# Dissolved concentrations and stable isotope ratios of Fe, Zn, and Cd from Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1815) on R/V Roger Revelle from October to November 2018

**Website**: https://www.bco-dmo.org/dataset/884673
**Data Type**: Cruise Results
**Version**: 1
**Version Date**: 2022-12-06

**Project**
» US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)
» Collaborative research: US GEOTRACES PMT: Trace-metal concentrations and stable isotopes in the North Pacific (PMT TM Stable Isotopes)

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



| Contributors | Affiliation | Role |
|---|---|---|
| Conway, Timothy M. | University of South Florida (USF) | Principal Investigator |
| John, Seth G. | University of Southern California (USC) | Co-Principal Investigator |
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**Abstract**
This dataset reports dissolved (0.2µm AcroPak filter) concentrations and stable isotope ratios of iron, zinc, and cadmium (Fe, Zn, and Cd) via Nobias PA-1 extraction and MC-ICPMS analysis in water samples collected by the GTC (GEOTRACES Trace-metal clean CTD carousel) and/or surface tow fish from 23 stations along the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15) on R/V Roger Revelle from October to November 2018. The GP15 cruise sailed from September to November 2018 on a meridional transect along 152°W from Alaska to Tahiti. Concentration and isotope data were collected by Dr. Matthias Sieber and Dr. Tim Conway at the University of South Florida using a Thermo Neptune Plus MC-ICPMS. Trace metal isotope ratios are an important tool to better understand the marine cycles of trace metals and their relationship to major nutrients.

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## Coverage

**Spatial Extent**: **N**:18.906 **E**:-151.992 **S**:-20 **W**:-155.258
**Temporal Extent**: 2018-10-25 - 2018-11-22

**Methods & Sampling**

Seawater samples were collected using the GEOTRACES trace-metal clean sampling system (rosette with 24 12-liter GO-FLO bottles) or a towfish for surface samples (Cutter and Bruland, 2012). Samples were filtered through acid-cleaned AcroPak capsule filters (0.2 micrometers (µm)) into acid-cleaned LDPE bottles. For concentration and isotope analysis at the University of South Florida (USF), 2 liters of filtered seawater were collected, acidified ashore at USF by addition of 2.4 milliliters (mL) 10 molar (M) Teflon-distilled HCl, and stored for at least 12 months at pH ~2 before processing.

Seawater samples were processed for isotope analysis following Sieber et al. (2019). Briefly, a double-spike for cadmium (Cd), iron (Fe), and zinc (Zn) was added prior to batch extraction using Nobias PA-1 chelating resin, followed by purification by anion-exchange chromatography using AG-MP1 resin. Isotope analyses were performed on a Thermo Neptune Plus MC-ICPMS in the Tampa Bay Plasma Facility at the University of South Florida using an Apex-Q (Cd) or Apex Ω (Fe, Zn) introduction system.

We express Cd stable isotope ratios in delta notation ($\delta^{114}Cd$) relative to the NIST SRM-3108 Cd standard. A secondary standard, BAM-I012, was analyzed over 8 sessions on the same timescale as the samples to provide an estimate of long-term instrumental precision. We obtain a value of −1.32 ± 0.06‰ (2SD, n = 172), in agreement with consensus values (Abouchami et al., 2013). Using the 2SD of offsets from the mean of full replicate measurements based on 26 pairs of replicate analysis on separate seawater samples collected at the same depth (the GP15 sampling strategy collected overlapping samples between casts), we obtain a second estimate of external precision (0.05‰), which is similar to analytical precision. Therefore, we consider a 2SD uncertainty of 0.06‰ as a conservative estimate of analytical precision, and have applied it to all samples, except for low-concentration samples where the larger internal error is considered a more conservative estimate of uncertainty. Concentrations were calculated using the isotope dilution technique based on on-peak blank, interference and mass-bias corrected $^{114}Cd/^{111}Cd$ ratios measured simultaneously with isotope analyses (Sieber et al., 2019). We express uncertainty (1SD) on Cd concentrations as 2%, based on replicate analysis on separate seawater samples collected at the same depth (n = 26).

