

X-ray absorption spectroscopy data for particulate iron from R/V Thomas G. Thompson cruise TN303 in the Eastern Tropical Pacific from October to December 2013

Website: <https://www.bco-dmo.org/dataset/746689>

Data Type: Cruise Results

Version: 1

Version Date: 2018-10-10

Project

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

» [Collaborative Research: GEOTRACES Pacific Section: The Geochemistry of Size-fractionated Suspended Particles Collected by In-situ Filtration](#) (EPZT Particle Geochemistry)

Program

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

Contributors	Affiliation	Role
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Lam, Phoebe J.	University of California-Santa Cruz (UCSC)	Co-Principal Investigator
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Abstract

This dataset includes x-ray absorption spectroscopy data for particulate iron from the GEOTRACES EPZT expedition on R/V Thomas G. Thompson (cruise TN303) in the Eastern Tropical Pacific from October to December 2013.

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Coverage

Spatial Extent: N:-10.5004 E:-112.75 S:-15.00033 W:-151.99952

Temporal Extent: 2013-11-21 - 2013-12-16

Methods & Sampling

The method for measuring particulate iron speciation in filter-bound hydrothermal particles has been published several times (Toner et al. 2009; 2012; 2014; 2016; Breier et al. 2012). The specific methods and analyses for this data contribution are described in Hoffman et al. 2018.

From Hoffman et al. 2018 with minor modification:

In-situ Filtration and Sample Preservation - As part of the US GEOTRACES-Eastern Pacific Zonal Transect cruise (GP16), marine particles were collected by in-situ filtration along a ~8000 km transect that includes greater than 4000 km of hydrothermally influenced waters. Samples were filtered using a custom manifold attached to the deployed dual-flow McLane pumps. The overall in-situ pump program is described by Heller et al., 2017, Lam et al., 2018, Lee et al., 2018, and Ohnemus and Lam, 2015. The filter manifold was used to collect up to four 25 mm filters simultaneously on a third, un-metered flowpath of the McLane pumps: two 0.2 μ m polycarbonate filters for analysis by Scanning Transmission X-ray Microscopy (STXM) and two 0.2 μ m polyethersulfone (PES) filters for X-ray microprobe. Shipboard, the filter manifold was opened in an anaerobic chamber (Coy Labs) to prevent exposure of the sample to ambient oxygen, and all sample processing occurred under a nitrogen-hydrogen (95% N₂, 5% H₂) atmosphere (the anaerobic chamber was located within a self-built shipboard High Efficiency Particulate Arresting (HEPA) chamber). Filters were rinsed using N₂-sparged 18.2 M Ω ·cm purified double distilled water (MilliQ) via vacuum pump to remove seasalts (the pump was located outside of the HEPA bubble with a line plumbed to the anaerobic chamber). Replicate filters were: (1) placed in acid-washed petri-slides for X-ray microprobe analysis and archiving, and (2) placed in acid-washed microfuge tubes with 0.5 mL N₂-sparged MilliQ for STXM preparation. Prior to leaving the anaerobic chamber, all samples were sealed in mylar bags with an oxygen-free atmosphere. Sample packs were then frozen at -20°C to reduce the kinetics of chemical oxidation.

Sediment Core Collection - Sediment cores were collected using a Royal Netherlands Institute for Sea Research (NIOZ) mono-corer, specifically designed to collect surface sediment samples with minimal disturbance of the sediment-water interface which was suspended from the ODF (Ocean Data Facility) CTD (conductivity, temperature, depth)-rosette for the final deep cast conducted at that station. In a shipboard cold room (4°C), the overlying seawater was syphoned off, down to ~ 0.5 cm above the 1-2 cm thick visible fluff layer. Then, the fluff layer was syphoned off, being careful not to re-suspend the consolidated sediment, and solids were separated by centrifugation within hour of sediment core recovery. The pellet of fluff material was then frozen in the tip of the 50 mL polypropylene centrifuge tubes. Shore-based splitting of the fluff layer sample was accomplished by thawing the pellet and re-suspending in pH purified water (Milli-Q water with a small volume of ultraclean NH₄OH), then removing representative sub-samples with a pipet while vortex mixing to maintain a homogeneous suspension. Prior to spectroscopic analysis, fluff layer materials were separated from aqueous solution by 0.2 μ m filtration.

