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

Website: https://www.bco-dmo.org/dataset/915447
Data Type: Cruise Results
Version: 1
Version Date: 2023-12-19

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
Goldstein, Steven L.	Lamont-Doherty Earth Observatory (LDEO)	Principal Investigator
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Abstract
This dataset includes dissolved neodymium (Nd) isotopes and concentrations of rare earth elements (REEs) in seawater samples collected along the GEOTRACES GP16 East Pacific Zonal Transect. The cruise was aboard the R/V Thomas G. Thompson between October 25 and December 20, 2013 from Manta, Ecuador to Papeete, Tahiti. Multicollector-inductively coupled plasma-mass spectrometry (MC-ICP-MS) was used to analyze Nd isotopes and quadrupole ICP-MS was used to analyze REE concentrations. This cruise provides a great opportunity to understand sources, sinks, and cycling of REEs in the ocean as well as how well Nd isotopes behave as a conservative water mass tracer. The data were collected by Yingzhe Wu and Chandranath Basak at Lamont-Doherty Earth Observatory of Columbia University.

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Coverage

Spatial Extent: **N**:-10.5003 **E**:-77.657 **S**:-16.0006 **W**:-152.079
Temporal Extent: 2013-10-29 - 2013-12-18

Methods & Sampling

Seawater samples were collected during the GEOTRACES GP16 cruise on R/V Thomas G. Thompson (TN303) along the East Pacific Zonal Transect in 2013. Five liters (L) of seawater were collected and stored in a cubitainer for each sample. The samples were filtered using 0.2-micrometer (µm) Sartobran cartridges and acidified using ultrapure Seastar hydrochloric acid (HCl) to pH ~ 2 shortly after sampling.

For neodymium (Nd) isotope analysis, rare-earth elements (REEs) were preconcentrated from seawater using C18 cartridges (Waters Corp., Sep-Pak classic, 360-milligrams (mg), 55-105 µm) loaded with complexing agent composed of a mixture of 2-ethylhexyl hydrogen phosphate (HDEHP) and 2-ethylhexyl dihydrogen phosphate (H2MEHP), which was first proposed by Shabani et al. (1992). In this study, we followed the methods by Jeandel et al. (1998), Lacan and Jeandel (2001), and Pahnke et al. (2012). Specifically, C18 cartridges were first cleaned in a 0.5 N HCl bath overnight, passed through 10 milliliters (mL) of 6 N HCl and then flushed with >500 mL of Milli-Q water. Cartridges were stored in Milli-Q water after cleaning. 300 µL of complexing agent HDEHP/H2MEHP was loaded on a clean cartridge for a 5 L sample. Seawater samples were adjusted to pH ≈ 3.5 by adding Optima® ammonium hydroxide before being pumped through the cartridges at 20 mL/minute by a peristaltic pump in the ultra-clean chemistry laboratory at LDEO. Cartridges were then eluted with 10 mL of 0.01 N HCl to remove barium. After barium elution, cartridges were eluted with 35 mL of 6 N HCl at 10 mL/minute by a peristaltic pump to collect REEs. REEs were dried and further purified by TRU-spec column chemistry. Nd fractions were extracted from REEs by LN-spec column chemistry and dried. They were redissolved in 0.3 mL of 3% HNO3 for the Nd isotope analysis.

For REE concentration analysis, a multi-element REE spike enriched in 138La, 142Ce, 145Nd, 149Sm, 153Eu, 155Gd, 161Dy, 167Er, 171Yb, and 176Lu (Wu et al., 2020) was added to each sample (~10 mL). The sample-spike mixture was allowed to equilibrate for at least 24 hours and then was purified and pre-concentrated through the seaFast Automated Preconcentration System for Undiluted Seawater (Elemental Scientific Inc. or ESI, Omaha, Nebraska, USA).

Data Processing Description

The Nd isotopic composition is expressed as:

$\varepsilon Nd = [(^{143}Nd/^{144}Ndsample/^{143}Nd/^{144}NdCHUR) - 1] \times 10^4$

This study uses $^{143}Nd/^{144}NdCHUR = 0.512638$ (Jacobsen and Wasserburg, 1980).

