Dissolved concentrations of rare earth elements (including Y) from Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1815) on R/V Roger Revelle from October to November 2018

Website: https://www.bco-dmo.org/dataset/932559
Data Type: Cruise Results
Version: 1
Version Date: 2024-07-12

Project
» US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)
» US GEOTRACES PMT: Rare earth elements, gallium, barium, and methane as indicators of internal cycling and input processes (PMT REEs Ga Ba CH4)

Program
» U.S. GEOTRACES (U.S. GEOTRACES)

Contributors	Affiliation	Role
Shiller, Alan M.	University of Southern Mississippi (USM)	Principal Investigator
Gilbert, Melissa	University of Southern Mississippi (USM)	Scientist
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset reports dissolved concentrations of rare earth elements (including Y) from Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1815) on R/V Roger Revelle from October to November 2018 along 152 W. The data include dissolved concentrations from bottle and towed fish samples. Including the data from Leg 1 (Seattle, WA to Hilo, HI), the PMT sampled margin interactions, subarctic high nutrient low chlorophyll waters, the oldest deep water in the world's oceans, the distal ends of hydrothermal plumes (Juan de Fuca Ridge and East Pacific Rise) and oxygen minimum zones, equatorial upwelling, and oligotrophic waters in the South Pacific gyre at 20°S. The rare earth element data are pertinent for studies of removal and internal cycling of trace elements, tracing material inputs, and understanding of conservative vs non-conservative tracer distributions.

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Coverage

Location: Pacific Ocean from Hawaii to Tahiti, mainly along 152 W
Spatial Extent: **N**:18.906 **E**:-151.99 **S**:-20 **W**:-155.258
Temporal Extent: 2018-10-25 - 2018-11-22

Methods & Sampling

Clean seawater samples were collected using a GEOTRACES CTD referred to as GT-C/12L GoFlo, and also from the Super-GeoFISH towed surface vehicle. For more information, see the cruise report.

Water samples were filtered through pre-cleaned, 0.2-micrometer (µm) Pall Acropak Supor filter capsules as described elsewhere (e.g., Cutter et al., 2014; Hatta et al., 2015). Filtered water was collected in 125-milliliter (mL) HDPE bottles (Nalgene) that had been precleaned by soaking in hot 1.2 M HCl (reagent grade) for at least 8 hours with subsequent thorough rinsing with ultrapure distilled deionized water (Barnstead E-pure).

Dissolved Rare Earth Elements (REEs including Y), were determined using 14 mL of sample, which was spiked with a mixture of isotopically-enriched Nd-145, Sm-149, Eu-153, Gd-155, Dy-161, Er-167, and Yb-171 (Oak Ridge National Labs). Each spike was >90% enriched in the listed isotopes. The sample/spike ratio was chosen so as to have the analytical isotope ratios approximately the geometric mean of the natural and enriched spike isotope ratios. Samples were then extracted/pre-concentrated using a SeaFAST system (Elemental Scientific, Inc.) operated in offline mode. A similar online SeaFAST extraction procedure is described by Hathorne et al., 2012. The extracted samples were subsequently analyzed using a Thermo-Fisher high-resolution ICP-MS with an Apex-FAST high-efficiency sample introduction system with Spiro desolvator (Elemental Scientific, Inc.). The instrument was operated in low resolution. The enriched isotope spikes also served to provide counts/sec calibration factors for elements that were not spiked with enriched isotopes. This calibration was also examined with a standard made in dilute nitric acid. Precision and recovery were checked by analysis of a large-volume composite seawater sample. Spiked (with a natural isotopic abundance elemental spike) and unspiked aliquots of this sample were analyzed twice in each analytical run. A Ba standard was also run to check for BaO+ interference on several isotopes and Ba in the extracted samples was also monitored. Because the extraction resin in the SeaFAST system (Nobias PA-1) discriminates against Ba, plus the reduction of the BaO+ interference by the desolvation system, BaO+ was less than 0.1% of the counts in Eu-151, Eu-153, Gd-155, and Gd-157. Tests also revealed no significant low REE oxide interference on mid-/high-REEs.

