Dissolved copper, nickel, manganese, and vanadium from GeoFISH and bottle samples during the R/V Thomas G. Thompson cruise TN303 (GP16) from Peru to Tahiti in 2013 (U.S. GEOTRACES EPZT project)

Website: https://www.bco-dmo.org/dataset/648030
Data Type: Cruise Results
Version: 1
Version Date: 2016-12-20

Project
» U.S. GEOTRACES East Pacific Zonal Transect (GP16) (U.S. GEOTRACES EPZT)
» Geotraces Pacific Section: Gallium, vanadium, and associated elements indicative of dust input and redox cycling (EPZT_Ga_V_others)

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

Contributors	Affiliation	Role
Shiller, Alan M.	University of Southern Mississippi (USM)	Principal Investigator, Contact
Allison, Dicky	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Dissolved copper, nickel, manganese, and vanadium from GeoFISH and bottle samples during the R/V Thomas G. Thompson cruise TN303 (GP16) from Peru to Tahiti in 2013.

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Coverage

Spatial Extent: **N**:-10.224 **E**:-77.3761 **S**:-16.0006 **W**:-152.079
Temporal Extent: 2013-10-28 - 2013-12-17

Dataset Description

Dissolved copper, nickel, manganese, and vanadium concentrations from samples taken at EPZT GEOTRACES stations using the Super-GeoFISH towed surface sampler and bottle samples from the GEOTRACES CTD carousel.

Methods & Sampling

Clean seawater samples were collected from two sources; a GEOTRACES CTD referred to as GT-C/12L GoFlo, and the Super-GeoFISH towed surface vehicle. For more information on these methods, see the cruise report (Supplemental File) and the GeoFish description (under Instruments).

Water column samples were filtered through pre-cleaned, 0.2 µm Pall Acropak Supor filter capsules as described elsewhere (e.g., Cutter et al., 2012; Hatta et al., 2015). Near surface water samples were collected using an underway towed-fish pumped seawater system (Bruland et al., 2005) with samples filtered through sequential 0.45 µm Osmonics and 0.2 µm Polycarbonate (PCTE) cartridge filters. 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). Samples were acidified in a laminar flow bench aboard ship using 0.5 mL of ultrapure HCl per 125 mL sample.

Data Processing Description

For analysis of dissolved V, Ni, Cu, and Mn, 14 mL of sample was spiked with a mixture of isotopically-enriched Ni-62, Cu-65, and V-50 (Oak Ridge Nat'l. Labs). Each spike was >90% enriched in the listed isotopes, except for V-50 (0.25% natural abundance) which was 44.3% enriched. 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 Hawthorn 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. For Mn-55 the V, 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. Ti-47 and Cr-52 were monitored to correct for any Ti-50 or Cr-50 isobaric interference on V-50; the correction was generally <1%.

The reproducibility error of this method was estimated by comparing samples collected at the same depths on different casts at the same station. For 32 pairs of these replicate samples, the average absolute deviation was 0.8 nmol/kg or typically 2%. Repeated runs of US GEOTRACES intercalibration samples and in-house reference solutions suggest a precision of ±1.5%; the limit of detection for vanadium was ~0.5 nmol/kg. Recovery of the method, as determined by repeated analysis of a spiked and unspiked seawater sample was 99.5 ± 2.8%.

Data Version Information:

Current Version 20 Dec 2016 replaces the version from 08 Jun 2016. This change corrected V, Ni, Cu, and Mn data and data flags that were in the wrong column. They were bottle samples and they were in the fish sample columns. After consulting the master event log to confirm they were bottle samples, the values were moved to the bottle column.

BCO-DMO Processing notes:

- variable names changed to conform to GEOTRACES conventions
- split GeoFISH data and bottle sample data into separate columns so GEOTRACES naming conventions of _BOTTLE and _FISH would be appropriate
- added DEPTH_FISH to distinguish between that and CTDDEPTH
- 20 Dec 2016, moved data from station 25 cast 1 from FISH to BOTTLE columns
- 04 March 2019: removed embargo on dataset.