We express Fe stable isotope ratios in delta notation ($\delta^{56}Fe$) relative to the IRMM-014 standard. A secondary Fe standard, NIST-3126, was analyzed over 44 sessions to provide an estimate of long-term instrumental precision. We obtain a value of +0.36 ± 0.05‰ (2SD, n = 604), in agreement with consensus values (Conway et al., 2013). As a second estimate of external precision, we use the 2SD of offsets from the mean of full replicate measurements based on 26 pairs of replicate analysis using separate seawater samples collected at the same depth (0.08‰), which is similar to the analytical precision. Therefore, we consider a 2SD uncertainty of 0.05‰ as an estimate of analytical precision, and have applied it to all samples, except for low-concentration samples where the larger internal error is considered a more conservative estimate of uncertainty. Concentrations were calculated using the isotope dilution technique based on on-peak blank, interference and mass-bias corrected $^{57}Fe/^{56}Fe$ ratios measured simultaneously with isotope analysis. We express uncertainty (1SD) on Fe concentrations as 2%, based on replicate analysis on separate seawater samples collected at the same depth (n = 26).

We express Zn stable isotope ratios in delta notation ($\delta^{66}Zn$) relative to the JMC-Lyon standard. A secondary Zn standard, AA-ETH, was analyzed on the same timescale as the samples (over 10 sessions) to provide an estimate of long-term instrumental precision. We obtain a value of +0.28 ± 0.03‰ (2SD, n = 147), in agreement with consensus values (Archer et al., 2017). As a second estimate of external precision, we use the 2SD of offsets from the mean of full replicate measurements based on 26 pairs of replicate analysis using separate seawater samples collected at the same depth (0.03‰), which is similar to the analytical precision. Therefore, we consider a 2SD uncertainty of 0.03‰ as an estimate of analytical precision, and have applied it to all samples, except for low-concentration samples where the larger internal error is considered a more conservative estimate of uncertainty. Concentrations were calculated using the isotope dilution technique based on on-peak blank, interference and mass-bias corrected $^{67}Zn/^{66}Zn$ ratios measured simultaneously with isotope analysis. We express uncertainty (1SD) on Zn concentrations as 5%, based on replicate analysis on separate seawater samples collected at the same depth (n = 26).

## Data Processing Description

**Data Processing:**
Microsoft Excel was used for managing data.

Concentrations are calculated using isotope dilution. Data reduction of isotope data is based on the iterative approach of Siebert et al. (2001).

Data are assigned quality flags according to GEOTRACES Flag Policy (https://www.geotraces.org/geotraces-quality-flag-policy/); obvious outliers are marked as 4, missing data as 9, and good data as 2.

**BCO-DMO Processing:**
- moved data for station 18.6 from RR1814 to RR1815;
- changed incorrect years of 2013 and 2016 to 2018;
- for station 18.6, changed end date from 2018-10-21 to 2018-10-25;
- renamed fields to comply with BCO-DMO naming conventions;
- added start and end date-time columns in ISO 8601 format.

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## Data Files

| File |
|---|
| **884673_v1_gp15-fe-zn-cd-dissolved-and-stable-isotope-ratios-leg-2.csv** (Comma Separated Values (.csv), 85.76 KB) MD5:08b69163a7805a1825182a043213ce28<br>Primary data file for dataset ID 884673, version 1 |

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## Related Publications


Abouchami, W., Galer, S. J. G., Horner, T. J., Rehkämper, M., Wombacher, F., Xue, Z., Lambelet, M., Gault-Ringold, M., Stirling, C. H., Schönbächler, M., Shiel, A. E., Weis, D., & Holdship, P. F. (2012). A Common Reference Material for Cadmium Isotope Studies - NIST SRM 3108. Geostandards and Geoanalytical Research, 37(1), 5–17. https://doi.org/10.1111/j.1751-908x.2012.00175.x
*Methods*