Dissolved Nd was determined in a separate seaFAST extraction, but with essentially the same methodology as the transition metals as described in related dataset "GP15 Dissolved Ba Cd Cu Ga Mn Ni and Pb Leg 2" (https://www.bco-dmo.org/dataset/836121). The samples were spiked with isotopically-enriched Nd-145. Nd was determined in low resolution.

Data Processing Description

Quality Flags:
SeaDataNet quality flags have been assigned. More information on SeaDataNet quality flags is available from GEOTRACES at https://www.geotraces.org/geotraces-quality-flag-policy/ and from SeaDataNet at https://www.seadatanet.org/Standards/Data-Quality-Control. In summary:

0 = no quality control;
1 = good value;
2 = probably good value;
3 = probably bad value;
4 = bad value;
5 = changed value;
6 = value below detection;
7 = value in excess;
8 = interpolated value;
9 = missing value;
A = value phenomenon uncertain.

BCO-DMO Processing Description

- Imported original file "RR1815_dataTemplate.xlsx" into the BCO-DMO system.
- Renamed fields to comply with BCO-DMO naming conventions.
- Created start date-time column in ISO8601 format.
- Removed unused columns: Gear_ID, End_Date_UTC, End_Time_UTC, End_Latitude, End_Longitude. (SD columns are also not used, but kept those).
- Saved the final file as "932559_v1_gp15_dissolved_rees_leg2.csv".
- Converted the Intercalibration report from .docx to .pdf and attached it as a Supplemental File named "0000-0002-2068-7909-RR1815-multiple-param-intercal-report.pdf".

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Data Files

File
932559_v1_gp15_dissolved_rees_leg2.csv (Comma Separated Values (.csv), 116.68 KB) MD5:d69e53dac66632300ad0f9584c761d6c Primary data file for dataset ID 932559, version 1

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Supplemental Files

File
0000-0002-2068-7909-RR1815-multiple-param-intercal-report_rev.pdf (Portable Document Format (.pdf), 2.09 MB) MD5:a4fdefbd277d6c10f8aa0e3730f78769 GEOTRACES Intercalibration Report for dataset 932559 (PI: Alan Shiller)

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Related Publications

Cutter, G.A., Andersson, P., Codispoti, L., Croot, P., Francois, R., Lohan, M., Obata, H., van der Loeff, M. R. (2014) Sampling and Sample-Handing Protocols for GEOTRACES Cruises (cookbook) Version 2.0; December 2014. http://www.geotraces.org/images/stories/documents/intercalibration/Cookbook_v2.pdf
Methods

Hathorne, E. C., Haley, B., Stichel, T., Grasse, P., Zieringer, M., & Frank, M. (2012). Online preconcentration ICP-MS analysis of rare earth elements in seawater. Geochemistry, Geophysics, Geosystems, 13(1), n/a–n/a. doi:10.1029/2011gc003907 https://doi.org/10.1029/2011GC003907
Methods

Hatta, M., Measures, C. I., Wu, J., Roshan, S., Fitzsimmons, J. N., Sedwick, P., & Morton, P. (2015). An overview of dissolved Fe and Mn distributions during the 2010–2011 U.S. GEOTRACES north Atlantic cruises: GEOTRACES GA03. Deep Sea Research Part II: Topical Studies in Oceanography, 116, 117–129. doi:10.1016/j.dsr2.2014.07.005
Methods

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Related Datasets

Continues

Shiller, A. M., Gilbert, M. (2024) **Dissolved concentrations of rare earth elements (including Y) from Leg 1 of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from September to October 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-07-11 doi:10.26008/1912/bco-dmo.932161.1 [view at BCO-DMO]
Relationship Description: GP15 was made up of two cruise legs, RR1814 (Leg 1) and RR1815 (Leg 2)

IsRelatedTo

Shiller, A. M. (2024) **Dissolved concentrations of Ba, Cd, Cu, Ga, Mn, Ni, and Pb from Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1815) on R/V Roger Revelle from Oct-Nov 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 3) Version Date 2024-07-16 doi:10.26008/1912/bco-dmo.836121.3 [view at BCO-DMO]