Additional Information (including references) can be found in GEOTRACES Intercalibration Document

Additional GEOTRACES Processing:

As was done for the GEOTRACES-NAT data, BCO-DMO added standard US GEOTRACES information, such as the US GEOTRACES event number, to each submitted dataset lacking this information. To accomplish this, BCO-DMO compiled a 'master' dataset composed of the following parameters:

cruise_id, EXPOCODE,SECT_ID, STNNBR, CASTNO, GEOTRC_EVENTNO, GEOTRC_SAMPNO, GEOTRC_INSTR, SAMPNO, GF_NO, BTLNBR, BTLNBR_FLAG_W, DATE_START_EVENT, TIME_START_EVENT, ISO_DATETIME_UTC_START_EVENT, EVENT_LAT, EVENT_LON, DEPTH_MIN, DEPTH_MAX, BTL_DATE, BTL_TIME, BTL_ISO_DATETIME_UTC, BTL_LAT, BTL_LON, ODF_CTDPRS, SMDEPTH, FMDEPTH, BTMDEPTH, CTDPRS, CTDDEPTH.

This added information will facilitate subsequent analysis and inter comparison of the datasets.

Bottle parameters in the master file were taken from the GT-C_Bottle and ODF_Bottle datasets. Non-bottle parameters, including those from GeoFish tows, Aerosol sampling, and McLane Pumps, were taken from the TN303 Event Log (version 30 Oct 2014). Where applicable, pump information was taken from the PUMP_Nuts_Sals dataset.

A standardized BCO-DMO method (called "join") was then used to merge the missing parameters to each US GEOTRACES dataset, most often by matching on GEOTRC_SAMPNO or on some unique combination of other parameters.

If the master parameters were included in the original data file and the values did not differ from the master file, the original data columns were retained and the names of the parameters were changed from the PI-submitted names to the standardized master names. If there were differences between the PI-supplied parameter values and those in the master file, both columns were retained. If the original data submission included all of the master parameters, no additional columns were added, but parameter names were modified to match the naming conventions of the master file.

See the dataset parameters documentation for a description of which parameters were supplied by the PI and which were added via the join method.

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Data Files

File
dust_elem_joined.csv (Comma Separated Values (.csv), 110.63 KB) MD5:5cb5be2a31a421e8c56fc3d1c95642fe Primary data file for dataset ID 648030

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Supplemental Files

File
EPZT Cu, Ni, Mn, V Intercalibration Report filename: Shiller_supplementary-V_Cu_Ni_Mn.pdf (Portable Document Format (.pdf), 265.70 KB) MD5:50f4e996d82a369e909fcb85db1c0a2f GEOTRACES Intercalibration report for the Cu, Ni, Mn, and V data from the EPZT (GP16) cruise; reported by PI Alan Shiller.
GEOTRACES EPZT (GT13, TN303, GP16) Cruise Report filename: GT13_EPZT_ODFReport_All.pdf (Portable Document Format (.pdf), 1.41 MB) MD5:ed968b1b4986e55f65f007c48b0237ca GEOTRACES EPZT (GT13, TN303, GP16) Cruise Report

