

Water-column dissolved iron (Fe) concentrations for major stations occupied during U.S. GEOTRACES EPZT cruise (R/V Thomas G. Thompson TN303) from October to December 2013; post-cruise analyses conducted at Old Dominion University

Website: <https://www.bco-dmo.org/dataset/670285>

Data Type: Cruise Results

Version: 19 December 2016

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Project

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

» [US GEOTRACES Pacific Section-Shipboard Al, Mn and Fe](#) (EPZT Shipboard Al Mn Fe)

Program

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

Contributors	Affiliation	Role
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Dataset Description

Water-column dissolved iron concentrations for major stations occupied during U.S. GEOTRACES Eastern Pacific Zonal Transect cruise (GEOTRACES cruise GP16).

Note: These data are from post-cruise analyses conducted at Old Dominion University and supersede preliminary shipboard data "FE_DISS" in BCO-DMO file "CTD - GT-C Bottle"

Methods & Sampling

Sample collection and processing:

Water-column samples for trace metal analysis were collected in modified 12 L Teflon-lined GO-FLO samplers (General Oceanics Inc.), deployed on the U.S. GEOTRACES clean CTD rosette system with a total of 24 samplers. All samples were filtered as soon as possible after recovery by GEOTRACES sampling personnel using a 0.2 um Supor Acropak filter cartridge (Pall Corp.) inside the U.S. GEOTRACES clean-air laboratory van. Near-surface samples (~3 m depth) were collected whilst underway near each station using the Bruland-Smith "Geofish" sampling system towed outside of the ship's wake; seawater from the Geofish was pumped into a clean-air laboratory van, where it was filtered through 0.2 um Supor Acropak filter cartridges.

Dissolved iron (DFe) analysis:

The filtered seawater samples were collected in 125 mL acid-cleaned Nalgene wide-mouth low-density polyethylene bottles, acidified at-sea to pH ~1.8 with Fisher Optima grade ultrapure hydrochloric acid, and then stored at room temperature until post-cruise analysis by Bettina Sohst at Old Dominion University. Dissolved iron was determined by flow injection analysis (FIA) with colorimetric detection after in-line preconcentration on resin-immobilized 8-hydroxyquinoline (Sedwick et al., 2015), using a method modified from Measures et al. (1995). Analyses were performed on a volumetric basis, so concentrations are reported in units of nanomole liter⁻¹ (nM), which may be converted to units of nmol kg⁻¹ by assuming a mean solution density of 1.023 kg L⁻¹ at laboratory temperature. Analytical precision is estimated from multiple (separate-day) determinations of the SAFE seawater reference materials, which yield uncertainties (expressed as one relative standard deviation on the mean, or one sigma) of ~15% at the concentration level of SAFE S seawater (0.090 nM), and ~10% at the concentration level of SAFE D2 seawater (0.90 nM). The analytical limit of detection is estimated as the DFe concentration equivalent to a peak area that is three times the standard deviation on the "zero-loading blank" (or "manifold blank"), which yield a detection limit below 0.04 nM (Bowie et al., 2004). Blank contributions from the ammonium acetate sample buffer solution (added on-line during analysis) and hydrochloric acid (added after collection) are typically negligible (i.e., too low to quantify).

Intercalibration information:

A preliminary intercomparison of DFe data from the U.S. GEOTRACES EPZT cruise carried out as part of a cruise data workshop in November 2015 indicated that our shipboard DFe analyses were in some cases as much as 10-20% higher than corresponding post-cruise determinations by the other analysts, which is an issue that has been previously noted for shipboard versus post-cruise DFe measurements using FIA. Consequently, we undertook a re-analysis of all cruise samples at Old Dominion University, which yielded mostly lower values that agree more closely with the other EPZT DFe data sets. A subsequent intercalibration of EPZT DFe data for samples collected from stations 1, 11, 17, 18, 26 and 36 has been carried out by PIs Ken Bruland, Seth John, Peter Sedwick and Jingfeng Wu. At this writing (November 2016), the results of this intercalibration exercise are being evaluated by the International GEOTRACES Standards and Intercalibration Committee.

