Dissolved concentrations of Ba, Cd, Cu, Ga, Mn, Nd, Ni, and Pb from Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from September to October 2018

Website: https://www.bco-dmo.org/dataset/835589
Data Type: Cruise Results
Version: 2
Version Date: 2021-04-01

Project
» US GEOTRACES Pacific Meridional Transect (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
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Dissolved concentrations of Ba, Cd, Cu, Ga, Mn, Nd, Ni, and Pb from Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from September to October 2018.

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Coverage

Spatial Extent: **N**:56.094 **E**:-151.999 **S**:19.681 **W**:-156.962
Temporal Extent: 2018-09-24 - 2018-10-21

Acquisition Description

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 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 mL HDPE bottles (Nalgene) that had been precleaned by soaking in hot 1.2 M HCl (reagent grade) for at least 8 h with subsequent thorough rinsing with ultrapure distilled deionized water (Barnstead E-pure).

Dissolved Ga was determined by isotope dilution ICP-MS using a ThermoFisher Element XR operated in low resolution. Samples (20-30 mL) were concentrated using a SeaFAST system; a dilute HF rinse was used for column cleaning between samples. An enriched isotope spike of known concentration was prepared using purified enriched 71Ga (99.8%), obtained from Oak Ridge National Laboratories. The substantial sample pre-concentration of this method allows for ICP-MS analysis using medium resolution which eliminates isobaric interferences including doubly charged 138Ba with 69Ga.

The reagent blank contribution to the dissolved Ga analysis is typically 0.6 pmol/kg and the detection limit (based on 3 times the standard deviation of the blank) is 0.3 pmol/kg. Repeated runs of US GEOTRACES intercalibration samples (GS and GD), in-house reference solutions, and cast overlap samples suggest a precision of ± 4%; the limit of detection for Ga was 1.5 pmol/kg. Recovery of the method, as determined by repeated analysis of a spiked and unspiked seawater sample was 100 ± 7%. See Table 1 Supplemental File for data.

Dissolved Ba was measured using a ThermoFisher Element XR Inductively Coupled Plasma Mass Spectrometer (ICP-MS) and the isotope dilution method as described by Jacquet et al. (2005). Aliquots (50 µL) of each sample were spiked with 25 µL of a 135Ba-enriched solution (~170 nM) and then diluted 30-fold with 0.2 µm ultrapure filtered water. A sample of ~93% enriched 135Ba was obtained from Oak Ridge National Laboratories for use as the enriched isotope spike. The ICP-MS was operated in low resolution and both 135Ba and 138Ba were determined. The samples were bracketed every 10 samples with a blank and the spike 135Ba solution. The volumes of the spikes, samples and dilution water were accurately assessed by calibrating each pipette by weight. The reproducibility error of this method was estimated by comparing samples collected at the same depths on different casts at the same station. For 12 pairs of these replicate samples, the average absolute deviation of 0.7 nmol/kg or typically 1.5%. Repeated runs of runs of US GEOTRACES intercalibration samples and in-house reference solutions suggest a similar precision; the limit of detection for barium was 0.7 nmol/kg. Our precision is similar to that reported by other labs for Ba (e.g., Jacquet et al., 2005). See Table 1 Supplemental File for data.

Dissolved Ni, Cu, Cd, Pb, and Mn were determined using 14 mL of sample that was spiked with a mixture of isotopically-enriched Ni-62, Cu-65, Cd-111, and Pb-207 (Oak Ridge Nat'l. 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 10-mL sample loop was employed and the elution volume was 750 µL. A similar online SeaFAST extraction procedure is described by Hathorne et al. (2012) for rare earth elements. 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.). All elements were determined in medium resolution, except Cd which was determined in low resolution. For Mn-55, the Ni and Cu spikes served as internal standards. Calibration was checked by analysis of a large-volume composite North Atlantic surface seawater sample. Spiked (with a natural isotopic abundance elemental spike) and unspiked aliquots of this sample were analyzed twice in each analytical run. Mo-98 was monitored to correct for MoO+ interference on Cd isotopes.

Dissolved Nd was determined in a separate seaFAST extraction, but with essentially the same methodology as the transition metals. The samples were spike with isotopically-enriched Nd-145. Nd was determined in low resolution.

The reproducibility error of this method was estimated by comparing samples collected at the same depths on different casts at the same station as well as by repeated measurement of GEOTRACES reference waters and an in-house standard. Recovery of the method was determined by repeated analysis of a spiked and unspiked seawater. The recoveries, precisions, and comparisons to reference waters are shown in Table 1 Supplemental File for the dissolved concentration data.

Processing Description

BCO-DMO Processing:
- renamed fields;
- added date/time fields in ISO8601 format;
- replaced all missing data values with 'nd';
- 2021-04-01 (published dataset v2) - replaced Event_ID "6544" with "6548" (for samples 12486-12508). As per the event log, 6544 was aborted and those sample numbers were used in event 6548.