BCO-DMO Curation Notes

- Imported original file "DOoR_GEOTRACES GP16_eNd&REEs_LDEO.xlsx" into the BCO-DMO system.
- Flagged '-999' values as missing data values (missing data are blank/empty in the final CSV file).
- Renamed fields to comply with BCO-DMO naming conventions.
- Created the date/time field in ISO 8601 format.
- Removed the end lat/lon and end date/time columns (all empty).

- Saved the final file as "915447_v1_gp16_diss_nd_and_rees_ldeo.csv".

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Data Files

File	
915447_v1_gp16_diss_nd_and_rees_ldeo.csv	(Comma Separated Values (.csv), 88.12 KB) MD5:6be91f8240988af0da9f1fb13b1ab0a0
Primary data file for dataset ID 915447, version 1	

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Related Publications

Haley, B. A., Wu, Y., Muratli, J. M., Basak, C., Pena, L. D., & Goldstein, S. L. (2021). Rare earth element and neodymium isotopes of the eastern US GEOTRACES Equatorial Pacific Zonal Transect (GP16). Earth and Planetary Science Letters, 576, 117233. https://doi.org/10.1016/j.epsl.2021.117233
Results

Jacobsen, S. B., & Wasserburg, G. J. (1980). Sm-Nd isotopic evolution of chondrites. Earth and Planetary Science Letters, 50(1), 139–155. doi:10.1016/0012-821x(80)90125-9 https://doi.org/10.1016/0012-821X(80)90125-9
Methods

Jeandel, C., Thouron, D., & Fieux, M. (1998). Concentrations and isotopic compositions of neodymium in the eastern Indian Ocean and Indonesian straits. Geochimica et Cosmochimica Acta, 62(15), 2597–2607. doi:10.1016/s0016-7037(98)00169-0 https://doi.org/10.1016/S0016-7037(98)00169-0
Methods

Lacan, F., & Jeandel, C. (2004). Denmark Strait water circulation traced by heterogeneity in neodymium isotopic compositions. Deep Sea Research Part I: Oceanographic Research Papers, 51(1), 71–82. doi:10.1016/j.dsr.2003.09.006
Methods

Pahnke, K., van de Flierdt, T., Jones, K. M., Lambelet, M., Hemming, S. R., & Goldstein, S. L. (2012). GEOTRACES intercalibration of neodymium isotopes and rare earth element concentrations in seawater and suspended particles. Part 2: Systematic tests and baseline profiles. Limnology and Oceanography: Methods, 10(4), 252–269. doi:10.4319/lom.2012.10.252
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
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
Methods

Wu, Y., Pena, L. D., Goldstein, S. L., Basak, C., Bolge, L. L., Jones, K. M., … Hemming, S. R. (2020). A User-Friendly Workbook to Facilitate Rapid and Accurate Rare Earth Element Analyses by ICP-MS for Multispiked Samples. Geochemistry, Geophysics, Geosystems, 21(9). doi:10.1029/2020gc009042 https://doi.org/10.1029/2020GC009042
Methods

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Related Datasets

IsRelatedTo

Haley, B., Goldstein, S. L. (2020) **Dissolved REE concentrations and Nd isotopes from the GEOTRACES EPZT R/V Thomas G. Thompson cruise TN303 from November to December 2013.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2020-01-23 doi:10.1575/1912/bco-dmo.788195.1 [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
Station_ID	Station number	unitless
ISO_DateTime_UTC_Start	Date and time (UTC) at start of sampling event in ISO 8601 format	unitless
Start_Date_UTC	Date at start of sampling event	unitless
Start_Time_UTC	Time (UTC) at start of sampling event	unitless
Start_Latitude	Latitude; North is positive.	decimal degrees
Start_Longitude	Longitude; East is positive.	decimal degrees
Event_ID	GEOTRACES event number	unitless
Sample_ID	GEOTRACES sample number	unitless
Sample_Depth	Sampling depth	meters (m)
CTDPRS_T_VALUE_SENSOR_vvdwtp	Sampling pressure of CTD	decibars (dbar)