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Parameters

Parameter	Description	Units

Station_ID	Station number	unitless
Event_ID	Event number	unitless
Start_ISO_DateTime_UTC	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 at start of sampling event	decimal degrees
Start_Longitude	Longitude at start of sampling event	decimal degrees
Rosette_Position	Bottle position on rosette	unitless
Sample_ID	Sample ID number	unitless
Sample_Depth	Sample depth	meters (m)
Y_D_CONC_BOTTLE_vbtqm7	Concentration of dissolved Y from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Y_D_CONC_BOTTLE_vbtqm7	Standard deviation of Y_D_CONC_BOTTLE_vbtqm7	picomoles per kilogram (pmol/kg)
Flag_Y_D_CONC_BOTTLE_vbtqm7	Quality flag for Y_D_CONC_BOTTLE_vbtqm7	unitless
Y_D_CONC_FISH_asoboe	Concentration of dissolved Y from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Y_D_CONC_FISH_asoboe	Standard deviation of Y_D_CONC_FISH_asoboe	picomoles per kilogram (pmol/kg)
Flag_Y_D_CONC_FISH_asoboe	Quality flag for Y_D_CONC_FISH_asoboe	unitless
La_D_CONC_BOTTLE_19sfbu	Concentration of dissolved La from bottle samples	picomoles per kilogram (pmol/kg)
SD1_La_D_CONC_BOTTLE_19sfbu	Standard deviation of La_D_CONC_BOTTLE_19sfbu	picomoles per kilogram (pmol/kg)
Flag_La_D_CONC_BOTTLE_19sfbu	Quality flag for La_D_CONC_BOTTLE_19sfbu	unitless
La_D_CONC_FISH_l1u3qy	Concentration of dissolved La from towed GeoFish samples	picomoles per kilogram (pmol/kg)

SD1_La_D_CONC_FISH_l1u3qy	Standard deviation of LLa_D_CONC_FISH_l1u3qy	picomoles per kilogram (pmol/kg)
Flag_La_D_CONC_FISH_l1u3qy	Quality flag for La_D_CONC_FISH_l1u3qy	unitless
Ce_D_CONC_BOTTLE_7r1crl	Concentration of dissolved Ce from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Ce_D_CONC_BOTTLE_7r1crl	Standard deviation of Ce_D_CONC_BOTTLE_7r1crl	picomoles per kilogram (pmol/kg)
Flag_Ce_D_CONC_BOTTLE_7r1crl	Quality flag for Ce_D_CONC_BOTTLE_7r1crl	unitless
Ce_D_CONC_FISH_nrzhse	Concentration of dissolved Ce from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Ce_D_CONC_FISH_nrzhse	Standard deviation of Ce_D_CONC_FISH_nrzhse	picomoles per kilogram (pmol/kg)
Flag_Ce_D_CONC_FISH_nrzhse	Quality flag for Ce_D_CONC_FISH_nrzhse	unitless
Pr_D_CONC_BOTTLE_kytybd	Concentration of dissolved Pr from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Pr_D_CONC_BOTTLE_kytybd	Standard deviation of Pr_D_CONC_BOTTLE_kytybd	picomoles per kilogram (pmol/kg)
Flag_Pr_D_CONC_BOTTLE_kytybd	Quality flag for Pr_D_CONC_BOTTLE_kytybd	unitless
Pr_D_CONC_FISH_xp0hyb	Concentration of dissolved Pr from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Pr_D_CONC_FISH_xp0hyb	Standard deviation of Pr_D_CONC_FISH_xp0hyb	picomoles per kilogram (pmol/kg)
Flag_Pr_D_CONC_FISH_xp0hyb	Quality flag for Pr_D_CONC_FISH_xp0hyb	unitless
Nd_D_CONC_BOTTLE_4vjjtn	Concentration of dissolved Nd from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Nd_D_CONC_BOTTLE_4vjjtn	Standard deviation of Nd_D_CONC_BOTTLE_4vjjtn	picomoles per kilogram (pmol/kg)
Flag_Nd_D_CONC_BOTTLE_4vjjtn	Quality flag for Nd_D_CONC_BOTTLE_4vjjtn	unitless
Nd_D_CONC_FISH_ea16lv	Concentration of dissolved Nd from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Nd_D_CONC_FISH_ea16lv	Standard deviation of Nd_D_CONC_FISH_ea16lv	picomoles per kilogram (pmol/kg)
Flag_Nd_D_CONC_FISH_ea16lv	Quality flag for Nd_D_CONC_FISH_ea16lv	unitless