Particulate Iron Speciation - The speciation of particulate Fe in filter-bound hydrothermal plume particles was measured using micro-focused X-ray fluorescence mapping (u-XRF) and micro-focused Fe 1s X-ray absorption near edge structure (uXANES) spectroscopy at beamline 10.3.2 of the Advanced Light Source (ALS), Lawrence Berkeley National Laboratory, U.S.A., with previously developed methods for marine particles (Breier et al., 2012; Lam et al., 2012; Marcus et al., 2004; Toner et al., 2009, 2012, 2016, 2014). The data for this contribution were first reported in Hoffman et al. 2018. All particles were analyzed on original polyethersulfone (PES; trademark SUPOR) filters and all sample preparation was conducted within positive pressure (N₂ or Ar) glove bags. The final step in sample preparation included application of a layer of sulfur-free mylar film (Premier Lab Supply TF-125-255) to limit exposure of the sample to ambient oxygen during analysis using the method established by Zeng et al., (2013). The monochromator was calibrated using an Fe foil XANES scan with the inflection point set to 7110.75 eV (Kraft et al., 1996). Micro-XRF and uXANES data were collected using a Canberra 7-element Ge solid-state fluorescence detector. Micro-XANES data were collected from 7012 to 7417 eV in quick-XANES mode with a single sweep of the monochromator lasting 30 s.

Data collection occurred in the following manner for each filter: (1) a large uXRF "survey" map with an area of approximately 1000 × 3000 μ m², pixels of 6 × 6 μ m², and incident energy of 10 keV was collected to measure the distribution of particles and elements on the filter; (2) "fine" uXRF sub-maps of approximately 100 × 100 μ m², pixels of 3 × 3 μ m², and incident energies spanning the Fe 1s absorption edge; and (3) Fe 1s point-XANES spectra.

Data Processing Description

Data processing: Data processing for XRF maps included deadtime correction and plotting with beamline 10.3.2 software (Marcus et al., 2004). Data processing for the XANES spectra included deadtime correction, energy calibration, pre-edge subtraction, post-edge normalization, and linear least-squares fitting with a reference database using beamline 10.3.2., Athena, SixPack, and mrfit software (Marcus et al., 2008, 2004; Ravel and Newville, 2005; Webb, 2005; Nicholas et al. 2017).

A table was generated showing the best fits to each experimental spectrum in terms of the exact reference spectra used in the best fits Table 1 "mrfit". These reference spectra

were then binned according to the type of particulate Fe they represent using the Table 2 "key" worksheet to create a "binned" (Table 3) version of the data. The final version of the data provided to BCO-DMO is the "annotated" data in Table 4. The original Excel file containing Tables 1-3 is available for reference: [BCO-DMO-Toner-TN303-particulate-iron-speciation.xlsx](#) (51 kb)

Problem report: Appearance of "native Fe" in two samples (GT# 8564 and 10160) are considered contaminants.

- BCO-DMO Processing:**
- modified parameter names (replaced spaces with underscores; removed parentheses; applied GEOTRACES naming conventions where applicable);
 - added links to spectral files from the data file names;
 - joined to EPZT master events file for location, date, and cast information.
 - This dataset has been published "as is". Final review by the data submitter was not received after the data were imported into the BCO-DMO data system.

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Data Files

File
746689_v1_partic_iron_speciation_joined.csv (Comma Separated Values (.csv), 68.11 KB) MD5:e70b89ac1f5c74952e0f11837f5982db
Primary data file for dataset ID 746689, version 1

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Supplemental Files

File
BCO-DMO-Toner-TN303-particulate-iron-speciation.xlsx (Microsoft Excel, 51.73 KB) MD5:bc96d9c1414fb884647671a62d0701ba
Supplemental file for dataset ID 746689, version 1. This is the original Excel file submitted to BCO-DMO. It contains Tables 1-3, which are described in the metadata.
Fe-XANES-data.zip (ZIP Archive (ZIP), 1.63 MB) MD5:6a0cd94a77a3bb899cb241d597cfd22
Supplemental file for dataset ID 746689, version 1; contains the spectroscopic data files (.nor format)