Archer, C., Andersen, M. B., Cloquet, C., Conway, T. M., Dong, S., Ellwood, M., Moore, R., Nelson, J., Rehkämper, M., Rouxel, O., Samanta, M., Shin, K.-C., Sohrin, Y., Takano, S., & Wasylenki, L. (2017). Inter-calibration of a proposed new primary reference standard AA-ETH Zn for zinc isotopic analysis. Journal of Analytical Atomic Spectrometry, 32(2), 415–419. https://doi.org/10.1039/c6ja00282j https://doi.org/10.1039/C6JA00282J
*Methods*

Conway, T. M., Rosenberg, A. D., Adkins, J. F., & John, S. G. (2013). A new method for precise determination of iron, zinc and cadmium stable isotope ratios in seawater by double-spike mass spectrometry. Analytica Chimica Acta, 793, 44–52. doi:10.1016/j.aca.2013.07.025
*Methods*

Cutter, G. A., & Bruland, K. W. (2012). Rapid and noncontaminating sampling system for trace elements in global ocean surveys. Limnology and Oceanography: Methods, 10(6), 425–436. doi:10.4319/lom.2012.10.425
*Methods*

Sieber, M., Conway, T. M., de Souza, G. F., Obata, H., Takano, S., Sohrin, Y., & Vance, D. (2019). Physical and biogeochemical controls on the distribution of dissolved cadmium and its isotopes in the Southwest Pacific Ocean. Chemical Geology, 511, 494–509. doi:10.1016/j.chemgeo.2018.07.021
*Methods*


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## Related Datasets

#### Continues

Conway, T. M., John, S. G., Sieber, M. (2022) **Dissolved concentrations and stable isotope ratios of Fe, Zn, and Cd 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.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-12-06 doi:10.26008/1912/bco-dmo.883862.1 [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 | Sampling station ID | unitless |

| | | |
|---|---|---|
| Start_ISO_DateTime_UTC | Date and time (UTC) of start of sampling in ISO 8601 format | unitless |
| End_ISO_DateTime_UTC | Date and time (UTC) of end of sampling in ISO 8601 format | unitless |
| Start_Latitude | Latitude of station location | degrees North |
| Start_Longitude | Longitude of station location | degrees East |
| End_Latitude | Latitude of station location | degrees North |
| End_Longitude | Longitude of station location | degrees East |
| Cast_number | Cast number | unitless |
| Event_ID | Event number | unitless |
| Sample_ID | Unique GEOTRACES sample number | unitless |
| Sample_Depth | Sample depth | meters (m) |
| Fe_56_54_D_DELTA_BOTTLE_bodzi6 | Atom ratio of dissolved Fe isotopes expressed in conventional delta notation (from bottle samples) | per mil |
| SD2_Fe_56_54_D_DELTA_BOTTLE_bodzi6 | Error (2SD) of Fe_56_54_D_DELTA_BOTTLE_bodzi6 | per mil |
| Flag_Fe_56_54_D_DELTA_BOTTLE_bodzi6 | Quality flag for Fe_56_54_D_DELTA_BOTTLE_bodzi6 | unitless |
| Cd_D_CONC_BOTTLE_igyghz | Concentration of dissolved Cadmium (Cd) from bottle samples | nanomoles per kilogram (nmol/kg) |
| SD1_Cd_D_CONC_BOTTLE_igyghz | Error (1SD) of Cd_D_CONC_BOTTLE_igyghz | nanomoles per kilogram (nmol/kg) |
| Flag_Cd_D_CONC_BOTTLE_igyghz | Quality flag for Cd_D_CONC_BOTTLE_igyghz | unitless |
| Cd_114_110_D_DELTA_BOTTLE_ikpkep | Atom ratio of dissolved Cd isotopes expressed in conventional delta notation (from bottle samples) | per mil |
| SD2_Cd_114_110_D_DELTA_BOTTLE_ikpkep | Error (2SD) of Cd_114_110_D_DELTA_BOTTLE_ikpkep | per mil |