SD1_CTDPRS_T_VALUE_SENSOR_vvdwtp	Standard deviation of CTDPRS_T_VALUE_SENSOR_vvdwtp	decibars (dbar)
Flag_CTDPRS_T_VALUE_SENSOR_vvdwtp	Quality flag for CTDPRS_T_VALUE_SENSOR_vvdwtp	unitless
CTDTMP_T_VALUE_SENSOR_fp7gnu	Sampling temperature of CTD	degrees Celsius
SD1_CTDTMP_T_VALUE_SENSOR_fp7gnu	Standard deviation of CTDTMP_T_VALUE_SENSOR_fp7gnu	degrees Celsius
Flag_CTDTMP_T_VALUE_SENSOR_fp7gnu	Quality flag for CTDTMP_T_VALUE_SENSOR_fp7gnu	unitless
CTDSAL_D_CONC_SENSOR_dipxfj	Sampling salinity of CTD	PSU?
SD1_CTDSAL_D_CONC_SENSOR_dipxfj	Standard deviation of CTDSAL_D_CONC_SENSOR_dipxfj	PSU?
Flag_CTDSAL_D_CONC_SENSOR_dipxfj	Quality flag for CTDSAL_D_CONC_SENSOR_dipxfj	unitless
CTDOXY_D_CONC_SENSOR_wpflfa	Sampling oxygen concentration of CTD	micromoles per kilogram (umol/kg)
SD1_CTDOXY_D_CONC_SENSOR_wpflfa	Standard deviation of CTDOXY_D_CONC_SENSOR_wpflfa	micromoles per kilogram (umol/kg)
Flag_CTDOXY_D_CONC_SENSOR_wpflfa	Quality flag for CTDOXY_D_CONC_SENSOR_wpflfa	unitless
SILICATE_D_CONC_BOTTLE_7ccpa2	Silicate concentration	micromoles per kilogram (umol/kg)
SD1_SILICATE_D_CONC_BOTTLE_7ccpa2	Standard deviation of SILICATE_D_CONC_BOTTLE_7ccpa2	micromoles per kilogram (umol/kg)
Flag_SILICATE_D_CONC_BOTTLE_7ccpa2	Quality flag for SILICATE_D_CONC_BOTTLE_7ccpa2	unitless
PHOSPHATE_D_CONC_BOTTLE_145nsm	Phosphate concentration	micromoles per kilogram (umol/kg)
SD1_PHOSPHATE_D_CONC_BOTTLE_145nsm	Standard deviation of PHOSPHATE_D_CONC_BOTTLE_145nsm	micromoles per kilogram (umol/kg)
Flag_PHOSPHATE_D_CONC_BOTTLE_145nsm	Quality flag for PHOSPHATE_D_CONC_BOTTLE_145nsm	unitless
NITRATE_D_CONC_BOTTLE_oxilrz	Nitrate concentration	micromoles per kilogram (umol/kg)
SD1_NITRATE_D_CONC_BOTTLE_oxilrz	Standard deviation of NITRATE_D_CONC_BOTTLE_oxilrz	micromoles per kilogram (umol/kg)
Flag_NITRATE_D_CONC_BOTTLE_oxilrz	Quality flag for NITRATE_D_CONC_BOTTLE_oxilrz	unitless
Nd_143_144_D_EPSILON_BOTTLE_6yxwln	Dissolved 143Nd/144Nd ratio normalized to 0.512638 in parts per 10000	unitless
SD1_Nd_143_144_D_EPSILON_BOTTLE_6yxwln	Standard deviation of Nd_143_144_D_EPSILON_BOTTLE_6yxwln. External 1 standard deviation of repeatedly measured JNdi standards during the analysis normalized to 0.512638 in parts per 10000	unitless
Flag_Nd_143_144_D_EPSILON_BOTTLE_6yxwln	Quality flag for Nd_143_144_D_EPSILON_BOTTLE_6yxwln. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
La_D_CONC_BOTTLE_3i8t0o	Dissolved Lanthanum (La) concentration	picomoles per kilogram (pmol/kg)
SD1_La_D_CONC_BOTTLE_3i8t0o	External 1 standard deviation of La_D_CONC_BOTTLE_3i8t0o	picomoles per kilogram (pmol/kg)
Flag_La_D_CONC_BOTTLE_3i8t0o	Quality flag for La_D_CONC_BOTTLE_3i8t0o. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Ce_D_CONC_BOTTLE_khndur	Dissolved Cerium (Ce) concentration	picomoles per kilogram (pmol/kg)

