Dissolved concentrations of nickel and copper from bottle samples collected on 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/885335
Data Type: Cruise Results
Version: 1
Version Date: 2022-12-15

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
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Abstract
This dataset contains dissolved concentrations of nickel (Ni) and copper (Cu) from bottle samples. The samples were collected during the U.S. GEOTRACES PMT cruise aboard the R/V Roger Revelle (RR1815 from October 24th to November 23rd of 2018). The dataset also includes station number, date, time, latitude, longitude, event number, event description, sample number, depth, and data quality flag. The data from Leg 1 of this transect, RR1814, are available as a related dataset.

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Coverage

Spatial Extent: **N**:18.906 **E**:-151.99 **S**:-20 **W**:-155.258
Temporal Extent: 2018-10-25 - 2018-11-22

Methods & Sampling

Samples were obtained from the GEOTRACES GP15 cruise aboard the R/V *Roger Revelle* (RR1814 from September 18 to October 21 of 2018, and RR1815 from October 24 to November 23 of 2018). The *Revelle* was equipped with the GEOTRACES CTD/rosette (Model 32G, Sea-Bird Electronics). This rosette contained 24 Teflon-coated 12-liter (L) GO-FLO bottles for trace metal clean sampling (Model 10812 T, General Oceanics) with sensors for dissolved oxygen, conductivity, chlorophyll fluorescence, pressure, beam transmittance, and temperature. These samples were

preserved by filtering them through 0.2-micrometer (µm) Acropak-200 Supor capsule filter (Pall Corporation) and storing them in acid-washed 1 L Low-Density Polyethylene (Nalgene; LDPE) bottles. Samples (1L) were acidified to pH = 1.8 with 1 mL concentrated distilled HCl and added with 1 mL 30% H2O2 (Optima™ grade; Fisher; CAS#: 7722-84-1), and left for over 1 month.

Metal concentration analyses were identical to those used in Hawco et al. (2020). For each sample, 15 milliliters (mL) seawater was transferred to a acid-washed 15 mL polypropylene Falcon tube (VWR; Catalog #89049-172), then 50 microliters (µL) of an isotope spike (containing ^{57}Fe, ^{62}Ni, ^{65}Cu, ^{67}Zn, ^{207}Pb, and ^{110}Cd) was added to the 15 mL tube and thoroughly mixed with the sample. The samples would then sit overnight before they were preconcentrated by a SC-DX seaFAST system (Elemental Scientific; M-SFS2-MG-52). The seaFAST system helped to preconcentrate the seawater samples and remove the salt matrix. About 10 mL of seawater was injected through the Nobias PA-1 column of seaFAST and 0.5 mL eluent (1M HNO_3 containing 1 ppb In) was used to elute trace metals for concentration measurement. The trace metal concentrations were then measured by a Thermo Element 2™ Inductively Coupled Plasma - Mass Spectrometer. Concentrations of copper (Cu) and nickel (Ni) were derived by using an isotope dilution method.

Data Processing Description

Data Processing:
Excel 2016 with home-made data reduction algorithms.

Quality Flags:
Quality flags were assigned following the GEOTRACES Quality Flag Policy (https://www.geotraces.org/geotraces-quality-flag-policy/), which recommends the SeaDataNet Scheme. Flags are defined as:
0 = no quality control;
1 = good value;
2 = probably good value;
3 = probably bad value;
4 = bad value;
5 = changed value;
6 = value below detection (BDL);
7 = value in excess;
8 = interpolated value;
9 = missing value;
A = value phenomenon uncertain.

BCO-DMO Processing:
- renamed fields to comply with BCO-DMO naming conventions;
- created the ISO8601 date-time fields;
- replaced "N/A" with "nd" (no data);
- changed years of 2013 and 2016 in date columns to 2018.

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Data Files

File
Ni_Cu_Leg2.csv (Comma Separated Values (.csv), 72.23 KB) MD5:61020de4f2e708611df2632ae00bcbfd Primary data file for dataset ID 885335

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Related Publications

Bian et al. (in prep) An automated chromatography method for seawater Ni and Cu isotope analysis.
Results

Hawco, N. J., Yang, S.-C., Foreman, R. K., Funkey, C. P., Dugenne, M., White, A. E., Wilson, S. T., Kelly, R. L., Bian, X., Huang, K.-F., Karl, D. M., & John, S. G. (2020). Metal isotope signatures from lava-seawater interaction during the 2018 eruption of Kīlauea. Geochimica et Cosmochimica Acta, 282, 340–356. https://doi.org/10.1016/j.gca.2020.05.005
Methods

John, S. G., Kelly, R. L., Bian, X., Fu, F., Smith, M. I., Lanning, N. T., Liang, H., Pasquier, B., Seelen, E. A., Holzer, M., Wasylenki, L., Conway, T. M., Fitzsimmons, J. N., Hutchins, D. A., & Yang, S.-C. (2022). The biogeochemical balance of oceanic nickel cycling. Nature Geoscience, 15(11), 906–912. https://doi.org/10.1038/s41561-022-01045-7
Results

Liang, H., Moffett, J. W., & John, S. G. (2023). Toward a Better Understanding of the Global Ocean Copper Distribution and Speciation through a Data-constrained Model. Global Biogeochemical Cycles. Portico. https://doi.org/10.1029/2023gb007769 https://doi.org/10.1029/2023GB007769
Results