| | | |
|---|---|---|
| Flag_Cd_114_110_D_DELTA_BOTTLE_ikpkep | Quality flag for Cd_114_110_D_DELTA_BOTTLE_ikpkep | unitless |
| Fe_D_CONC_BOTTLE_kroefs | Concentration of dissolved Iron (Fe) from bottle samples | nanomoles per kilogram (nmol/kg) |
| SD1_Fe_D_CONC_BOTTLE_kroefs | Error (1SD) of Fe_D_CONC_BOTTLE_kroefs | nanomoles per kilogram (nmol/kg) |
| Flag_Fe_D_CONC_BOTTLE_kroefs | Quality flag for Fe_D_CONC_BOTTLE_kroefs | unitless |
| Cd_D_CONC_FISH_6fkamf | Concentration of dissolved Cadmium (Cd) from GeoFish samples | nanomoles per kilogram (nmol/kg) |
| SD1_Cd_D_CONC_FISH_6fkamf | Error (1SD) of Cd_D_CONC_FISH_6fkamf | nanomoles per kilogram (nmol/kg) |
| Flag_Cd_D_CONC_FISH_6fkamf | Quality flag for Cd_D_CONC_FISH_6fkamf | unitless |
| Zn_66_64_D_DELTA_BOTTLE_mcjbhp | Atom ratio of dissolved Zn isotopes expressed in conventional delta notation (from bottle samples) | per mil |
| SD2_Zn_66_64_D_DELTA_BOTTLE_mcjbhp | Error (2SD) of Zn_66_64_D_DELTA_BOTTLE_mcjbhp | per mil |
| Flag_Zn_66_64_D_DELTA_BOTTLE_mcjbhp | Quality flag for Zn_66_64_D_DELTA_BOTTLE_mcjbhp | unitless |
| Fe_56_54_D_DELTA_FISH_65u814 | Atom ratio of dissolved Fe isotopes expressed in conventional delta notation (from GeoFish samples) | per mil |
| SD2_Fe_56_54_D_DELTA_FISH_65u814 | Error (2SD) of Fe_56_54_D_DELTA_FISH_65u814 | per mil |
| Flag_Fe_56_54_D_DELTA_FISH_65u814 | Quality flag for Fe_56_54_D_DELTA_FISH_65u814 | unitless |
| Zn_D_CONC_BOTTLE_arrnao | Concentration of dissolved Zinc (Zn) from bottle samples | nanomoles per kilogram (nmol/kg) |
| SD1_Zn_D_CONC_BOTTLE_arrnao | Error (1SD) of Zn_D_CONC_BOTTLE_arrnao | nanomoles per kilogram (nmol/kg) |
| Flag_Zn_D_CONC_BOTTLE_arrnao | Quality flag for Zn_D_CONC_BOTTLE_arrnao | unitless |
| Zn_66_64_D_DELTA_FISH_6o34bc | Atom ratio of dissolved Zn isotopes expressed in conventional delta notation (from GeoFish samples) | per mil |
| SD2_Zn_66_64_D_DELTA_FISH_6o34bc | Error (2SD) of Zn_66_64_D_DELTA_FISH_6o34bc | per mil |

| | | |
|---|---|---|
| Flag_Zn_66_64_D_DELTA_FISH_6o34bc | Quality flag for Zn_66_64_D_DELTA_FISH_6o34bc | unitless |
| Zn_D_CONC_FISH_okrvqj | Concentration of dissolved Zinc (Zn) from GeoFish samples | nanomoles per kilogram (nmol/kg) |
| SD1_Zn_D_CONC_FISH_okrvqj | Error (1SD) of Zn_D_CONC_FISH_okrvqj | nanomoles per kilogram (nmol/kg) |
| Flag_Zn_D_CONC_FISH_okrvqj | Quality flag for Zn_D_CONC_FISH_okrvqj | unitless |
| Cd_114_110_D_DELTA_FISH_rqkhol | Atom ratio of dissolved Cd isotopes expressed in conventional delta notation (from GeoFish samples) | per mil |
| SD2_Cd_114_110_D_DELTA_FISH_rqkhol | Error (2SD) of Cd_114_110_D_DELTA_FISH_rqkhol | per mil |
| Flag_Cd_114_110_D_DELTA_FISH_rqkhol | Quality flag for Cd_114_110_D_DELTA_FISH_rqkhol | unitless |
| Fe_D_CONC_FISH_yau1bo | Concentration of dissolved Iron (Fe) from GeoFish samples | nanomoles per kilogram (nmol/kg) |
| SD1_Fe_D_CONC_FISH_yau1bo | Error (1SD) of Fe_D_CONC_FISH_yau1bo | nanomoles per kilogram (nmol/kg) |
| Flag_Fe_D_CONC_FISH_yau1bo | Quality flag for Fe_D_CONC_FISH_yau1bo | unitless |