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Related Publications

Breier, J. A., Toner, B. M., Fakra, S. C., Marcus, M. A., White, S. N., Thurnherr, A. M., & German, C. R. (2012). Sulfur, sulfides, oxides and organic matter aggregated in submarine hydrothermal plumes at 9°50'N East Pacific Rise. *Geochimica et Cosmochimica Acta*, 88, 216–236. doi:[10.1016/j.gca.2012.04.003](#)
Methods

Heller, M. I., Lam, P. J., Moffett, J. W., Till, C. P., Lee, J.-M., Toner, B. M., & Marcus, M. A. (2017). Accumulation of Fe oxyhydroxides in the Peruvian oxygen deficient zone implies non-oxygen dependent Fe oxidation. *Geochimica et Cosmochimica Acta*, 211, 174–193. doi:[10.1016/j.gca.2017.05.019](#)
Methods

Hoffman, C. L., Nicholas, S. L., Ohnemus, D. C., Fitzsimmons, J. N., Sherrell, R. M., German, C. R., ... Toner, B. M. (2018). Near-field iron and carbon chemistry of non-buoyant hydrothermal plume particles, Southern East Pacific Rise 15°S. *Marine Chemistry*, 201, 183–197. doi:[10.1016/j.marchem.2018.01.011](#)
Methods

Kraft, S., Stümpel, J., Becker, P., & Kuetgens, U. (1996). High resolution x-ray absorption spectroscopy with absolute energy calibration for the determination of absorption edge energies. *Review of Scientific Instruments*, 67(3), 681–687. doi:[10.1063/1.1146657](#)
Methods

Lam, P. J., Lee, J.-M., Heller, M. I., Mehic, S., Xiang, Y., & Bates, N. R. (2018). Size-fractionated distributions of suspended particle concentration and major phase composition from the U.S. GEOTRACES Eastern Pacific Zonal Transect (GP16). *Marine Chemistry*, 201, 90–107. doi:[10.1016/j.marchem.2017.08.013](#)
Methods

Lam, P. J., Ohnemus, D. C., & Marcus, M. A. (2012). The speciation of marine particulate iron adjacent to active and passive continental margins. *Geochimica et Cosmochimica Acta*, 80, 108–124. doi:[10.1016/j.gca.2011.11.044](#)
Methods

Lee, J.-M., Heller, M. I., & Lam, P. J. (2018). Size distribution of particulate trace elements in the U.S. GEOTRACES Eastern Pacific Zonal Transect (GP16). *Marine Chemistry*, 201, 108–123. doi:[10.1016/j.marchem.2017.09.006](#)
Methods

Marcus, M. A., MacDowell, A. A., Celestre, R., Manceau, A., Miller, T., Padmore, H. A., & Sublett, R. E. (2004). Beamline 10.3.2 at ALS: a hard X-ray microprobe for environmental and materials sciences. *Journal of Synchrotron Radiation*, 11(3), 239–247. doi:10.1107/s0909049504005837 <https://doi.org/10.1107/S0909049504005837>
Methods

Marcus, M. A., Westphal, A. J., & Fakra, S. C. (2008). Classification of Fe-bearing species from K-edge XANES data using two-parameter correlation plots. *Journal of Synchrotron Radiation*, 15(5), 463–468. doi:10.1107/s0909049508018293 <https://doi.org/10.1107/S0909049508018293>
Methods

Nicholas, S. L., Erickson, M. L., Woodruff, L. G., Knaeble, A. R., Marcus, M. A., Lynch, J. K., & Toner, B. M. (2017). Solid-phase arsenic speciation in aquifer sediments: A micro-X-ray absorption spectroscopy approach for quantifying trace-level speciation. *Geochimica et Cosmochimica Acta*, 211, 228–255. doi:[10.1016/j.gca.2017.05.018](#)
Methods

Ohnemus, D. C., & Lam, P. J. (2015). Cycling of lithogenic marine particles in the US GEOTRACES North Atlantic transect. *Deep Sea Research Part II: Topical Studies in Oceanography*, 116, 283–302. doi:[10.1016/j.dsr2.2014.11.019](#)
Methods

Ravel, B., & Newville, M. (2005). ATHENA, ARTEMIS, HEPHAESTUS: data analysis for X-ray absorption spectroscopy using IFEFFIT. *Journal of Synchrotron Radiation*, 12(4), 537–541. doi:10.1107/s0909049505012719 <https://doi.org/10.1107/S0909049505012719>
Methods