Sm_D_CONC_BOTTLE_4ekw3t	Concentration of dissolved Sm from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Sm_D_CONC_BOTTLE_4ekw3t	Standard deviation of Sm_D_CONC_BOTTLE_4ekw3t	picomoles per kilogram (pmol/kg)
Flag_Sm_D_CONC_BOTTLE_4ekw3t	Quality flag for Sm_D_CONC_BOTTLE_4ekw3t	unitless
Sm_D_CONC_FISH_3j9pqw	Concentration of dissolved Sm from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Sm_D_CONC_FISH_3j9pqw	Standard deviation of Sm_D_CONC_FISH_3j9pqw	picomoles per kilogram (pmol/kg)
Flag_Sm_D_CONC_FISH_3j9pqw	Quality flag for Sm_D_CONC_FISH_3j9pqw	unitless
Eu_D_CONC_BOTTLE_vbw6j8	Concentration of dissolved Eu from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Eu_D_CONC_BOTTLE_vbw6j8	Standard deviation of Eu_D_CONC_BOTTLE_vbw6j8	picomoles per kilogram (pmol/kg)
Flag_Eu_D_CONC_BOTTLE_vbw6j8	Quality flag for Eu_D_CONC_BOTTLE_vbw6j8	unitless
Eu_D_CONC_FISH_60umzp	Concentration of dissolved Eu from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Eu_D_CONC_FISH_60umzp	Standard deviation of Eu_D_CONC_FISH_60umzp	picomoles per kilogram (pmol/kg)
Flag_Eu_D_CONC_FISH_60umzp	Quality flag for Eu_D_CONC_FISH_60umzp	unitless
Gd_D_CONC_BOTTLE_fgu3vr	Concentration of dissolved Gd from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Gd_D_CONC_BOTTLE_fgu3vr	Standard deviation of Gd_D_CONC_BOTTLE_fgu3vr	picomoles per kilogram (pmol/kg)
Flag_Gd_D_CONC_BOTTLE_fgu3vr	Quality flag for Gd_D_CONC_BOTTLE_fgu3vr	unitless
Gd_D_CONC_FISH_vv3b0x	Concentration of dissolved Gd from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Gd_D_CONC_FISH_vv3b0x	Standard deviation of Gd_D_CONC_FISH_vv3b0x	picomoles per kilogram (pmol/kg)
Flag_Gd_D_CONC_FISH_vv3b0x	Quality flag for Gd_D_CONC_FISH_vv3b0x	unitless
Tb_D_CONC_BOTTLE_whliao	Concentration of dissolved Tb from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Tb_D_CONC_BOTTLE_whliao	Standard deviation of Tb_D_CONC_BOTTLE_whliao	picomoles per kilogram (pmol/kg)

Flag_Tb_D_CONC_BOTTLE_whliao	Quality flag for Tb_D_CONC_BOTTLE_whliao	unitless
Tb_D_CONC_FISH_j519ko	Concentration of dissolved Tb from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Tb_D_CONC_FISH_j519ko	Standard deviation of Tb_D_CONC_FISH_j519ko	picomoles per kilogram (pmol/kg)
Flag_Tb_D_CONC_FISH_j519ko	Quality flag for Tb_D_CONC_FISH_j519ko	unitless
Dy_D_CONC_BOTTLE_qhjczn	Concentration of dissolved Dy from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Dy_D_CONC_BOTTLE_qhjczn	Standard deviation of Dy_D_CONC_BOTTLE_qhjczn	picomoles per kilogram (pmol/kg)
Flag_Dy_D_CONC_BOTTLE_qhjczn	Quality flag for Dy_D_CONC_BOTTLE_qhjczn	unitless
Dy_D_CONC_FISH_drvjhn	Concentration of dissolved Dy from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Dy_D_CONC_FISH_drvjhn	Standard deviation of Dy_D_CONC_FISH_drvjhn	picomoles per kilogram (pmol/kg)
Flag_Dy_D_CONC_FISH_drvjhn	Quality flag for Dy_D_CONC_FISH_drvjhn	unitless
Ho_D_CONC_BOTTLE_qafdfm	Concentration of dissolved Ho from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Ho_D_CONC_BOTTLE_qafdfm	Standard deviation of Ho_D_CONC_BOTTLE_qafdfm	picomoles per kilogram (pmol/kg)
Flag_Ho_D_CONC_BOTTLE_qafdfm	Quality flag for Ho_D_CONC_BOTTLE_qafdfm	unitless
Ho_D_CONC_FISH_gjxtdt	Concentration of dissolved Ho from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Ho_D_CONC_FISH_gjxtdt	Standard deviation of Ho_D_CONC_FISH_gjxtdt	picomoles per kilogram (pmol/kg)
Flag_Ho_D_CONC_FISH_gjxtdt	Quality flag for Ho_D_CONC_FISH_gjxtdt	unitless
Er_D_CONC_BOTTLE_dxdypm	Concentration of dissolved Er from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Er_D_CONC_BOTTLE_dxdypm	Standard deviation of Er_D_CONC_BOTTLE_dxdypm	picomoles per kilogram (pmol/kg)
Flag_Er_D_CONC_BOTTLE_dxdypm	Quality flag for Er_D_CONC_BOTTLE_dxdypm	unitless