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### Instruments

| | |
|---|---|
| **Dataset-specific Instrument Name** | towfish |
| **Generic Instrument Name** | GeoFish Towed near-Surface Sampler |
| **Dataset-specific Description** | A towfish was used to collect surface samples. |
| **Generic Instrument Description** | The GeoFish towed sampler is a custom designed near surface ( |

| | |
|---|---|
| **Dataset-specific Instrument Name** | Trace-metal clean sampling system |
| **Generic Instrument Name** | GO-FLO Teflon Trace Metal Bottle |
| **Dataset-specific Description** | A Trace-metal clean sampling system (rosette with 24 12 liter GO-FLO bottles) was used for seawater sample collection. |
| **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. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | Thermo Neptune Plus MC-ICPMS |
| **Generic Instrument Name** | Multi Collector Inductively Coupled Plasma Mass Spectrometer |
| **Dataset-specific Description** | A Thermo Neptune Plus MC-ICPMS was used for concentration and isotope analyses. |
| **Generic Instrument Description** | A Multi Collector Inductively Coupled Plasma Mass Spectrometry (MC-ICPMS) is a type of mass spectrometry where the sample is ionized in a plasma (a partially ionized gas, such as Argon, containing free electrons) that has been generated by electromagnetic induction. A series of collectors is used to detect several ion beams simultaneously. A MC-ICPMS is a hybrid mass spectrometer that combines the advantages of an inductively coupled plasma source and the precise measurements of a magnetic sector multicollector mass spectrometer. The primary advantage of the MC-ICPMS is its ability to analyze a broader range of elements, including those with high ionization potential that are difficult to analyze by Thermal Ionization Mass Spectrometry (TIMS). The ICP source also allows flexibility in how samples are introduced to the mass spectrometer and allows the analysis of samples introduced either as an aspirated solution or as an aerosol produced by laser ablation. |

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## Deployments

**RR1815**

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

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## Project Information

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

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

**Coverage**: Pacific Meridional Transect along 152W (GP15)

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

*Description from NSF award abstract:*
GEOTRACES is a global effort in the field of Chemical Oceanography in which the United States plays a major role. The goal of the GEOTRACES program is to understand the distributions of many elements and their isotopes in the ocean. Until quite recently, these elements could not be measured at a global scale. Understanding the distributions of these elements and isotopes will increase the understanding of processes that shape their distributions and also the processes that depend on these elements. For example, many "trace elements" (elements that are present in very low

amounts) are also important for life, and their presence or absence can play a vital role in the population of marine ecosystems. This project will launch the next major U.S. GEOTRACES expedition in the Pacific Ocean between Alaska and Tahiti. The award made here would support all of the major infrastructure for this expedition, including the research vessel, the sampling equipment, and some of the core oceanographic measurements. This project will also support the personnel needed to lead the expedition and collect the samples.