Moriyasu, R., John, S. G., Bian, X., Yang, S., & Moffett, J. W. (2023). Cu Exists Predominantly as Kinetically Inert Complexes Throughout the Interior of the Equatorial and North Pacific Ocean. Global Biogeochemical Cycles, 37(7). Portico. https://doi.org/10.1029/2022gb007521 https://doi.org/10.1029/2022GB007521
Results

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Related Datasets

Continues

Bian, X., Yang, S., John, S. G. (2022) **Dissolved concentrations of nickel and copper from bottle samples collected on 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 2022-12-15 doi:10.26008/1912/bco-dmo.885319.1 [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
Cruise_ID	Cruise ID number	unitless
Station_ID	Station ID number	unitless
Start_Date_UTC	Date (UTC) at start of sample collection	unitless
Start_Time_UTC	Time (UTC) at start of sample collection	unitless
Start_ISO_DateTime_UTC	Date and time (UTC) at start of sample collection in ISO8601 format	unitless
End_Date_UTC	Date (UTC) at end of sample collection	unitless
End_Time_UTC	Time (UTC) at end of sample collection	unitless
End_ISO_DateTime_UTC	Date and time (UTC) at end of sample collection in ISO8601 format	unitless
Start_Latitude	Latitude at start of sample collection	degrees North

Start_Longitude	Longitude at start of sample collection	degrees East
End_Latitude	Latitude at end of sample collection	degrees North
End_Longitude	Longitude at end of sample collection	degrees East
Cast_number	Cast number	unitless
Event_ID	Event number	unitless
Sample_ID	GEOTRACES sample ID number	unitless
Sample_Depth	Sample depth	meters (m)
Ni_D_CONC_BOTTLE_j33jms	Total dissolved Ni (<0.2 um) by Niskin or similar water sampling bottle	nanomoles per kilogram (nmol/kg)
SD1_Ni_D_CONC_BOTTLE_j33jms	One standard deviation of Ni_D_CONC_BOTTLE_j33jms	nanomoles per kilogram (nmol/kg)
Flag_Ni_D_CONC_BOTTLE_j33jms	Quality flag for Ni_D_CONC_BOTTLE_j33jms	unitless
Cu_D_CONC_BOTTLE_pp1kvz	Total dissolved Cu (<0.2 um) by Niskin or similar water sampling bottle	nanomoles per kilogram (nmol/kg)
SD1_Cu_D_CONC_BOTTLE_pp1kvz	One standard deviation of Cu_D_CONC_BOTTLE_pp1kvz	nanomoles per kilogram (nmol/kg)
Flag_Cu_D_CONC_BOTTLE_pp1kvz	Quality flag for Cu_D_CONC_BOTTLE_pp1kvz	unitless
Ni_D_CONC_FISH_e6ltcx	Total dissolved Ni (<0.2 um) by trace-metal clean towed surface sampler	nanomoles per kilogram (nmol/kg)
SD1_Ni_D_CONC_FISH_e6ltcx	One standard deviation of Ni_D_CONC_FISH_e6ltcx	nanomoles per kilogram (nmol/kg)
Flag_Ni_D_CONC_FISH_e6ltcx	Quality flag for Ni_D_CONC_FISH_e6ltcx	unitless
Cu_D_CONC_FISH_lfp3bg	Total dissolved Cu (<0.2 um) by trace-metal clean towed surface sampler	nanomoles per kilogram (nmol/kg)
SD1_Cu_D_CONC_FISH_lfp3bg	One standard deviation of Cu_D_CONC_FISH_lfp3bg	nanomoles per kilogram (nmol/kg)
Flag_Cu_D_CONC_FISH_lfp3bg	Quality flag for Cu_D_CONC_FISH_lfp3bg	unitless

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Instruments

Dataset-specific Instrument Name	GEOTRACES CTD/rosette (Model 32G, Sea-Bird Electronics)
Generic Instrument Name	CTD Sea-Bird
Generic Instrument Description	A Conductivity, Temperature, Depth (CTD) sensor package from SeaBird Electronics. This instrument designation is used when specific make and model are not known or when a more specific term is not available in the BCO-DMO vocabulary. Refer to the dataset-specific metadata for more information about the specific CTD used. More information from: http://www.seabird.com/

Dataset-specific Instrument Name	Teflon-coated 12 L GO-FLO bottles (Model 10812 T, General Oceanics)
Generic Instrument Name	GO-FLO Teflon Trace Metal Bottle
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 Element 2 Inductively Coupled Plasma - Mass Spectrometer (ICP-MS)
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	The concentrations were determined using an high-resolution ICP-MS (Thermo Element 2TM) with a PC3 desolvation system (Elemental Scientific).
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	SC-DX seaFAST system (Elemental Scientific; M-SFS2-MG-52)
Generic Instrument Name	SeaFAST Automated Preconcentration System
Generic Instrument Description	The seaFAST is an automated sample introduction system for analysis of seawater and other high matrix samples for analyses by ICPMS (Inductively Coupled Plasma Mass Spectrometry).

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Deployments

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-1736896

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