

# Dissolved REE concentrations and Nd isotopes reported by OSU researchers from samples collected on the GEOTRACES EPZT R/V Thomas G. Thompson cruise TN303 from November to December 2013

Website: <https://www.bco-dmo.org/dataset/788195>

Data Type: Cruise Results

Version: 1

Version Date: 2020-01-23

## Project

» [U.S. GEOTRACES East Pacific Zonal Transect \(GP16\)](#) (U.S. GEOTRACES EPZT)

» [Collaborative Research: GEOTRACES Pacific Section - Nd isotopes and REEs in the South Pacific](#) (EPZT Nd REEs)

## Program

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

Contributors	Affiliation	Role
<a href="#">Haley, Brian</a>	Oregon State University (OSU)	Principal Investigator, Contact
<a href="#">Goldstein, Steven L.</a>	Lamont-Doherty Earth Observatory (LDEO)	Co-Principal Investigator
<a href="#">Rauch, Shannon</a>	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

## Abstract

Dissolved REE concentrations and Nd isotopes from the GEOTRACES EPZT R/V Thomas G. Thompson cruise TN303 from November to December 2013. This collaborative project was investigated by neodymium (Nd) isotope groups at Lamont-Doherty Earth Observatory (LDEO) and Oregon State University (OSU). The two groups analyzed samples at alternate stations. Samples in this dataset were processed and analyzed by the Nd isotope group at OSU. The LDEO samples are available as a related dataset (BCO-DMO dataset 915447).

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## Coverage

**Spatial Extent:** N:-10.7652 E:282.62201 S:-15.0003 W:212.49899

**Temporal Extent:** 2013-11-01 - 2013-12-14

## Methods & Sampling

Samples were filtered, acidified, and split at sea. Samples were collected by Niskin bottle and the towed GeoFish. Refer to the EPZT cruise report for more information on cruise operations ([http://dmoserv3.who.edu/data\\_docs/GEOTRACES/EPZT/GT13\\_EPZT\\_ODFReport\\_All.pdf](http://dmoserv3.who.edu/data_docs/GEOTRACES/EPZT/GT13_EPZT_ODFReport_All.pdf)).

We prepared our 5L split for neodymium isotopic analysis following Shabani et al. (1992). Samples were pH-adjusted to pH ~3.5, then pumped through 300 µl of HDEHP in a C18 cartridge to capture REEs. Rare earth elements were eluted from the cartridge using 6M HCl, then Nd was isolated using sequential chromatographic columns: AG50-X8 (BioRad) and Ln-Spec (Eichrom). Neodymium isotopic measurements were made at Lamont-Doherty Earth Observatory (Palisades, NY) using a Thermo Neptune multicollector ICP-MS.

For REE concentrations we removed an aliquot after pH-adjustment of each sample. Sample methodology is described in Behrens et al. (2006), as Lab #3. We pre-concentrated 20 ml of sample offline using a SeaFast PICO system (ESI), then analysed the resulting solution at Oregon State University (Corvallis, OR) using a Thermo X-Series II ICP-MS.

Problem Report: Cerium measurements yielded questionable data during a couple of run days, these data are indicated using IODE quality flag 3- Questionable Data. Sample gaps in REE concentrations are due to analytical error during pre-concentration, sample gaps in Nd isotope data are due to insufficient quantity of Nd to make a measurement.

## Data Processing Description

Neodymium isotope ratios were corrected using JNdi-1 standard for reference (Tanaka et al., 2000). Dissolved concentrations were determined by external calibration. Calibration standards were diluted by weight and pre-concentrated using the same method as the samples. To account for evaporation we included pre-concentrations of an in-house REE consistency standard at regular intervals. Validation of the correction was done by additional pre-concentrations and measurements of two in-house seawater samples, one from Bransfield Strait (~1100m depth) and one from nearshore California (~surface depth).