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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

Jacquet, S. H. M., Dehairs, F., Cardinal, D., Navez, J., & Delille, B. (2005). Barium distribution across the Southern Ocean frontal system in the Crozet–Kerguelen Basin. Marine Chemistry, 95(3-4), 149–162. doi:10.1016/j.marchem.2004.09.002
Methods

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Related Datasets

IsContinuedBy

Shiller, A. M. (2021) **Dissolved concentrations of Ba, Cd, Cu, Ga, Mn, Nd, 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 1) Version Date 2021-01-14 doi:10.26008/1912/bco-dmo.836121.1 [view at BCO-DMO]
Relationship Description: GP15 was made up of two cruise legs, RR1814 (Leg 1) and RR1815 (Leg 2).

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Parameters

Parameter	Description	Units
Station_ID	Station number	unitless
Start_Date_UTC	Date (UTC) at start of sample collection; format: DD/MM/YYYY	unitless
Start_Time_UTC	Time (UTC) at start of sample collection; format: hhmm	unitless
Start_ISO_DateTime_UTC	Date and time (UTC) at start of sample collection; formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
End_Date_UTC	Date (UTC) at end of sample collection; format: DD/MM/YYYY	unitless
End_Time_UTC	Time (UTC) at end of sample collection; format: hhmm	unitless
End_ISO_DateTime_UTC	Date and time (UTC) at end of sample collection; formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
Start_Latitude	Latitude at start of sample collection	degrees North
Start_Longitude	Longitude at start of sample collection	degrees East
End_Latitude	Latitude at end of sample collection	degrees North

End_Longitude	Longitude at end of sample collection	degrees East
Event_ID	Event number	unitless
Sample_ID	GEOTRACES sample number	unitless
Sample_Depth	Sample depth	meters (m)
CTD_Pressure	CTD pressure	decibars (dbar)
Ba_D_CONC_BOTTLE_hndhco	Dissolved barium concentration from bottle samples	nanomoles per kilogram (nmol/kg)
SD1_Ba_D_CONC_BOTTLE_hndhco	One standard deviation of Ba_D_CONC_BOTTLE_hndhco	nanomoles per kilogram (nmol/kg)
Flag_Ba_D_CONC_BOTTLE_hndhco	SeaDataNet quality flag for Ba_D_CONC_BOTTLE_hndhco	unitless
Ba_D_CONC_FISH_nwzpfg	Dissolved barium concentration from towed GeoFISH samples	nanomoles per kilogram (nmol/kg)
SD1_Ba_D_CONC_FISH_nwzpfg	One standard deviation of Ba_D_CONC_FISH_nwzpfg	nanomoles per kilogram (nmol/kg)
Flag_Ba_D_CONC_FISH_nwzpfg	SeaDataNet quality flag for Ba_D_CONC_FISH_nwzpfg	unitless
Cd_D_CONC_BOTTLE_3qngnv	Dissolved cadmium from bottle samples	nanomoles per kilogram (nmol/kg)
SD1_Cd_D_CONC_BOTTLE_3qngnv	One standard deviation of Cd_D_CONC_BOTTLE_3qngnv	nanomoles per kilogram (nmol/kg)
Flag_Cd_D_CONC_BOTTLE_3qngnv	SeaDataNet quality flag for Cd_D_CONC_BOTTLE_3qngnv	unitless
Cd_D_CONC_FISH_rysl9e	Dissolved cadmium from towed GeoFISH samples	nanomoles per kilogram (nmol/kg)
SD1_Cd_D_CONC_FISH_rysl9e	One standard deviation of Cd_D_CONC_FISH_rysl9e	nanomoles per kilogram (nmol/kg)
Flag_Cd_D_CONC_FISH_rysl9e	SeaDataNet quality flag for Cd_D_CONC_FISH_rysl9e	unitless
Cu_D_CONC_BOTTLE_l8pofx	Dissolved copper from bottle samples	nanomoles per kilogram (nmol/kg)
SD1_Cu_D_CONC_BOTTLE_l8pofx	One standard deviation of Cu_D_CONC_BOTTLE_l8pofx	nanomoles per kilogram (nmol/kg)
Flag_Cu_D_CONC_BOTTLE_l8pofx	SeaDataNet quality flag for Cu_D_CONC_BOTTLE_l8pofx	unitless
Cu_D_CONC_FISH_lkwnfb	Dissolved copper from towed GeoFISH samples	nanomoles per kilogram (nmol/kg)
SD1_Cu_D_CONC_FISH_lkwnfb	One standard deviation of Cu_D_CONC_FISH_lkwnfb	nanomoles per kilogram (nmol/kg)
Flag_Cu_D_CONC_FISH_lkwnfb	SeaDataNet quality flag for Cu_D_CONC_FISH_lkwnfb	unitless
Ga_D_CONC_BOTTLE_wbt8su	Dissolved gallium from bottle samples	picomoles per kilogram (pmol/kg)

