Inert copper and inorganic iodine concentrations 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

Website: https://www.bco-dmo.org/dataset/873183
Data Type: Cruise Results
Version: 3
Version Date: 2025-04-21

Project
» US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)
» U.S. GEOTRACES PMT: Measurement of the organic complexation and chemical lability of dissolved copper using multiple techniques (PMT Copper)

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

Contributors	Affiliation	Role
Moffett, James W.	University of Southern California (USC)	Principal Investigator
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Abstract
This dataset includes inert copper and inorganic iodine concentrations from Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814), which took place on R/V Roger Revelle from September to October 2018. Iodate was analyzed on UV-Vis Spectrophotometer while Iodide was analyzed on the Hanging Mercury Drop Electrode with the Cathodic Square Wave Stripping Voltammetry setting. Inert copper was determined by Rintaro Moriyasu using the solvent extraction method published in Moriyasu & Moffett, 2022 (doi: 10.1016/j.marchem.2021.104073).

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Coverage

Spatial Extent: **N**:56.058 **E**:-152 **S**:24.5 **W**:-156.962
Temporal Extent: 2018-09-26 - 2018-10-18

Methods & Sampling

Iodate and Iodide were measured along the GEOTRACES GP15 transect aboard R/V Roger Revelle. Samples were collected using the GEOTRACES trace-metal clean rosette. For the purposes of preserving the speciation, all samples were immediately frozen at -20 °C and shipped back to the United States in a cooler, overnight. The samples were kept frozen until analysis, at which point, they were defrosted. Iodate was analyzed on UV-Vis Spectrophotometer while Iodide was analyzed on the Hanging Mercury Drop Electrode with the Cathodic Square Wave Stripping Voltammetry

setting. Both methods were described previously in Moriyasu et al., (2020). Inert copper was determined by ligand exchange solvent extraction (Moriyasu & Moffett, 2022).

Data Processing Description

Data Quality Flags:
The data quality flags of 1 indicate "good" data.

BCO-DMO Processing:
version 1 (2022-04-20):
- renamed fields to comply with BCO-DMO naming conventions;
- created date-time columns in ISO8601 format.

version 2 (2022-12-28):
- added the inert copper columns to the dataset;
- rounded SD1_L1Cu_D_CONC_BOTTLE_ypaxln column to decimal places.

version 3 (2025-04-21):
- Corrected the end dates and times for event number 6609 (station 8, cast 10).
- Populated the quality flags in column "Flag_L1Cu_D_CONC_BOTTLE_ypaxln".
- Saved the final file as "873183_v3_gp15_inert_copper_and_iodine_leg1.csv".

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Data Files

File	
873183_v3_gp15_inert_copper_and_iodine_leg1.csv	(Comma Separated Values (.csv), 18.58 KB) MD5:7cd52a96be7a3ba99aa1bc412d9cf21f
Primary data file for dataset ID 873183, version 3	

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Related Publications

Moriyasu, R., & Moffett, J. W. (2022). Determination of inert and labile copper on GEOTRACES samples using a novel solvent extraction method. Marine Chemistry, 239, 104073. https://doi.org/10.1016/j.marchem.2021.104073
Methods

Moriyasu, R., Evans, Z. C., Bolster, K. M., Hardisty, D. S., & Moffett, J. W. (2020). The Distribution and Redox Speciation of Iodine in the Eastern Tropical North Pacific Ocean. Global Biogeochemical Cycles, 34(2). doi:10.1029/2019gb006302 https://doi.org/10.1029/2019GB006302
Methods