## IODE Quality Flag Codes:

Good quality = 1

Not evaluated, not available, or unknown quality = 2

Questionable/suspect quality = 3

Bad quality = 4

Missing data = 9

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## Data Files

File
<b>REEs.csv</b> (Comma Separated Values (.csv), 49.84 KB) MDS:dfd39f17bed40d38ed5573dee3899991
Primary data file for dataset ID 788195

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## Related Publications

Behrens, M. K., Muratli, J., Pradoux, C., Wu, Y., Böning, P., Brumsack, H.-J., ... Pahnke, K. (2016). Rapid and precise analysis of rare earth elements in small volumes of seawater - Method and intercomparison. *Marine Chemistry*, 186, 110-120. doi:[10.1016/j.marchem.2016.08.006](https://doi.org/10.1016/j.marchem.2016.08.006)  
*Methods*

Shabani, M. B., Akagi, T., & Masuda, A. (1992). Preconcentration of trace rare-earth elements in seawater by complexation with bis(2-ethylhexyl) hydrogen phosphate and 2-ethylhexyl dihydrogen phosphate adsorbed on a C18 cartridge and determination by inductively coupled plasma mass spectrometry. *Analytical Chemistry*, 64(7), 737-743. doi:[10.1021/ac00031a008](https://doi.org/10.1021/ac00031a008)  
*Methods*

Tanaka, T., Togashi, S., Kamioka, H., Amakawa, H., Kagami, H., Hamamoto, T., ... Dragusanu, C. (2000). JNdi-1: a neodymium isotopic reference in consistency with Lajolla neodymium. *Chemical Geology*, 168(3-4), 279-281. doi:10.1016/S0009-2541(00)00198-4 [https://doi.org/10.1016/S0009-2541\(00\)00198-4](https://doi.org/10.1016/S0009-2541(00)00198-4)  
*Methods*

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## Related Datasets

### IsRelatedTo

Wu, Y., Basak, C., Pena, L. D., Bolje, L. L., Goldstein, S. L. (2023) **Dissolved neodymium (Nd) isotopes and concentrations of rare-earth elements (REEs) reported by LDEO in seawater samples collected during the GEOTRACES GP16 East Pacific Zonal Transect cruise (TN303) on R/V Thomas G. Thompson from October to December 2013.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-12-19 doi:10.26008/1912/bco-dmo.915447.1 [[view at BCO-DMO](#)]

*Relationship Description: This collaborative project was investigated by Nd isotope groups at LDEO and OSU. The two groups analyzed samples at alternate stations.*