Toner, B. M., Fakra, S. C., Manganini, S. J., Santelli, C. M., Marcus, M. A., Moffett, J. W., ... Edwards, K. J. (2009). Preservation of iron(II) by carbon-rich matrices in a hydrothermal plume. *Nature Geoscience*, 2(3), 197–201. doi:[10.1038/ngeo433](#)
Methods

Toner, B. M., German, C. R., Dick, G. J., & Breier, J. A. (2015). Deciphering the Complex Chemistry of Deep-Ocean Particles Using Complementary Synchrotron X-ray Microscope and Microprobe Instruments. *Accounts of Chemical Research*, 49(1), 128–137. doi:[10.1021/acs.accounts.5b00282](#)
Methods

Toner, B. M., Nicholas, S. L., & Wasik, J. K. C. (2014). Scaling up: fulfilling the promise of X-ray microprobe for biogeochemical research. *Environmental Chemistry*, 11(1), 4. doi:10.1071/en13162 <https://doi.org/10.1071/EN13162>
Methods

Toner, B., Marcus, M., Edwards, K., Rouxel, O., & German, C. (2012). Measuring the Form of Iron in Hydrothermal Plume Particles. *Oceanography*, 25(1), 209–212. doi:[10.5670/oceanog.2012.19](#)
Methods

Webb, S. M. (2005). SIXPack a Graphical User Interface for XAS Analysis Using IFEFFIT. Physica Scripta, 1011. doi:[10.1238/physica.topical.115a01011](https://doi.org/10.1238/physica.topical.115a01011)
Methods

Zeng, T., Arnold, W. A., & Toner, B. M. (2013). Microscale Characterization of Sulfur Speciation in Lake Sediments. Environmental Science & Technology, 47(3), 1287-1296.
doi:[10.1021/es303914q](https://doi.org/10.1021/es303914q)
Methods

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Parameters

Parameter	Description	Units
cruise_id	Cruise identification; added by BCO-DMO	unitless
GEOTRC_SAMPNO	Unique GEOTRACES sample number	unitless
GEOTRC_EVENTNO	GEOTRACES event number; joined to dataset from BCO-DMO master EPZT events file.	unitless
STNNBR	Station number	unitless
Water_column_feature	Descriptive terms for where sample was collected relative to the non-buoyant hydrothermal plume. Options include: "Above plume background" = in the water column above the well-defined non-buoyant plume; "Fluff" = the unconsolidated sediment layer suspended in seawater above sediment cores; "Near bottom background" = in the water column below the well-defined non-buoyant plume; "Plume-bottom" = within the well-defined non-buoyant plume; "Plume-middle" = within the well-defined non-buoyant plume; "Plume-top" = within the well-defined non-buoyant plume.	unitless
Filter_type	Includes description of filter diameter (25 mm), pore size (0.2 micron), and type (SUPOR is polyethersulfone, and PC is polycarbonate)	unitless
Fe_sulfide	Relative proportion of particulate iron in the form of an iron sulfide mineral	% on per atom basis
Fe_II	Relative proportion of particulate iron in the form of Fe(II)-bearing solid	% on per atom basis
Fe_III	Relative proportion of particulate iron in the form of an Fe(III)-bearing solid	% on per atom basis
native_Fe	Relative proportion of particulate iron in the form of metallic iron, considered contaminant	% on per atom basis
silicate	Relative proportion of particulate iron in the form of an iron-bearing silicate	% on per atom basis
CASTNO	Cast number; joined to dataset from BCO-DMO master EPZT events file.	unitless
SAMPNO	Sequential sample number within the cast (usually corresponds to bottle number); joined to dataset from BCO-DMO master EPZT 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. Format: YYYY-MM-DDTHH:MM:SS[.xx]Z. Joined to dataset from BCO-DMO master EPZT events file.	unitless
EVENT_LAT	Latitude at the start of the event; north is positive; joined to dataset from BCO-DMO master EPZT events file.	decimal degrees
EVENT_LON	Longitude at the start of the event; east is positive; joined to dataset from BCO-DMO master EPZT events file.	decimal degrees
GEOTRC_INSTR	Sampling instrument; joined to dataset from BCO-DMO master EPZT events file.	unitless
Data_File	Unique file name and link to file containing spectroscopic data. File extension = .nor	unitless

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Instruments

Dataset-specific Instrument Name	Mono-corer
Generic Instrument Name	Gravity Corer
Dataset-specific Description	Sediment cores were collected using a Royal Netherlands Institute for Sea Research (NIOZ) mono-corer, specifically designed to collect surface sediment samples with minimal disturbance of the sediment-water interface which was suspended from the ODF (Ocean Data Facility) CTD-rosette.
Generic Instrument Description	The gravity corer allows researchers to sample sediment layers at the bottom of lakes or oceans. The coring device is deployed from the ship and gravity carries it to the seafloor. (http://www.whoi.edu/instruments/viewInstrument.do?id=1079).