SD1_Ce_D_CONC_BOTTLE_khndur	External 1 standard deviation of Ce_D_CONC_BOTTLE_khndur	picomoles per kilogram (pmol/kg)
Flag_Ce_D_CONC_BOTTLE_khndur	Quality flag for Ce_D_CONC_BOTTLE_khndur. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Pr_D_CONC_BOTTLE_oxu3mt	Dissolved Praseodymium (Pr) concentration	picomoles per kilogram (pmol/kg)
SD1_Pr_D_CONC_BOTTLE_oxu3mt	External 1 standard deviation of Pr_D_CONC_BOTTLE_oxu3mt	picomoles per kilogram (pmol/kg)
Flag_Pr_D_CONC_BOTTLE_oxu3mt	Quality flag for Pr_D_CONC_BOTTLE_oxu3mt. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Nd_D_CONC_BOTTLE_awd28c	Dissolved Neodymium (Nd) concentration	picomoles per kilogram (pmol/kg)
SD1_Nd_D_CONC_BOTTLE_awd28c	External 1 standard deviation of Nd_D_CONC_BOTTLE_awd28c	picomoles per kilogram (pmol/kg)
Flag_Nd_D_CONC_BOTTLE_awd28c	Quality flag for Nd_D_CONC_BOTTLE_awd28c. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Sm_D_CONC_BOTTLE_iumac7	Dissolved Samarium (Sm) concentration	picomoles per kilogram (pmol/kg)
SD1_Sm_D_CONC_BOTTLE_iumac7	External 1 standard deviation of Sm_D_CONC_BOTTLE_iumac7	picomoles per kilogram (pmol/kg)
Flag_Sm_D_CONC_BOTTLE_iumac7	Quality flag for Sm_D_CONC_BOTTLE_iumac7. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Eu_D_CONC_BOTTLE_phoc0h	Dissolved Europium (Eu) concentration	picomoles per kilogram (pmol/kg)
SD1_Eu_D_CONC_BOTTLE_phoc0h	External 1 standard deviation of Eu_D_CONC_BOTTLE_phoc0h	picomoles per kilogram (pmol/kg)
Flag_Eu_D_CONC_BOTTLE_phoc0h	Quality flag for Eu_D_CONC_BOTTLE_phoc0h. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Gd_D_CONC_BOTTLE_mqpxwv	Dissolved Gadolinium (Gd) concentration	picomoles per kilogram (pmol/kg)
SD1_Gd_D_CONC_BOTTLE_mqpxwv	External 1 standard deviation of Gd_D_CONC_BOTTLE_mqpxwv	picomoles per kilogram (pmol/kg)
Flag_Gd_D_CONC_BOTTLE_mqpxwv	Quality flag for Gd_D_CONC_BOTTLE_mqpxwv. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Tb_D_CONC_BOTTLE_qn56fc	Dissolved Terbium (Tb) concentration	picomoles per kilogram (pmol/kg)
SD1_Tb_D_CONC_BOTTLE_qn56fc	External 1 standard deviation of Tb_D_CONC_BOTTLE_qn56fc	picomoles per kilogram (pmol/kg)
Flag_Tb_D_CONC_BOTTLE_qn56fc	Quality flag for Tb_D_CONC_BOTTLE_qn56fc. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Dy_D_CONC_BOTTLE_ryfy4p	Dissolved Dysprosium (Dy) concentration	picomoles per kilogram (pmol/kg)
SD1_Dy_D_CONC_BOTTLE_ryfy4p	External 1 standard deviation of Dy_D_CONC_BOTTLE_ryfy4p	picomoles per kilogram (pmol/kg)
Flag_Dy_D_CONC_BOTTLE_ryfy4p	Quality flag for Dy_D_CONC_BOTTLE_ryfy4p. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Ho_D_CONC_BOTTLE_viczuk	Dissolved Holmium (Ho) concentration	picomoles per kilogram (pmol/kg)