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## Parameters

Parameter	Description	Units
Cruise	Cruise identification (GP16; TN303)	unitless
Station	Station number	unitless
GEOTRC_SAMPNO	Unique GEOTRACES sample number	unitless
DEPTH	Sample depth	meters (m)
Sampling_Device	Sampling instrument	unitless
Year	4-digit year; format: yyyy	unitless
Date_Time	Date and time (UTC); format: yyyy-mm-ddTHH:MM:SS	unitless
Longitude	Longitude	degrees East
Latitude	Latitude	degrees North
La_D_CONC_BOTTLE	Dissolved Concentration of Lanthanum (La) from bottle samples	picomoles per kilogram (pmol/kg)
La_D_CONC_BOTTLE_QV_IODE	La_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Ce_D_CONC_BOTTLE	Dissolved Concentration of Cerium (Ce) from bottle samples	pmol/kg
Ce_D_CONC_BOTTLE_QV_IODE	Ce_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Pr_D_CONC_BOTTLE	Dissolved Concentration of Praseodymium (Pr) from bottle samples	pmol/kg
Pr_D_CONC_BOTTLE_QV_IODE	Pr_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Nd_D_CONC_BOTTLE	Dissolved Concentration of Neodymium (Nd) from bottle samples	pmol/kg
Nd_D_CONC_BOTTLE_QV_IODE	Nd_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Sm_D_CONC_BOTTLE	Dissolved Concentration of Samarium (Sm) from bottle samples	pmol/kg
Sm_D_CONC_BOTTLE_QV_IODE	Sm_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Eu_D_CONC_BOTTLE	Dissolved Concentration of Europium (Eu) from bottle samples	pmol/kg
Eu_D_CONC_BOTTLE_QV_IODE	Eu_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Gd_D_CONC_BOTTLE	Dissolved Concentration of Gadolinium (Gd) from bottle samples	pmol/kg
Gd_D_CONC_BOTTLE_QV_IODE	Gd_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Tb_D_CONC_BOTTLE	Dissolved Concentration of Terbium (Tb) from bottle samples	pmol/kg
Tb_D_CONC_BOTTLE_QV_IODE	Tb_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Dy_D_CONC_BOTTLE	Dissolved Concentration of Dysprosium (Dy) from bottle samples	pmol/kg
Dy_D_CONC_BOTTLE_QV_IODE	Dy_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Ho_D_CONC_BOTTLE	Dissolved Concentration of Holmium (Ho) from bottle samples	pmol/kg
Ho_D_CONC_BOTTLE_QV_IODE	Ho_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Er_D_CONC_BOTTLE	Dissolved Concentration of Erbium (Er) from bottle samples	pmol/kg
Er_D_CONC_BOTTLE_QV_IODE	Er_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Tm_D_CONC_BOTTLE	Dissolved Concentration of Thulium ( Tm) from bottle samples	pmol/kg
Tm_D_CONC_BOTTLE_QV_IODE	Tm_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Yb_D_CONC_BOTTLE	Dissolved Concentration of Ytterbium (Yb) from bottle samples	pmol/kg
Yb_D_CONC_BOTTLE_QV_IODE	Yb_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Lu_D_CONC_BOTTLE	Dissolved Concentration of Lutetium (Lu) from bottle samples	pmol/kg
Lu_D_CONC_BOTTLE_QV_IODE	Lu_D_CONC_BOTTLE data quality flag using IODE scheme	unitless
Nd_143_144_D_EPSILON_BOTTLE	Isotopic ratio of neodymium 143/144 from bottle samples	epsilon units
Nd_143_144_D_EPSILON_BOTTLE_SD	1-sigma error of Epsilon Nd from bottle samples	epsilon units
Nd_143_144_D_EPSILON_BOTTLE_QV_IODE	Nd_143_144_D_EPSILON_BOTTLE data quality flag using IODE scheme	unitless
La_D_CONC_FISH	Dissolved Concentration of Lanthanum (La) from GeoFish samples	pmol/kg
La_D_CONC_FISH_QV_IODE	La_D_CONC_FISH data quality flag using IODE scheme	unitless
Ce_D_CONC_FISH	Dissolved Concentration of Cerium (Ce) from GeoFish samples	pmol/kg
Ce_D_CONC_FISH_QV_IODE	Ce_D_CONC_FISH data quality flag using IODE scheme	unitless

Pr_D_CONC_FISH	Dissolved Concentration of Praseodymium (Pr) from GeoFish samples	pmol/kg
Pr_D_CONC_FISH_QV_IODE	Pr_D_CONC_FISH data quality flag using IODE scheme	unitless
Nd_D_CONC_FISH	Dissolved Concentration of Neodymium (Nd) from GeoFish samples	pmol/kg
Nd_D_CONC_FISH_QV_IODE	Nd_D_CONC_FISH data quality flag using IODE scheme	unitless
Sm_D_CONC_FISH	Dissolved Concentration of Samarium (Sm) from GeoFish samples	pmol/kg
Sm_D_CONC_FISH_QV_IODE	Sm_D_CONC_FISH data quality flag using IODE scheme	unitless
Eu_D_CONC_FISH	Dissolved Concentration of Europium (Eu) from GeoFish samples	pmol/kg
Eu_D_CONC_FISH_QV_IODE	Eu_D_CONC_FISH data quality flag using IODE scheme	unitless
Gd_D_CONC_FISH	Dissolved Concentration of Gadolinium (Gd) from GeoFish samples	pmol/kg
Gd_D_CONC_FISH_QV_IODE	Gd_D_CONC_FISH data quality flag using IODE scheme	unitless
Tb_D_CONC_FISH	Dissolved Concentration of Terbium (Tb) from GeoFish samples	pmol/kg
Tb_D_CONC_FISH_QV_IODE	Tb_D_CONC_FISH data quality flag using IODE scheme	unitless
Dy_D_CONC_FISH	Dissolved Concentration of Dysprosium (Dy) from GeoFish samples	pmol/kg
Dy_D_CONC_FISH_QV_IODE	data quality flag using IODE scheme	unitless
Ho_D_CONC_FISH	Dissolved Concentration of Holmium (Ho) from GeoFish samples	pmol/kg
Ho_D_CONC_FISH_QV_IODE	Ho_D_CONC_FISH data quality flag using IODE scheme	unitless
Er_D_CONC_FISH	Dissolved Concentration of Erbium (Er) from GeoFish samples	pmol/kg
Er_D_CONC_FISH_QV_IODE	Er_D_CONC_FISH data quality flag using IODE scheme	unitless
Tm_D_CONC_FISH	Dissolved Concentration of Thulium ( Tm) from GeoFish samples	pmol/kg
Tm_D_CONC_FISH_QV_IODE	Tm_D_CONC_FISH data quality flag using IODE scheme	unitless
Yb_D_CONC_FISH	Dissolved Concentration of Ytterbium (Yb) from GeoFish samples	pmol/kg
Yb_D_CONC_FISH_QV_IODE	Yb_D_CONC_FISH data quality flag using IODE scheme	unitless
Lu_D_CONC_FISH	Dissolved Concentration of Lutetium (Lu) from GeoFish samples	pmol/kg
Lu_D_CONC_FISH_QV_IODE	Lu_D_CONC_FISH data quality flag using IODE scheme	unitless
Nd_143_144_D_EPSILON_FISH	Isotopic ratio of neodymium 143/144 from GeoFish samples	epsilon units
Nd_143_144_D_EPSILON_FISH_SD	1-sigma error of Epsilon Nd from GeoFish samples	epsilon units
Nd_143_144_D_EPSILON_FISH_QV_IODE	Nd_143_144_D_EPSILON_FISH data quality flag using IODE scheme	unitless