Er_D_CONC_FISH_flv4pg	Concentration of dissolved Er from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Er_D_CONC_FISH_flv4pg	Standard deviation of Er_D_CONC_FISH_flv4pg	picomoles per kilogram (pmol/kg)
Flag_Er_D_CONC_FISH_flv4pg	Quality flag for Er_D_CONC_FISH_flv4pg	unitless
Tm_D_CONC_BOTTLE_d8qf2f	Concentration of dissolved Tm from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Tm_D_CONC_BOTTLE_d8qf2f	Standard deviation of Tm_D_CONC_BOTTLE_d8qf2f	picomoles per kilogram (pmol/kg)
Flag_Tm_D_CONC_BOTTLE_d8qf2f	Quality flag for Tm_D_CONC_BOTTLE_d8qf2f	unitless
Tm_D_CONC_FISH_vshlpq	Concentration of dissolved Tm from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Tm_D_CONC_FISH_vshlpq	Standard deviation of Tm_D_CONC_FISH_vshlpq	picomoles per kilogram (pmol/kg)
Flag_Tm_D_CONC_FISH_vshlpq	Quality flag for Tm_D_CONC_FISH_vshlpq	unitless
Yb_D_CONC_BOTTLE_aebv5r	Concentration of dissolved Yb from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Yb_D_CONC_BOTTLE_aebv5r	Standard deviation of Yb_D_CONC_BOTTLE_aebv5r	picomoles per kilogram (pmol/kg)
Flag_Yb_D_CONC_BOTTLE_aebv5r	Quality flag for Yb_D_CONC_BOTTLE_aebv5r	unitless
Yb_D_CONC_FISH_7thabf	Concentration of dissolved Yb from towed GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Yb_D_CONC_FISH_7thabf	Standard deviation of Yb_D_CONC_FISH_7thabf	picomoles per kilogram (pmol/kg)
Flag_Yb_D_CONC_FISH_7thabf	Quality flag for Yb_D_CONC_FISH_7thabf	unitless
Lu_D_CONC_BOTTLE_dgzysp	Concentration of dissolved Lu from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Lu_D_CONC_BOTTLE_dgzysp	Standard deviation of Lu_D_CONC_BOTTLE_dgzysp	picomoles per kilogram (pmol/kg)
Flag_Lu_D_CONC_BOTTLE_dgzysp	Quality flag for Lu_D_CONC_BOTTLE_dgzysp	unitless
Lu_D_CONC_FISH_jcdlov	Concentration of dissolved Lu from towed GeoFish samples	picomoles per kilogram (pmol/kg)

SD1_Lu_D_CONC_FISH_jcdlov	Standard deviation of Lu_D_CONC_FISH_jcdlov	picomoles per kilogram (pmol/kg)
Flag_Lu_D_CONC_FISH_jcdlov	Quality flag for Lu_D_CONC_FISH_jcdlov	unitless

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Instruments

Dataset-specific Instrument Name	Super-GeoFISH towed surface vehicle
Generic Instrument Name	GeoFish Towed near-Surface Sampler
Generic Instrument Description	The GeoFish towed sampler is a custom designed near surface (

Dataset-specific Instrument Name	GT-C/12L GoFlo
Generic Instrument Name	GO-FLO Bottle
Generic Instrument Description	GO-FLO bottle cast used to collect water samples for pigment, nutrient, plankton, etc. The GO-FLO sampling bottle is specially designed 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	SeaFAST system (Elemental Scientific, Inc.)
Generic Instrument Name	SeaFAST Automated Preconcentration System
Generic Instrument Description	The seaFAST is an automated sample introduction system for analysis of seawater and other high matrix samples for analyses by ICPMS (Inductively Coupled Plasma Mass Spectrometry).