SD1_Ho_D_CONC_BOTTLE_viczuk	External 1 standard deviation of Ho_D_CONC_BOTTLE_viczuk	picomoles per kilogram (pmol/kg)
Flag_Ho_D_CONC_BOTTLE_viczuk	Quality flag for Ho_D_CONC_BOTTLE_viczuk. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Er_D_CONC_BOTTLE_toj6xw	Dissolved Erbium (Er) concentration	picomoles per kilogram (pmol/kg)
SD1_Er_D_CONC_BOTTLE_toj6xw	External 1 standard deviation of Er_D_CONC_BOTTLE_toj6xw	picomoles per kilogram (pmol/kg)
Flag_Er_D_CONC_BOTTLE_toj6xw	Quality flag for Er_D_CONC_BOTTLE_toj6xw. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Tm_D_CONC_BOTTLE_zv4lag	Dissolved Thulium (Tm) concentration	picomoles per kilogram (pmol/kg)
SD1_Tm_D_CONC_BOTTLE_zv4lag	External 1 standard deviation of Tm_D_CONC_BOTTLE_zv4lag	picomoles per kilogram (pmol/kg)
Flag_Tm_D_CONC_BOTTLE_zv4lag	Quality flag for Tm_D_CONC_BOTTLE_zv4lag. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Yb_D_CONC_BOTTLE_pdkue2	Dissolved Ytterbium (Yb) concentration	picomoles per kilogram (pmol/kg)
SD1_Yb_D_CONC_BOTTLE_pdkue2	External 1 standard deviation of Yb_D_CONC_BOTTLE_pdkue2	picomoles per kilogram (pmol/kg)
Flag_Yb_D_CONC_BOTTLE_pdkue2	Quality flag for Yb_D_CONC_BOTTLE_pdkue2. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Lu_D_CONC_BOTTLE_akkbyc	Dissolved Lutetium (Lu) concentration	picomoles per kilogram (pmol/kg)
SD1_Lu_D_CONC_BOTTLE_akkbyc	External 1 standard deviation of Lu_D_CONC_BOTTLE_akkbyc	picomoles per kilogram (pmol/kg)
Flag_Lu_D_CONC_BOTTLE_akkbyc	Quality flag for Lu_D_CONC_BOTTLE_akkbyc. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Nd_143_144_D_EPSILON_FISH_otveuu	Dissolved 143Nd/144Nd ratio normalized to 0.512638 in parts per 10000	unitless
SD1_Nd_143_144_D_EPSILON_FISH_otveuu	Standard deviation of Nd_143_144_D_EPSILON_FISH_otveuu. External 1 standard deviation of repeatedly measured JNdi standards during the analysis normalized to 0.512638 in parts per 10000	unitless
Flag_Nd_143_144_D_EPSILON_FISH_otveuu	Quality flag for Nd_143_144_D_EPSILON_FISH_otveuu. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
La_D_CONC_FISH_h0emhv	Dissolved Lanthanum (La) concentration	picomoles per kilogram (pmol/kg)
SD1_La_D_CONC_FISH_h0emhv	External 1 standard deviation of La_D_CONC_FISH_h0emhv	picomoles per kilogram (pmol/kg)
Flag_La_D_CONC_FISH_h0emhv	Quality flag for La_D_CONC_FISH_h0emhv. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Ce_D_CONC_FISH_pfwxb4	Dissolved Cerium (Ce) concentration	picomoles per kilogram (pmol/kg)
SD1_Ce_D_CONC_FISH_pfwxb4	External 1 standard deviation of Ce_D_CONC_FISH_pfwxb4	picomoles per kilogram (pmol/kg)
Flag_Ce_D_CONC_FISH_pfwxb4	Quality flag for Ce_D_CONC_FISH_pfwxb4. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Pr_D_CONC_FISH_j8n3si	Dissolved Praseodymium (Pr) concentration	picomoles per kilogram (pmol/kg)

