concentration	nanomoles per meter cubed of air (nm/(m^3))

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Tisch Environmental TSP TE5170V
Generic Instrument Name	Aerosol Sampler
Dataset-specific Description	Samples were collected using Florida State University's high volume aerosol sampler (Tisch Environmental TSP TE5170V). Samples were collected at the rate of 1 cubic meter per minute on Whatman 41, 47 mm discs (glass fiber; GF) and were pre-combusted before deployment.
Generic Instrument Description	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

Dataset-specific Instrument Name	WestCo SmartChem 200
Generic Instrument Name	Discrete Analyzer
Dataset-specific Description	Concentration analysis of samples was completed using an automated colorimetric system (WestCo SmartChem 200).
Generic Instrument Description	Discrete analyzers utilize discrete reaction wells to mix and develop the colorimetric reaction, allowing for a wide variety of assays to be performed from one sample. These instruments are ideal for drinking water, wastewater, soil testing, environmental and university or research applications where multiple assays and high throughput are required.

Dataset-specific Instrument Name	ThermoFisher Delta V
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Based upon nitrate concentration, 10 nmol of N were injected into vials containing denitrifying bacteria to convert nitrate to nitrous oxide for isotopic analysis on a ThermoFisher Delta V 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).

[table of contents | back to top]

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

[table of contents | back to top]

Project Information

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

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

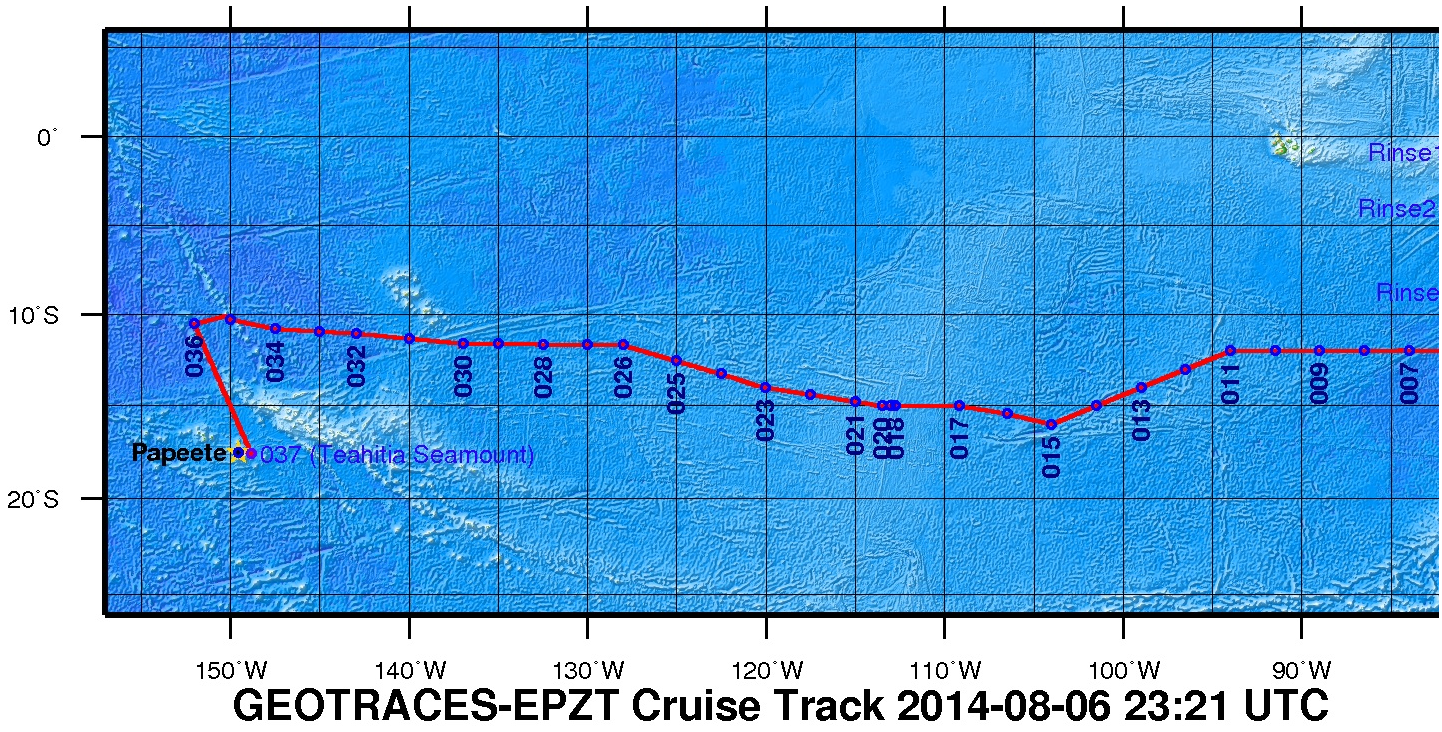
Coverage: Eastern Tropical Pacific - Transect from Peru to Tahiti (GP16)

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.

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1233140

[table of contents | back to top]