Dataset-specific Instrument Name	McLane pumps
Generic Instrument Name	McLane Pump
Dataset-specific Description	Marine particles were collected by in-situ filtration along a ~8000 km transect that includes greater than 4000 km of hydrothermally influenced waters. Samples were filtered using a custom manifold attached to the deployed dual-flow McLane pumps.
Generic Instrument Description	McLane pumps sample large volumes of seawater at depth. They are attached to a wire and lowered to different depths in the ocean. As the water is pumped through the filter, particles suspended in the ocean are collected on the filters. The pumps are then retrieved and the contents of the filters are analyzed in a lab.

Dataset-specific Instrument Name	near edge structure (uXANES) spectroscopy
Generic Instrument Name	Spectrometer
Dataset-specific Description	The speciation of particulate Fe in filter-bound hydrothermal plume particles was measured using micro-focused X-ray fluorescence mapping (u-XRF) and micro-focused Fe 1s X-ray absorption near edge structure (uXANES) spectroscopy at beamline 10.3.2 of the Advanced Light Source (ALS), Lawrence Berkeley National Laboratory, U.S.A
Generic Instrument Description	A spectrometer is an optical instrument used to measure properties of light over a specific portion of the electromagnetic spectrum.

Dataset-specific Instrument Name	micro-focused X-ray fluorescence mapping
Generic Instrument Name	X-ray fluorescence analyzer
Dataset-specific Description	The speciation of particulate Fe in filter-bound hydrothermal plume particles was measured using micro-focused X-ray fluorescence mapping (u-XRF) and micro-focused Fe 1s X-ray absorption near edge structure (uXANES) spectroscopy at beamline 10.3.2 of the Advanced Light Source (ALS), Lawrence Berkeley National Laboratory, U.S.A.
Generic Instrument Description	Instruments that identify and quantify the elemental constituents of a sample from the spectrum of electromagnetic radiation emitted by the atoms in the sample when excited by X-ray radiation.

Dataset-specific Instrument Name	Scanning Transmission X-ray Microscopy
Generic Instrument Name	X-Ray Microscope
Generic Instrument Description	An X-ray microscope uses electromagnetic radiation in the soft X-ray band to produce images of very small objects. The resolution of X-ray microscopy lies between that of the optical microscope and the electron microscope.

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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)