SD1_Pr_D_CONC_FISH_j8n3si	External 1 standard deviation of Pr_D_CONC_FISH_j8n3si	picomoles per kilogram (pmol/kg)
Flag_Pr_D_CONC_FISH_j8n3si	Quality flag for Pr_D_CONC_FISH_j8n3si. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Nd_D_CONC_FISH_ggfcf6	Dissolved Neodymium (Nd) concentration	picomoles per kilogram (pmol/kg)
SD1_Nd_D_CONC_FISH_ggfcf6	External 1 standard deviation of Nd_D_CONC_FISH_ggfcf6	picomoles per kilogram (pmol/kg)
Flag_Nd_D_CONC_FISH_ggfcf6	Quality flag for Nd_D_CONC_FISH_ggfcf6. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Sm_D_CONC_FISH_qjgqsy	Dissolved Samarium (Sm) concentration	picomoles per kilogram (pmol/kg)
SD1_Sm_D_CONC_FISH_qjgqsy	External 1 standard deviation of Sm_D_CONC_FISH_qjgqsy	picomoles per kilogram (pmol/kg)
Flag_Sm_D_CONC_FISH_qjgqsy	Quality flag for Sm_D_CONC_FISH_qjgqsy. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Eu_D_CONC_FISH_vyaby1	Dissolved Europium (Eu) concentration	picomoles per kilogram (pmol/kg)
SD1_Eu_D_CONC_FISH_vyaby1	External 1 standard deviation of Eu_D_CONC_FISH_vyaby1	picomoles per kilogram (pmol/kg)
Flag_Eu_D_CONC_FISH_vyaby1	Quality flag for Eu_D_CONC_FISH_vyaby1. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Gd_D_CONC_FISH_eud8ti	Dissolved Gadolinium (Gd) concentration	picomoles per kilogram (pmol/kg)
SD1_Gd_D_CONC_FISH_eud8ti	External 1 standard deviation of Gd_D_CONC_FISH_eud8ti	picomoles per kilogram (pmol/kg)
Flag_Gd_D_CONC_FISH_eud8ti	Quality flag for Gd_D_CONC_FISH_eud8ti. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Tb_D_CONC_FISH_3667kp	Dissolved Terbium (Tb) concentration	picomoles per kilogram (pmol/kg)
SD1_Tb_D_CONC_FISH_3667kp	External 1 standard deviation of Tb_D_CONC_FISH_3667kp	picomoles per kilogram (pmol/kg)
Flag_Tb_D_CONC_FISH_3667kp	Quality flag for Tb_D_CONC_FISH_3667kp. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Dy_D_CONC_FISH_wim6wr	Dissolved Dysprosium (Dy) concentration	picomoles per kilogram (pmol/kg)
SD1_Dy_D_CONC_FISH_wim6wr	External 1 standard deviation of Dy_D_CONC_FISH_wim6wr	picomoles per kilogram (pmol/kg)
Flag_Dy_D_CONC_FISH_wim6wr	Quality flag for Dy_D_CONC_FISH_wim6wr. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Ho_D_CONC_FISH_jz4sed	Dissolved Holmium (Ho) concentration	picomoles per kilogram (pmol/kg)
SD1_Ho_D_CONC_FISH_jz4sed	External 1 standard deviation of Ho_D_CONC_FISH_jz4sed	picomoles per kilogram (pmol/kg)
Flag_Ho_D_CONC_FISH_jz4sed	Quality flag for Ho_D_CONC_FISH_jz4sed. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Er_D_CONC_FISH_yj558b	Dissolved Erbium (Er) concentration	picomoles per kilogram (pmol/kg)

SD1_Er_D_CONC_FISH_yj558b	External 1 standard deviation of Er_D_CONC_FISH_yj558b	picomoles per kilogram (pmol/kg)
Flag_Er_D_CONC_FISH_yj558b	Quality flag for Er_D_CONC_FISH_yj558b. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Tm_D_CONC_FISH_69svdh	Dissolved Thulium (Tm) concentration	picomoles per kilogram (pmol/kg)
SD1_Tm_D_CONC_FISH_69svdh	External 1 standard deviation of Tm_D_CONC_FISH_69svdh	picomoles per kilogram (pmol/kg)
Flag_Tm_D_CONC_FISH_69svdh	Quality flag for Tm_D_CONC_FISH_69svdh. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Yb_D_CONC_FISH_wvyajs	Dissolved Ytterbium (Yb) concentration	picomoles per kilogram (pmol/kg)
SD1_Yb_D_CONC_FISH_wvyajs	External 1 standard deviation of Yb_D_CONC_FISH_wvyajs	picomoles per kilogram (pmol/kg)
Flag_Yb_D_CONC_FISH_wvyajs	Quality flag for Yb_D_CONC_FISH_wvyajs. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Lu_D_CONC_FISH_ajuhyg	Dissolved Lutetium (Lu) concentration	picomoles per kilogram (pmol/kg)
SD1_Lu_D_CONC_FISH_ajuhyg	External 1 standard deviation of Lu_D_CONC_FISH_ajuhyg	picomoles per kilogram (pmol/kg)
Flag_Lu_D_CONC_FISH_ajuhyg	Quality flag for Lu_D_CONC_FISH_ajuhyg. Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless

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Instruments

Dataset-specific Instrument Name	GeoFish
Generic Instrument Name	GeoFish-type Near-surface Towfish Sampler
Generic Instrument Description	This term describes a family of custom-designed, trace-metal-clean, near-surface seawater sampling systems based on the 'GeoFish' design developed by Geoffrey Smith and Ken Bruland at the University of California, Santa Cruz (UCSC). The systems consist of a weighted towed body or torpedo, clean intake tubing, a shipboard pneumatic pump, and a sampling manifold. They are deployed alongside a moving vessel, outside the ship's wake, with the intake typically positioned approximately 1 to 3 meters below the sea surface. Seawater is continuously pumped through the clean tubing to the ship for filtered and unfiltered sampling and, in some applications, direct connection to analytical instruments. This term includes the original GeoFish sampler, Super-GeoFISH variants, and subsequent modified towfish systems used on U.S. GEOTRACES cruises. These systems share the same basic sampling principle but may differ in body construction, depressor or stabilization design, deployment hardware, tubing, pump configuration, flow rate, and sampling manifold. The systems have been used for trace-metal, nutrient, biological, and other chemical measurements in both GEOTRACES and non-GEOTRACES studies, including Bruland et al. (2005).

Dataset-specific Instrument Name	Thermo Scientific Neptune-Plus® multicollector-inductively coupled plasma-mass spectrometer (MC-ICP-MS)
Generic Instrument Name	Multi Collector Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	The Nd isotopic compositions were measured by a Thermo Scientific Neptune-Plus® multicollector-inductively coupled plasma-mass spectrometer (MC-ICP-MS) at LDEO. The instrument was coupled with a desolvation introduction system (an Apex nebulizer). All measured Nd isotopic compositions were corrected for mass fractionation using an exponential law with $^{146}Nd/^{144}Nd = 0.7219$. For each analytical session, standard JNdi-1 was measured between every sample. For each sample, the measured Nd isotopic composition is normalized to $^{143}Nd/^{144}NdJNdi = 0.512115$ (Tanaka et al., 2000), using the average measured JNd sample of a measuring session. JNdi-1 standards yielded external reproducibilities (2σ) as follows: ± 0.30 εNd units for 50 ppb solutions, ± 0.32 for 40 ppb, ± 0.36 for 30 ppb, ± 0.33 for 20 ppb, and ± 0.42 for 10 ppb.
Generic Instrument Description	A Multi Collector Inductively Coupled Plasma Mass Spectrometry (MC-ICPMS) is a type of mass spectrometry where the sample is ionized in a plasma (a partially ionized gas, such as Argon, containing free electrons) that has been generated by electromagnetic induction. A series of collectors is used to detect several ion beams simultaneously. A MC-ICPMS is a hybrid mass spectrometer that combines the advantages of an inductively coupled plasma source and the precise measurements of a magnetic sector multicollector mass spectrometer. The primary advantage of the MC-ICPMS is its ability to analyze a broader range of elements, including those with high ionization potential that are difficult to analyze by Thermal Ionization Mass Spectrometry (TIMS). The ICP source also allows flexibility in how samples are introduced to the mass spectrometer and allows the analysis of samples introduced either as an aspirated solution or as an aerosol produced by laser ablation.

Dataset-specific Instrument Name	Niskin bottle
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.

Dataset-specific Instrument Name	VG PlasmaQuad ExCell® quadrupole ICP-MS
Generic Instrument Name	Quadrupole Mass Spectrometer
Dataset-specific Description	The preconcentrated REEs were measured on a VG PlasmaQuad ExCell® quadrupole ICP-MS, which was coupled to a desolvating introduction system (a CETAC Aridus™) that minimized molecular oxide ion formation with a self-aspirated Apex ST PFA micro flow nebulizer (ESI). For quality control, the LDEO lab repeatedly analyzes seawater samples from a GEOTRACES intercalibration station Bermuda Atlantic Time Series (BATS; 31.7°N, 64.1°W) in the North Atlantic at 20 m (n = 18) and 2,000 m (n = 16) (Wu et al., 2020). For the BATS 20 and 2,000 m samples, long-term external reproducibilities (2σ RSD%) range from 1.5% to 6.2%, depending on the element, using a two standard deviation filter on the data (Wu et al., 2020). Those elements showing small errors of
Generic Instrument Description	A piece of apparatus that consists of an ion source, a mass-to-charge analyser, a detector and a vacuum system and is used to measure mass spectra. The detector is a quadrupole mass-to-charge analyser, which holds the ions in a stable orbit by an electric field generated by four parallel electrodes.