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## Instruments

<b>Dataset-specific Instrument Name</b>	
<b>Generic Instrument Name</b>	GeoFish Towed near-Surface Sampler
<b>Generic Instrument Description</b>	The GeoFish towed sampler is a custom designed near surface (

<b>Dataset-specific Instrument Name</b>	Thermo Neptune multi-collector ICP-MS
<b>Generic Instrument Name</b>	Inductively Coupled Plasma Mass Spectrometer
<b>Dataset-specific Description</b>	Neodymium isotopic measurements were made at Lamont-Doherty Earth Observatory (Palisades, NY) using a Thermo Neptune multi-collector ICP-MS.
<b>Generic Instrument Description</b>	An ICP Mass Spec is an instrument that passes nebulized samples into an inductively-coupled gas plasma (8-10000 K) where they are atomized and ionized. Ions of specific mass-to-charge ratios are quantified in a quadrupole mass spectrometer.

<b>Dataset-specific Instrument Name</b>	Thermo X-Series II ICP-MS
<b>Generic Instrument Name</b>	Inductively Coupled Plasma Mass Spectrometer
<b>Dataset-specific Description</b>	Rare earth element dissolved concentrations were analysed at Oregon State University (Corvallis, OR) using a Thermo X-Series II ICP-MS.
<b>Generic Instrument Description</b>	An ICP Mass Spec is an instrument that passes nebulized samples into an inductively-coupled gas plasma (8-10000 K) where they are atomized and ionized. Ions of specific mass-to-charge ratios are quantified in a quadrupole mass spectrometer.

<b>Dataset-specific Instrument Name</b>	
<b>Generic Instrument Name</b>	Niskin bottle
<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)