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Parameters

Parameter	Description	Units
CRUISE_ID	Cruise identifier. TN = R/V Thomas G. Thompson.	unitless
SECT_ID	GEOTRACES cruise name.	unitless
STNNBR	Station number.	unitless
CASTNO	Cast Number	unitless
GEOTRC_SAMPNO	GEOTRACES sample number.	unitless
EVENT_LAT	Latitude at the start of the event; north is positive.	decimal degrees
EVENT_LON	Longitude at the start of the event; east is positive.	decimal degrees
CTDDEPTH	CTD bottle firing depth	meters
V_D_CONC_BOTTLE	dissolved vanadium concentration from bottle sample	nanomoles per kilogram
V_D_CONC_BOTTLE_FLAG_W	vanadium concentration WOCE convension quality flags (2: probably good data. 3: bad data that are potentially correctable. 4: bad data. 9: missing data)	unitless
Ni_D_CONC_BOTTLE	dissolved nickel concentration from bottle sample	nanomoles per kilogram
Ni_D_CONC_BOTTLE_FLAG_W	nickel concentration WOCE convension quality flags (2: probably good data. 3: bad data that are potentially correctable. 4: bad data. 9: missing data)	unitless
Cu_D_CONC_BOTTLE	dissolved copper concentration from bottle sample	nanomoles per kilogram
Cu_D_CONC_BOTTLE_FLAG_W	copper concentration WOCE convension quality flags (2: probably good data. 3: bad data that are potentially correctable. 4: bad data. 9: missing data)	unitless
Mn_D_CONC_BOTTLE	dissolved manganese concentration from bottle sample	nanomoles per kilogram
Mn_D_CONC_BOTTLE_FLAG_W	manganese concentration WOCE convension quality flags (2: probably good data. 3: bad data that are potentially correctable. 4: bad data. 9: missing data)	unitless
DEPTH_FISH	Super-GeoFISH surface vehicle sample depth	meters
V_D_CONC_FISH	dissolved vanadium concentration from Super-GeoFISH	nanomoles per kilogram
V_D_CONC_FISH_FLAG_W	vanadium concentration WOCE convension quality flags (2: probably good data. 3: bad data that are potentially correctable. 4: bad data. 9: missing data)	unitless
Ni_D_CONC_FISH	dissolved nickel concentration from Super-GeoFISH	nanomoles per kilogram
Ni_D_CONC_FISH_FLAG_W	nickel concentration WOCE convension quality flags (2: probably good data. 3: bad data that are potentially correctable. 4: bad data. 9: missing data)	unitless
Cu_D_CONC_FISH	dissolved copper concentration from Super-GeoFISH	nanomoles per kilogram
Cu_D_CONC_FISH_FLAG_W	copper concentration WOCE convension quality flags (2: probably good data. 3: bad data that are potentially correctable. 4: bad data. 9: missing data)	unitless
Mn_D_CONC_FISH	dissolved manganese concentration from Super-GeoFISH	nanomoles per kilogram
Mn_D_CONC_FISH_FLAG_W	manganese concentration WOCE convension quality flags (2: probably good data. 3: bad data that are potentially correctable. 4: bad data. 9: missing data)	unitless
ISO_DATETIME_UTC_START_EVENT	Date and time; formatted to the ISO 8601 standard; at the start of the sampling event; according to the event log. Format YYYY-MM-DDTHH:MM:SS[.xx]Z. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	unitless

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Instruments

Dataset-specific Instrument Name	FISH
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	ICP-MS
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	Samples were extracted/pre-concentrated using a SeaFAST system (Elemental Scientific, Inc.) operated in offline mode. 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.).
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	GEOTRACES CTD
Generic Instrument Name	Sea-Bird SBE 911plus CTD
Generic Instrument Description	[tethered, real-time] The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

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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)