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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/

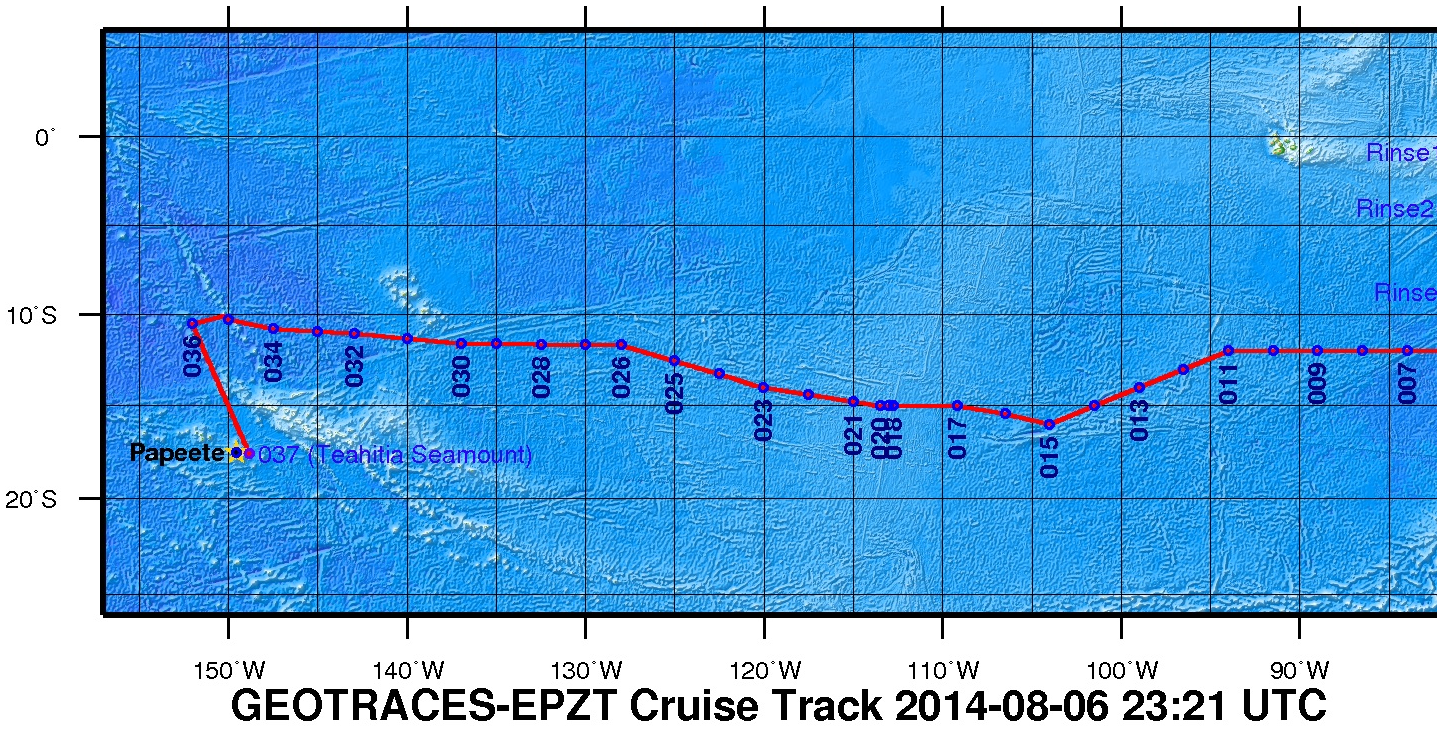
Coverage: Eastern Tropical Pacific - Transect from Peru to Tahiti (GP16)

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-EPZT Cruise Track 2014-08-06 23:21 UTC

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

Coverage: Equatorial East Pacific Zonal Trasect (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, strontrium, 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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1234687

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