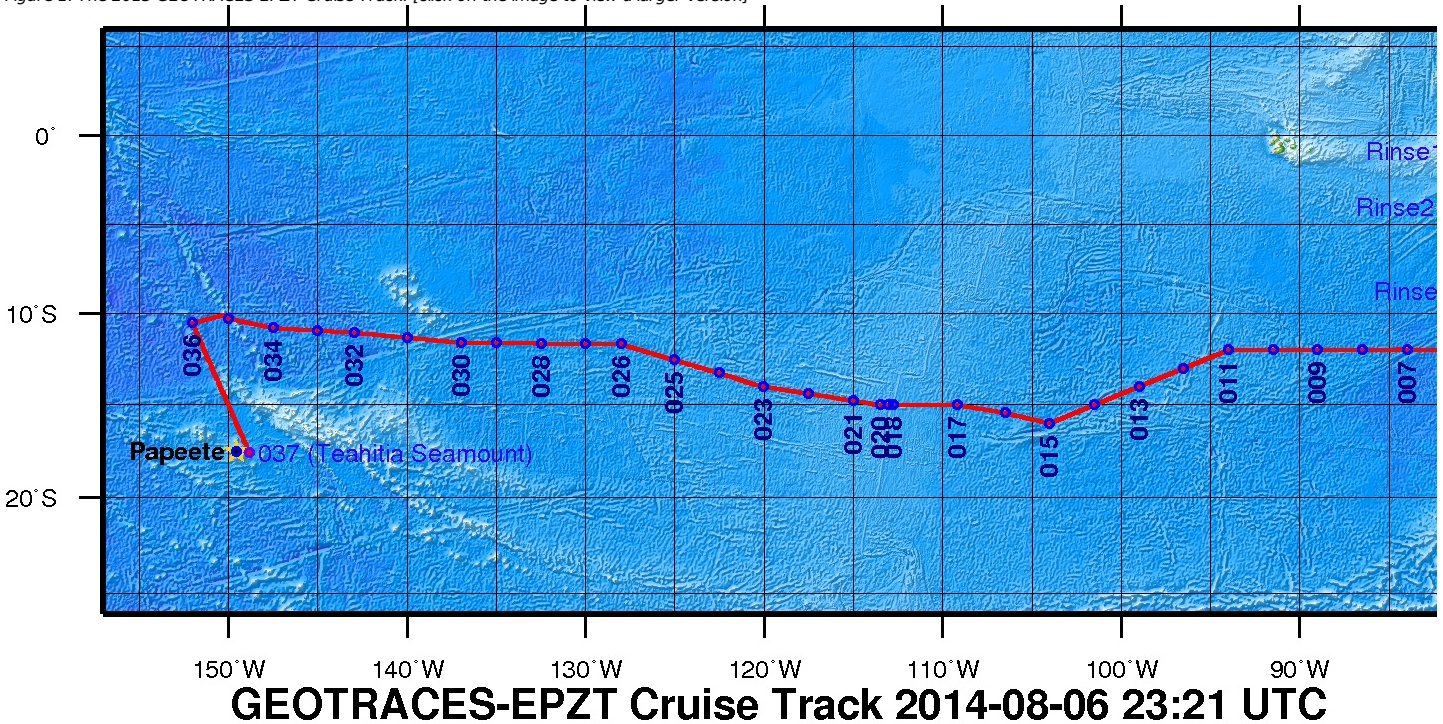
#### From the NSF Award Abstract

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 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]



**Collaborative Research:** GEOTRACES Pacific Section - Nd isotopes and REEs in the South Pacific (EPZT Nd REEs)

**Coverage:** Equatorial East Pacific Zonal Trsect (South)

NSF abstract:

Neodymium isotopes (Nd) and rare earth elements (REE) are recognized by the GEOTRACES program as key trace elements and isotopes (TEIs) because they trace the sources and mixing of water masses. Therefore, transport data generated by Nd measurements will potentially advance our understanding on the dominant processes that drive TEI distribution in the ocean. There is a particular need for Nd measurements in the South Pacific because current observations do not agree with GCM models. Researchers from Columbia University and Oregon State University will analyze seawater, aerosols, water column particulates, and sea-floor sediments for Nd, strontium, and REE during the upcoming 2013 GEOTRACES cruise. Because of the geographical transect of the GEOTRACES Pacific section cruise, investigators will assess impacts made by a suite of biological, chemical, and physical processes including: boundary exchange, high productivity, surface addition from aerosols, addition to bottom waters from detached nephloid layers, particles from hydrothermal vents, reversible scavenging, and groundwater fluxes. Furthermore, within the Peru-Chili Oxygen Minimum Zone (OMZ), investigators will utilize the TEI cerium to better understand relative effects of lateral and vertical processes. By improving understanding of the distribution of TEIs, results will also enhance biogeochemical models and advance knowledge of climate systems.

Broader Impacts: Research will advance careers of two young scientists, support education and training of Ph.D. and undergraduate students, and provide materials for outreach activities. Additionally, results will be published in scientific journals and all data will be submitted to the Biological and Chemical Oceanography Data Management Office.

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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-1234191</a>

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