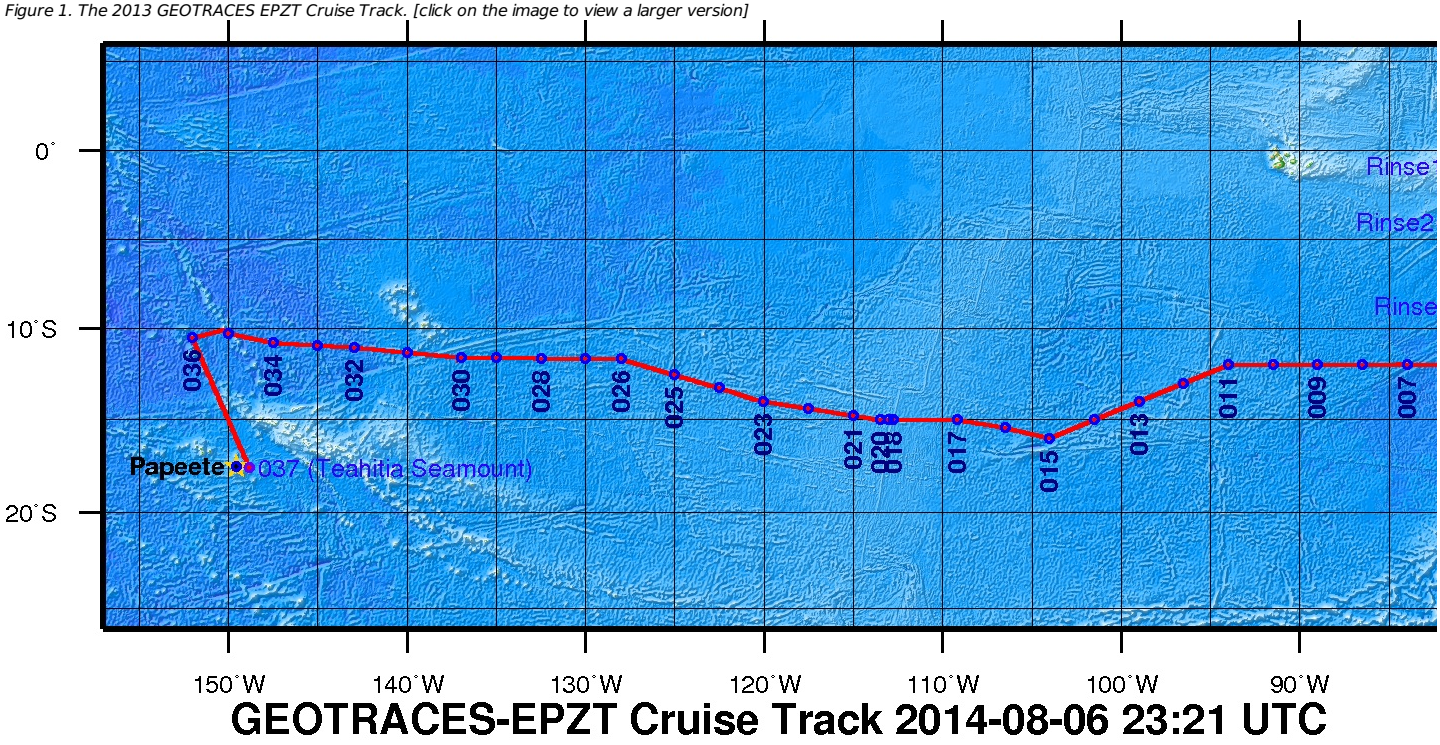
From the NSF Award Abstract
The mission of the International GEOTRACES Program (https://www.geotraces.org/), of which the U.S. chemical oceanography research community is a founding member, is "to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes 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 Pacific Section: Gallium, vanadium, and associated elements indicative of dust input and redox cycling (EPZT_Ga_V_others)

Coverage: Eastern Pacific

Extracted from the NSF award abstract:

During the 2013 GEOTRACES Eastern Pacific Zonal Section cruise, a scientist from the University of Southern Mississippi will determine the distributions of gallium (Ga) and vanadium (V), as well as V redox speciation. The planned cruise track is ideal for this effort because it will traverse various oceanic environments that influence the biogeochemistry of these elements namely, the Peru margin/upwelling zone and the associated oxygen minimum zone, gradients in atmospheric inputs and biological productivity from the Peru margin to Tahiti, and hydrothermal vents along the East Pacific Rise. Specific goals of the project include: (1) examine the discrepancy between surface water Ga and aluminum (Al) distributions and estimate dust inputs; (2) confirm the relationship observed in the North Pacific between the surface ocean Ga/Al ratio and the chlorophyll distribution; (3) compare the surface ocean manganese distribution with that of Ga, Al, and lead to differentiate between shelf and aerosol inputs; (4) determine if there is evidence of shelf V removal which contributes to the surface ocean V depletion; (5) test for hydrothermal influences on the V distribution downstream from the East Pacific Rise; and (6) compare V redox speciation with that of other elements including selenium, arsenic, and iodine as a means of examining the importance of water column reduction versus advective interactions with reducing coastal sediments. As such, the elements selected as the focus of this study, will provide information on dust input and redox cycling, especially when compared with other elements being determined by other cruise participants.

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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-1261214

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