Related references:

Bowie, A. R., P. N. Sedwick, and P. J. Worsfold (2004), Analytical intercomparison between flow injection-chemiluminescence and flow injection-spectrophotometry for the determination of picomolar concentrations of iron in seawater, *Limnology & Oceanography Methods*, 2, 42-54.

Measures, C. I., J. Yuan, and J. A. Resing (1995), Determination of iron in seawater by flow injection analysis using in-line preconcentration and spectrophotometric detection. *Marine Chemistry*, 50, 3-12.

Sedwick, P. N., B. M. Sohst, S. J. Ussher, and A. R. Bowie, A. R. (2015), A zonal picture of the water column distribution of dissolved iron(II) during the US GEOTRACES North Atlantic transect cruise (GEOTRACES GA03). *Deep Sea Research Part II: Topical Studies in Oceanography*, 116, 166-175.

Data Processing Description

Data Processing:

Following subtraction of zero-loading blank values, sample concentrations were calculated using least-squares linear regressions fit to daily calibration curves obtained by additions of iron standard solutions to low-iron seawater.

BCO-DMO Processing:

- modified parameter names to conform with BCO-DMO and GEOTRACES naming conventions;
- joined to BCO-DMO EPZT master events file;
- separated TEI data into different columns for BOTTLE and FISH samples, in accordance with GEOTRACES naming conventions;
- 19 December 2016: made corrections to PI-provided depths per conversation with PI.

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, EXPCODE,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, CTDDDEPTH.

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 sample_GEOTRC 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
dFe_ODU_joined_botfish.csv (Comma Separated Values (.csv), 127.08 KB) MD5:e5aa39d8eca2c9fa59e9c31821314a8f
Primary data file for dataset ID 670285

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Parameters

Parameter	Description	Units
cruise_id	Cruise identification; added from BCO-DMO EPZT master events file.	unitless
SECT_ID	Cruise section identifier; EPZT = GEOTRACES East Pacific Zonal Transect; EXTRA = additional non-GEOTRACES samples taken on the cruise; added from BCO-DMO EPZT master events file.	unitless
STNNBR	Station number	unitless
GEOTRC_SAMPNO	Four digit U.S. GEOTRACES sample identifier, unique to each surface sample and each GO-FLO bottle sampled	unitless
depth_pi	PI-provided sample collection depth below sea surface	meters (m)
GEOTRC_EVENTNO	GEOTRACES event number; added from BCO-DMO EPZT master events file.	unitless
CASTNO	Cast number; added from BCO-DMO EPZT master events file.	unitless
SAMPNO	Sequential sample number within the cast (usually corresponds to bottle number); added from BCO-DMO EPZT master events file.	unitless
lat_pi	PI-provided latitude. Approximate position when sampling cast was started in decimal degrees N, with degrees S presented as negative values; for shallow samples (ca. 3 m) this represents approximate location of collection whilst underway using Geofish sampler.	decimal degrees
lon_pi	PI-provided longitude. Approximate position when sampling cast was started in decimal degrees E, with degrees W presented as negative values; for shallow samples (ca. 3 m) this represents approximate location of collection whilst underway using Geofish sampler.	decimal degrees
Fe_D_CONC_BOTTLE	Dissolved iron (Fe) concentration from bottle samples	nanomoles per liter (nM)
Fe_D_CONC_BOTTLE_FLAG	Quality flag for dissolved iron concentration from bottle samples, as follows: 1 = good. 2 = good; average of at least two determinations on different days. 3 = good; analyzed without preconcentration and concentration presented to one decimal place. 4 = possibly contaminated; determination anomalously high and/or significantly higher than other analysts in intercalibration. 5 = likely contaminated; shore-based determination significantly higher than shipboard determination. 6 = data are for samples from second deep cast conducted at station.	unitless
Fe_D_CONC_FISH	Dissolved iron (Fe) concentration from GeoFish samples	nanomoles per liter (nM)
Fe_D_CONC_FISH_FLAG	Quality flag for dissolved iron concentration from GeoFish samples, as follows: 1 = good. 2 = good; average of at least two determinations on different days. 3 = good; analyzed without preconcentration and concentration presented to one decimal place. 4 = possibly contaminated; determination anomalously high and/or significantly higher than other analysts in intercalibration. 5 = likely contaminated; shore-based determination significantly higher than shipboard determination. 6 = data are for samples from second deep cast conducted at station.	unitless
GEOTRC_INSTR	Sampling instrument; added from BCO-DMO EPZT master events file.	unitless
GFISH_NO	GeoFish tow number; added from BCO-DMO EPZT master events file.	unitless
BTLNBR	Bottle number; typically 1-24; added from BCO-DMO EPZT master events file.	unitless
BTLNBR_FLAG_W	Bottle number quality flag; follows WOCE conventions. 2 = good; 3 = questionable; 4 = bad; 9 = missing data; added from BCO-DMO EPZT master events file.	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; added from BCO-DMO EPZT master events file.	YYYY-MM-DDTHH:MM:SS[.xx]Z
EVENT_LAT	Latitude at the start of the event; north is positive; added from BCO-DMO EPZT master events file.	decimal degrees
EVENT_LON	Longitude at the start of the event; east is positive; added from BCO-DMO EPZT master events file.	decimal degrees
BTL_ISO_DATETIME.UTC	Date and time, formatted to the ISO 8601 standard, at the time of bottle firing; added from BCO-DMO EPZT master events file.	YYYY-MM-DDTHH:MM:SS[.xx]Z
BTL_LAT	Latitude of bottle firing; north is positive; added from BCO-DMO EPZT master events file.	decimal degrees
BTL_LON	Longitude of bottle firing; east is positive; added from BCO-DMO EPZT master events file.	decimal degrees
CTDPRS	CTD pressure; added from BCO-DMO EPZT master events file.	decibars
CTDDDEPTH	CTD bottle firing depth; added from BCO-DMO EPZT master events file.	meters

Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Flow Injection Analyzer
Dataset-specific Description	Dissolved iron was determined by flow injection analysis (FIA) with colorimetric detection after in-line preconcentration on resin-immobilized 8-hydroxyquinoline.
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	
Generic Instrument Name	GeoFish Towed near-Surface Sampler
Dataset-specific Description	Near-surface samples (~3 m depth) were collected whilst underway near each station using the Bruland-Smith "Geofish" sampling system towed outside of the ship's wake
Generic Instrument Description	The GeoFish towed sampler is a custom designed near surface (

Dataset-specific Instrument Name	12 L Teflon-lined GO-FLO samplers
Generic Instrument Name	GO-FLO Teflon Trace Metal Bottle
Dataset-specific Description	Water-column samples for trace metal analysis were collected in modified 12 L Teflon-lined GO-FLO samplers (General Oceanics Inc.), deployed on the U.S. GEOTRACES clean CTD rosette system with a total of 24 samplers.
Generic Instrument Description	GO-FLO Teflon-lined Trace Metal free sampling bottles are used for collecting water samples for trace metal, nutrient and pigment analysis. The GO-FLO sampling bottle is designed specifically to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

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

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

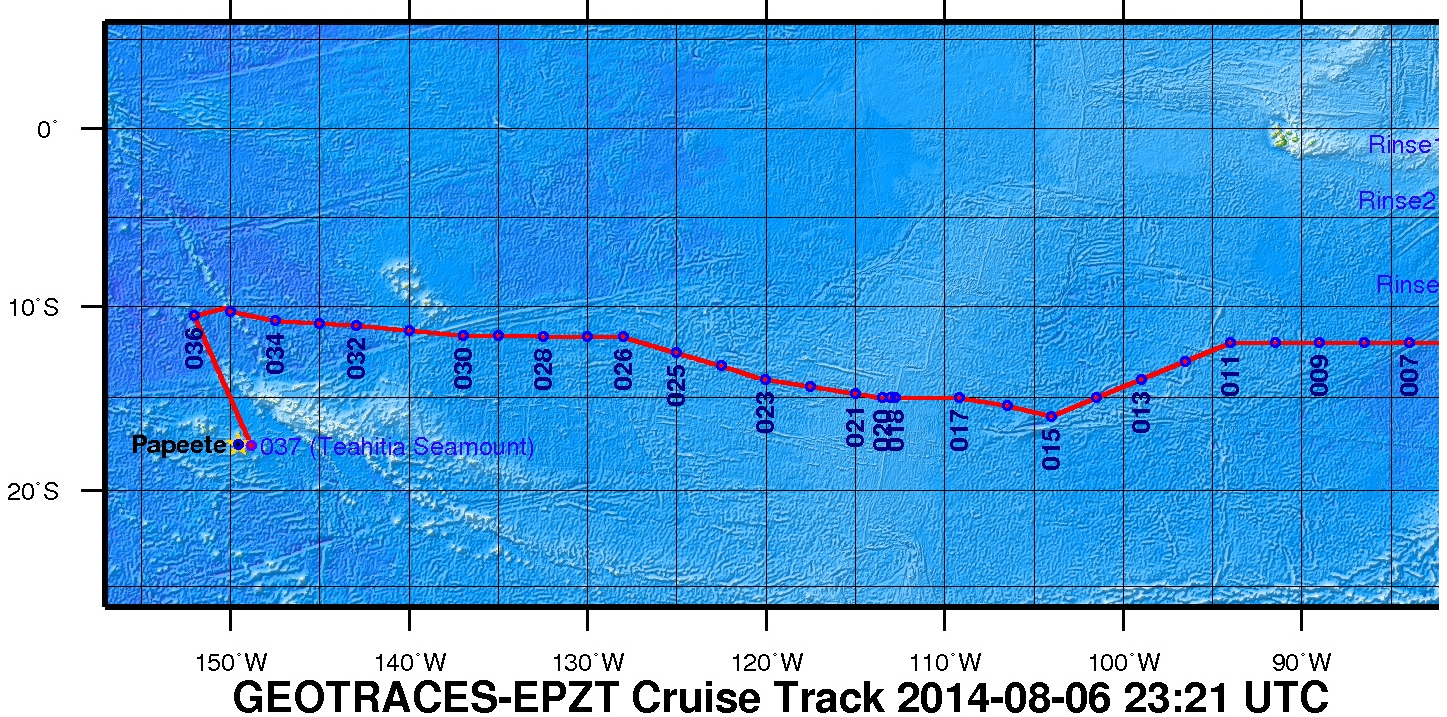
The mission of the International GEOTRACES Program (<https://www.geotraces.org/>), of which the U.S. chemical oceanography research community is a founding member, is "to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish 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]



US GEOTRACES Pacific Section-Shipboard Al, Mn and Fe (EPZT Shipboard Al Mn Fe)

Coverage: Eastern South Pacific Ocean

Description from NSF award abstract:

The 2013 GEOTRACES Eastern Pacific Zonal transect cruise will transit from the highly productive coastal upwelling region off Peru to the stratified oligotrophic waters of the South Pacific subtropical gyre on its way to Tahiti. A range of subsurface oxygen depleted water and sedimentary inputs from the Peru margin will be encountered, as well as hydrothermal vents at 15°S on the East Pacific Rise (EPR). Scientists from the University of Washington and Old Dominion University plan to analyze seawater samples for dissolved and total-dissolvable aluminum (Al), manganese (Mn), and iron (Fe) in water column samples. The dissolved Al, Mn, and Fe in samples from the upper water column (<1000 m depth) will be analyzed onboard to ensure samples being collected are uncontaminated, as well as samples from west of the EPR at hydrothermal plume depths. The shipboard analyses will be augmented by shore-based analyses of water column samples from all depths, as well as analyses of total-dissolvable Al, Mn, and Fe, which will complement the direct analyses of particulate metals undertaken by other GEOTRACES investigators. Results will be used to test the following hypotheses concerning the sources and cycling of Al, Mn and Fe in the ocean: (1) when Aeolian inputs are relatively constant, dissolved Al concentrations in surface waters vary as a function of biological production; (2) concentration maxima of dissolved Al, Mn, and Fe in subsurface waters of the Eastern Pacific oxygen minimum zone are the result of lateral transport from the continental margin by means of resuspension and remobilization; and (3) values about ambient levels with conservative behavior will be encountered in the neutrally buoyant plume about the East Pacific Rise ridge crest for dissolved Fe and Al.

As regards broader impacts, results from the study would be disseminated to the public via lectures, the internet, and press releases. One graduate and one undergraduate student from the University of Washington would be supported and trained as part of this project.

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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-1237011
NSF Division of Ocean Sciences (NSF OCE)	OCE-1237034

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