Dataset-specific Instrument Name	Thermo-Fisher high resolution ICP-MS
Generic Instrument Name	Thermo Scientific ELEMENT XR high resolution inductively coupled plasma mass spectrometer
Dataset-specific Description	Thermo-Fisher high resolution ICP-MS with an Apex-FAST high efficiency sample introduction system with Spiro desolvator (Elemental Scientific, Inc.)
Generic Instrument Description	A high-resolution (HR) inductively coupled plasma (ICP) mass spectrometer (MS) composed of a dual mode secondary electron multiplier (SEM) and a Faraday detector. The ELEMENT XR instrument has a dynamic range of 5 x 10^7 to 1 x 10^12 counts per second (cps), and allows simultaneous measurement of elements at concentrations over 1000 ug/g.

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Deployments

RR1815

Website	https://www.bco-dmo.org/deployment/776917
Platform	R/V Roger Revelle
Report	https://datadocs.bco-dmo.org/docs/geotraces/GEOTRACES_PMT/casciotti/data_docs/GP15_Cruise_Report_with_ODF_Report.pdf
Start Date	2018-10-24
End Date	2018-11-24
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RR1815

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Project Information

US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)

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

Coverage: Pacific Meridional Transect along 152W (GP15)

A 60-day research cruise took place in 2018 along a transect form Alaska to Tahiti at 152° W. A description of the project titled "*Collaborative Research: Management and implementation of the US GEOTRACES Pacific Meridional Transect*", funded by NSF, is below. Further project information is available on the US GEOTRACES website and on the cruise blog. A detailed cruise report is also available as a PDF.

Description from NSF award abstract:
GEOTRACES is a global effort in the field of Chemical Oceanography in which the United States plays a major role. The goal of the GEOTRACES program is to understand the distributions of many elements and their isotopes in the ocean. Until quite recently, these elements could not be measured at a global scale. Understanding the distributions of these elements and isotopes will increase the understanding of processes that shape their distributions and also the processes that depend on these elements. For example, many "trace elements" (elements that are present in very low amounts) are also important for life, and their presence or absence can play a vital role in the population of marine ecosystems. This project will launch the next major U.S. GEOTRACES expedition in the Pacific Ocean between Alaska and Tahiti. The award made here would support all of the major infrastructure for this expedition, including the research vessel, the sampling equipment, and some of the core oceanographic measurements. This project will also support the personnel needed to lead the expedition and collect the samples.

This project would support the essential sampling operations and infrastructure for the U.S. GEOTRACES Pacific Meridional Transect along 152° W to support a large variety of individual science projects on trace element and isotope (TEI) biogeochemistry that will follow. Thus, the major objectives of this management proposal are: (1) plan and coordinate a 60 day research cruise in 2018; (2) obtain representative samples for a wide variety of TEIs using a conventional CTD/rosette, GEOTRACES Trace Element Sampling Systems, and in situ pumps; (3) acquire conventional CTD hydrographic data along with discrete samples for salinity, dissolved oxygen, algal pigments, 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 data to the GEOTRACES Data Assembly Centre (via the US BCO-DMO data center); and (6) coordinate all cruise communications between investigators, including preparation of a hydrographic report/publication. This project would also provide baseline measurements of TEIs in the Clarion-Clipperton fracture zone (~7.5°N-17°N, ~155°W-115°W) where large-scale deep sea mining is planned. Environmental impact assessments are underway in partnership with the mining industry, but the effect of mining activities on TEIs in the water column is one that could be uniquely assessed by the GEOTRACES community. In support of efforts to communicate the science to a wide audience the investigators will recruit an early career freelance science journalist with interests in marine science and oceanography to participate on the cruise and do public outreach, photography and/or videography, and social media from the ship, as well as to submit articles about the research to national media. The project would also support several graduate students.