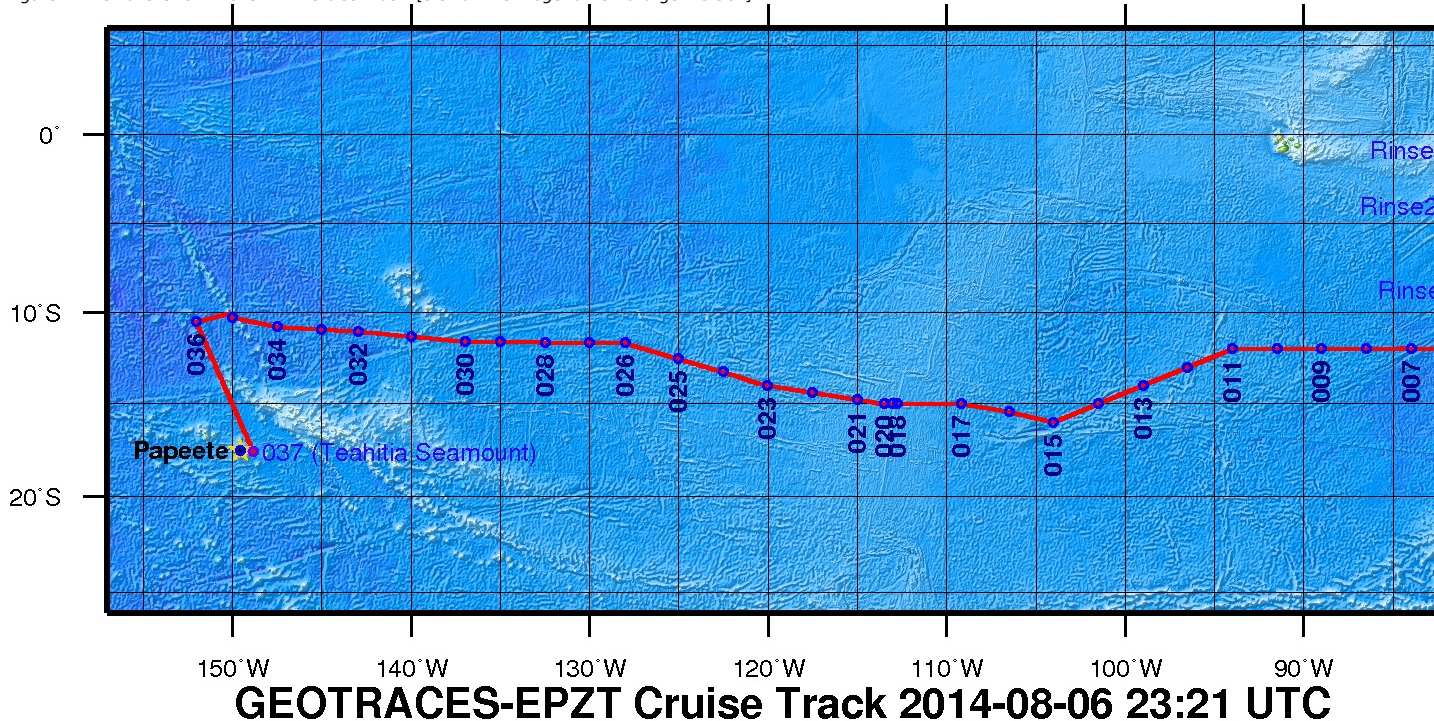
From the NSF Award Abstract

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 μ M 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]



Collaborative Research: GEOTRACES Pacific Section: The Geochemistry of Size-fractionated Suspended Particles Collected by In-situ Filtration (EPZT Particle Geochemistry)

NSF Award Abstract:

Particles play essential roles in the cycling and distribution of trace elements and isotopes (TEI). For instance scavenging onto particles and removal by particle export is a major sink for many TEIs. However the driving factors affecting the spatial extent and temporal variability of TEI scavenging remain largely unknown. The U.S. GEOTRACES East Pacific Zonal Transect between Peru and Tahiti will cross three biogeochemically important areas, setting the stage for researchers to constrain unknowns surrounding particle scavenging.

Scientists from Woods Hole Oceanographic Institution and University of Minnesota-Twin Cities will address fundamental questions on the location of particle formation, particle-dissolved species interactions, dominant particle phases, and the evolution of particle phases during transport. As regards particle phases, the researchers will measure particulate organic carbon (POC), calcium carbonate, opal, lithogenics, and oxyhydroxides, as well as the trace element compositions of size fractionated particles covering three distinct zones: large lateral productivity gradients, a major oxygen deficient zone off the coast of Peru, and a world renowned hydrothermal plume emanating from the southern East Pacific Rise. Furthermore, since previous results suggest particle type affects scavenging, investigators will specifically measure acid-leachable trace metals, particle concentration, and major particle composition. These combined measurements will allow them to disentangle the relative importance of hydrothermal particles, benthic nepheloid layers, and high productivity margins for scavenging of TEIs. The cruise transect will also offer unique opportunities to examine the speciation of Fe and POC in hydrothermal particles away from the vent field and the effects of aggregation and POC coatings on TEI partitioning.

As regards broader impacts, the researchers plan to create an educational module on particulate trace metals in the ocean which would become part of a five part GEOTRACES webinar series developed by Dr. Benjamin Twining at the Bigelow Laboratory for Ocean Sciences in collaboration with the Center for Ocean Sciences Education Excellence-Ocean Systems at the University of Maine. One graduate student from Woods Hole Oceanographic Institution and one graduate student from the University of Minnesota, Twin Cities, would be supported and trained as part of this project. In addition, an undergraduate student would participate in the research during the summer month as part of the Woods Hole Diversity Initiative Partnership in Education program.

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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-1232986

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