This project would support the essential sampling operations and infrastructure for the U.S. GEOTRACES Pacific Meridional Transect along 152° W to support a large variety of individual science projects on trace element and isotope (TEI) biogeochemistry that will follow. Thus, the major objectives of this management proposal are: (1) plan and coordinate a 60 day research cruise in 2018; (2) obtain representative samples for a wide variety of TEIs using a conventional CTD/rosette, GEOTRACES Trace Element Sampling Systems, and in situ pumps; (3) acquire conventional CTD hydrographic data along with discrete samples for salinity, dissolved oxygen, algal pigments, and dissolved nutrients at micro- and nanomolar levels; (4) ensure that proper QA/QC protocols are followed and reported, as well as fulfilling all GEOTRACES intercalibration protocols; (5) prepare and deliver all hydrographic data to the GEOTRACES Data Assembly Centre (via the US BCO-DMO data center); and (6) coordinate all cruise communications between investigators, including preparation of a hydrographic report/publication. This project would also provide baseline measurements of TEIs in the Clarion-Clipperton fracture zone (~7.5°N-17°N, ~155°W-115°W) where large-scale deep sea mining is planned. Environmental impact assessments are underway in partnership with the mining industry, but the effect of mining activities on TEIs in the water column is one that could be uniquely assessed by the GEOTRACES community. In support of efforts to communicate the science to a wide audience the investigators will recruit an early career freelance science journalist with interests in marine science and oceanography to participate on the cruise and do public outreach, photography and/or videography, and social media from the ship, as well as to submit articles about the research to national media. The project would also support several graduate students.

**Collaborative research: US GEOTRACES PMT: Trace-metal concentrations and stable isotopes in the North Pacific (PMT TM Stable Isotopes)**

**Coverage**: North Pacific

*NSF Award Abstract:*
The goal of the international GEOTRACES program is to understand the distributions of many chemical elements and their isotopes in the oceans. The National Science Foundation is supporting a U.S. GEOTRACES sampling expedition in the Pacific Ocean 2018, from Alaska to Tahiti. This award will focus on measurement of the stable isotopes of iron (Fe), nickel (Ni), zinc (Zn), copper (Cu), and cadmium (Cd) in seawater, filtered particles, and atmospheric aerosol particles on this expedition. The trace metals Fe, Ni, Zn, Cu, and Cd strongly influence marine biogeochemistry and carbon cycling. Measurements of isotope ratios -- the relative abundance of different forms of the same chemical element -- provide insights not possible from concentration measurements alone. The investigators will use isotope data to learn more about the inputs and outputs of these elements to the ocean as well as the biological processes that influence their distributions within the oceans, leading to greater understanding of the role these metals play in oceanic carbon cycling. The award will also host an international inter-lab comparison exercise for Cd isotope ratios at low concentrations in seawater. The project will support an early career investigator, a postdoctoral researcher, and undergraduate and graduate students.

The investigators will measure delta-56Fe, delta-60Ni, delta-65Cu, delta-66Zn, and delta-114Cd at high spatial resolution along the U.S. GEOTRACES Pacific Meridional Transect (PMT). The resulting oceanic sections of all five isotope systems will enable them to distinguish between competing ideas about the controls on trace metal distributions. A wide variety of hypotheses about marine biogeochemical trace metal cycling, addressing topics of global importance will be explored and tested, including: 1) How do different sources, productivity and export regimes, coupled with overturning circulation, control the distribution of Fe, Ni, Zn, Cu and Cd and their isotopes in the Pacific? 2) Do oxygen minimum zones act as sinks for Cd, Zn, Cu and Ni, while acting as sources for Fe? and 3) What sources are most important for supplying Fe to the North Pacific Ocean? The PMT section crosses two high nutrient-low chlorophyll (HNLC) regions and two oligotrophic gyres, as well as transecting the oldest waters in the ocean, allowing the investigators to use high-resolution isotope datasets to investigate competing hypotheses about the effect of vertical, horizontal and in situ biogeochemical processes on the distribution of all five metals and their isotopes. Aerosol dust, volcanogenic and reducing margin sediments, and hydrothermal vents such as the East Pacific Rise have all been hypothesized as major contributors to the dissolved Fe cycle in the Pacific. Measurement of iron isotope signatures in aerosols and near to oceanic sources will enable the identification and quantification the importance of these different iron sources and processes in supplying iron to the iron-limited surface ocean, especially important for the two HNLC regions along the PMT section.

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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-1737136 |

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