US GEOTRACES PMT: Rare earth elements, gallium, barium, and methane as indicators of internal cycling and input processes (PMT REEs Ga Ba CH4)

Coverage: Pacific Ocean from Aleutians to Tahiti along 152 W

NSF Award Abstract:
This project involves participation in an oceanographic research cruise scheduled for mid-2018 and going from Tahiti to Alaska along 152° W in the Pacific Ocean. This cruise transect will allow for sampling of ocean waters in a wide variety of environments. These environments include the Aleutian margin (where there is significant input of continental materials), the subarctic North Pacific (where plant productivity may be limited by iron availability), deep waters of the North Pacific (which are the oldest deep waters of the ocean), as well as oxygen minimum zones, hydrothermal plumes, and equatorial waters subject to upwelling. The investigators will determine dissolved concentrations of barium (Ba), gallium (Ga), rare earth elements (REEs), and methane. These studies are pertinent to important oceanic issues including delivery of mineral dust and nutrient iron to the surface ocean (Ga), removal and internal cycling of trace elements (Ba, REEs), development of tracers of past ocean processes (Ba), and tracing sources of material (Ga, Ba, REEs, methane) including margin sources (Ba, REEs, methane). Other researchers involved in the cruise will determine additional elements and isotopes including iron (Fe), aluminum (Al), and radium isotopes (Ra). Comparing these chemical distributions is key for all of the involved research groups to test hypothesized mechanisms of element input, removal, and cycling through the ocean. These mechanisms, in turn, are pertinent to understanding the ocean's biological productivity and its role in global climate. The knowledge and experience gained from this project will be incorporated into the principle investigator's courses in oceanography. A graduate student will also be supported and trained as part of this project.

A researcher from the University of Southern Mississippi will participate in the 2018 US GEOTRACES Pacific Meridional Transect (PMT) going from Tahiti to the Aleutians along 152° W. During the cruise, samples will be collected from regions exhibiting strong margin fluxes, the subarctic HNLC waters, the oldest deep water in the world's oceans, the distal ends of hydrothermal plumes from the Juan de Fuca Ridge and East Pacific Rise as well as oxygen minimum zones, equatorial upwelling, and some of the most oligotrophic waters in the world's oceans in the South Pacific gyre at 20°S. The samples will be analyzed for dissolved gallium (Ga), barium (Ba), rare earth elements (REEs) along with dissolved methane. These studies are pertinent to important issues including delivery of mineral dust and nutrient iron to the surface ocean (Ga), removal and internal cycling of trace elements (Ba, REEs), development of paleoceanographic tracers (Ba), tracing sources of material (Ga, Ba, REEs, methane) including margin sources (Ba, REEs, methane), and understanding of conservative vs non-conservative changes in tracer distributions (Ba, REEs). Overall, the gradients in dust delivery, productivity, age of deep waters, and extent of oxygen minimum zones in the PMT provide opportunities to compare how trace element distributions are affected by these gradients and hence inform the interpretation of the distributions. The PMT will also provide the opportunity to examine evolution of chemical signals in deep and bottom waters in a basin with fewer water masses and a longer timescale of basin mixing than the Atlantic. As such, this data may provide an opportunity to tease apart conservative mixing from non-conservative biogeochemistry and will include using water mass deconvolution to estimate the conservative component of trace element distributions, element-AOU plots, and distributions of the deviations from global element-nutrient correlations. The cruise also allows extensive collaboration with other investigators. Thus, the dissolved Ga data will be compared with data obtained by colleagues on distributions of other lithogenic, rapidly-scavenged elements like aluminum (Al) and thorium-232; the dissolved Ba data will be shared with those determining radium and Ba isotopes; and, the REE data will be made available to those examining neodymium (Nd) isotopes as well as compared with other scavenging tracers such as scandium (Sc). Comparing our chemical distributions with those determined by others is key for all of the involved research groups to test hypothesized mechanisms of element input, removal, and cycling through the ocean. These mechanisms, in turn, are pertinent to understanding the ocean's biological productivity and its role in global climate.

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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-1737024

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