SD1_Ga_D_CONC_BOTTLE_wbt8su	One standard deviation of Ga_D_CONC_BOTTLE_wbt8su	picomoles per kilogram (pmol/kg)
Flag_Ga_D_CONC_BOTTLE_wbt8su	SeaDataNet quality flag for Ga_D_CONC_BOTTLE_wbt8su	unitless
Ga_D_CONC_FISH_ucndh3	Dissolved gallium from towed GeoFISH samples	picomoles per kilogram (pmol/kg)
SD1_Ga_D_CONC_FISH_ucndh3	One standard deviation of Ga_D_CONC_FISH_ucndh3	picomoles per kilogram (pmol/kg)
Flag_Ga_D_CONC_FISH_ucndh3	SeaDataNet quality flag for Ga_D_CONC_FISH_ucndh3	unitless
Mn_D_CONC_BOTTLE_s3mevt	Dissolved manganese from bottle samples	nanomoles per kilogram (nmol/kg)
SD1_Mn_D_CONC_BOTTLE_s3mevt	One standard deviation of Mn_D_CONC_BOTTLE_s3mevt	nanomoles per kilogram (nmol/kg)
Flag_Mn_D_CONC_BOTTLE_s3mevt	SeaDataNet quality flag for Mn_D_CONC_BOTTLE_s3mevt	unitless
Mn_D_CONC_FISH_0k2rmu	Dissolved manganese from towed GeoFISH samples	nanomoles per kilogram (nmol/kg)
SD1_Mn_D_CONC_FISH_0k2rmu	One standard deviation of Mn_D_CONC_FISH_0k2rmu	nanomoles per kilogram (nmol/kg)
Flag_Mn_D_CONC_FISH_0k2rmu	SeaDataNet quality flag for Mn_D_CONC_FISH_0k2rmu	unitless
Nd_D_CONC_BOTTLE_cfkxfb	Dissolved neodymium from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Nd_D_CONC_BOTTLE_cfkxfb	One standard deviation of Nd_D_CONC_BOTTLE_cfkxfb	picomoles per kilogram (pmol/kg)
Flag_Nd_D_CONC_BOTTLE_cfkxfb	SeaDataNet quality flag for Nd_D_CONC_BOTTLE_cfkxfb	unitless
Nd_D_CONC_FISH_xs9ega	Dissolved neodymium from towed GeoFISH samples	picomoles per kilogram (pmol/kg)
SD1_Nd_D_CONC_FISH_xs9ega	One standard deviation of Nd_D_CONC_FISH_xs9ega	picomoles per kilogram (pmol/kg)
Flag_Nd_D_CONC_FISH_xs9ega	SeaDataNet quality flag for Nd_D_CONC_FISH_xs9ega	unitless
Ni_D_CONC_BOTTLE_9xta6d	Dissolved nickel from bottle samples	nanomoles per kilogram (nmol/kg)
SD1_Ni_D_CONC_BOTTLE_9xta6d	One standard deviation of Ni_D_CONC_BOTTLE_9xta6d	nanomoles per kilogram (nmol/kg)
Flag_Ni_D_CONC_BOTTLE_9xta6d	SeaDataNet quality flag for Ni_D_CONC_BOTTLE_9xta6d	unitless
Ni_D_CONC_FISH_yj7vul	Dissolved nickel from towed GeoFISH samples	nanomoles per kilogram (nmol/kg)

SD1_Ni_D_CONC_FISH_yj7vul	One standard deviation of Ni_D_CONC_FISH_yj7vul	nanomoles per kilogram (nmol/kg)
Flag_Ni_D_CONC_FISH_yj7vul	SeaDataNet quality flag for Ni_D_CONC_FISH_yj7vul	unitless
Pb_D_CONC_BOTTLE_xtsjbw	Dissolved lead from bottle samples	nanomoles per kilogram (nmol/kg)
SD1_Pb_D_CONC_BOTTLE_xtsjbw	One standard deviation of Pb_D_CONC_BOTTLE_xtsjbw	nanomoles per kilogram (nmol/kg)
Flag_Pb_D_CONC_BOTTLE_xtsjbw	SeaDataNet quality flag for Pb_D_CONC_BOTTLE_xtsjbw	unitless
Pb_D_CONC_FISH_ugbi36	Dissolved lead from towed GeoFISH samples	nanomoles per kilogram (nmol/kg)
SD1_Pb_D_CONC_FISH_ugbi36	One standard deviation of Pb_D_CONC_FISH_ugbi36	nanomoles per kilogram (nmol/kg)
Flag_Pb_D_CONC_FISH_ugbi36	SeaDataNet quality flag for Pb_D_CONC_FISH_ugbi36	unitless

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Instruments

Dataset-specific Instrument Name	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	ThermoFisher Element XR
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	High resolution inductively coupled plasma mass spectrometer, Element XR, ThermoFisher
Generic Instrument Description	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.

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	SeaFAST system
Generic Instrument Name	SeaFAST Automated Preconcentration System
Dataset-specific Description	Automated Preconcentration System for Undiluted Seawater, seaFAST, Elemental Scientific.
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).

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Deployments

RR1814

Website	https://www.bco-dmo.org/deployment/776913
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	2018-09-18
End Date	2018-10-21

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Project Information

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

Website: http://www.usgeotraces.org/USGEOTRACES_website/html/pacific-alaska.html

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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