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Related Datasets

IsContinuedBy

Moriyasu, R., Moffett, J. W. (2025) **Inert copper and inorganic iodine concentrations from Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES PMT cruise (GP15, RR1815) on R/V Roger Revelle from Oct-Nov 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 3) Version Date 2025-04-21 doi:10.26008/1912/bco-dmo.873193.3 [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	Station number	unitless
Start_Date_UTC	Sampling start date	unitless
Start_Time_UTC	Sampling start time (UTC)	unitless
Start_ISO_DateTime_UTC	Sampling start date and time (UTC) in ISO8601	unitless
End_Date_UTC	Sampling end date	unitless
End_Time_UTC	Sampling end time (UTC)	unitless
End_ISO_DateTime_UTC	Sampling end date and time (UTC) in ISO8601	unitless
Start_Latitude	Latitude at start of sample collection	decimal degrees North
Start_Longitude	Longitude at start of sample collection	decimal degrees East
End_Latitude	Latitude at end of sample collection	decimal degrees North
End_Longitude	Longitude at end of sample collection	decimal 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)
L1Cu_D_CONC_BOTTLE_ypaxln	Concentration of dissolved inert copper. We designated inert Cu as CuL1 in the dataset. This is primarily to conform with previous data sets. L1 is an operationally defined parameter that includes strong copper chelators having a conditional stability constant of logK > 12. In our work, the conditional stability constant of inert Cu has a lower limit of log K = 17. The units are in nM per kg	nanomoles per kilogram (nmol/kg)
SD1_L1Cu_D_CONC_BOTTLE_ypaxln	Standard deviation of L1Cu_D_CONC_BOTTLE_ypaxln	nanomoles per kilogram (nmol/kg)
Flag_L1Cu_D_CONC_BOTTLE_ypaxln	Data quality flag for L1Cu_D_CONC_BOTTLE_ypaxln	unitless

I_neg1_D_CONC_BOTTLE_byhuiw	Concentration of dissolved Iodide, iodine in the -I oxidation state	nanomoles per liter (nmol/L)
SD1_I_neg1_D_CONC_BOTTLE_byhuiw	Standard deviation of I_neg1_D_CONC_BOTTLE_byhuiw	nanomoles per liter (nmol/L)
Flag_I_neg1_D_CONC_BOTTLE_byhuiw	Data quality flag for I_neg1_D_CONC_BOTTLE_byhuiw (1 = good data)	unitless
I_V_D_CONC_BOTTLE_qlcfpy	Concentration of dissolved Iodate, iodine in the V oxidation state	nanomoles per liter (nmol/L)
SD1_I_V_D_CONC_BOTTLE_qlcfpy	Standard deviation of I_V_D_CONC_BOTTLE_qlcfpy	nanomoles per liter (nmol/L)
Flag_I_V_D_CONC_BOTTLE_qlcfpy	Data quality flag for I_V_D_CONC_BOTTLE_qlcfpy (1 = good data)	unitless

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Instruments

Dataset-specific Instrument Name	BASi Controlled Growth Mercury Electrode (CGME)
Generic Instrument Name	BASi Controlled Growth Mercury Electrode
Dataset-specific Description	Iodide analyses were done on the BASi Controlled Growth Mercury Electrode (CGME) stand with a Calomel reference electrode and platinum wire auxiliary electrode.
Generic Instrument Description	Bioanalytical Systems (BASi) Mercury drop electrodes are generated by the BASi Controlled Growth Mercury Electrode (CGME) in three modes: DME (Dropping Mercury Electrode) - mercury is allowed to flow freely from the reservoir down the capillary and so the growth of the mercury drop and its lifetime is controlled by gravity. (The optional 100 um capillary is recommended for this mode.) SMDE (Static Mercury Drop Electrode) - the drop size is determined by the length of time for which the fast-response capillary valve is opened, and the drop is dislodged by a drop knocker. The dispense/knock timing is microprocessor-controlled and is typically coordinated with the potential pulse or square-wave waveform. This mode can also used to generate the Hanging Mercury Drop Electrode required for stripping experiments. CGME (Controlled Growth Mercury Electrode) - the mercury drop is grown by a series of pulses that open the capillary valve. The number of pulses, their duration, and their frequency can be varied by PC control, providing great flexibility in both the drop size and its rate of growth. This CGME mode can be used for both polarographic and stripping experiments. http://www.basinc.com/products/ec/cgme.php

Dataset-specific Instrument Name	trace-metal clean rosette
Generic Instrument Name	GO-FLO Teflon Trace Metal Bottle
Dataset-specific Description	Samples were collected using the GEOTRACES trace-metal clean rosette.
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	ICPMS
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	Copper analyses were performed by ICPMS with isotope dilution after a ligand competition solvent extraction assay.
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	Perkin Elmer Lambda 35
Generic Instrument Name	Perkin Elmer Lambda 35 Spectrophotometer
Dataset-specific Description	Iodate analyses were done on the Perkin Elmer Lambda 35 using a 10 cm quartz cuvette.
Generic Instrument Description	The Lambda 35 is a double beam UV/Vis spectrophotometer from Perkin Elmer, packing pre-aligned Tungsten and Deuterium Lamps. It has a wavelength range of 190-1100nm and a variable bandwidth range of 0.5 to 4nm.

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Deployments

RR1814

Website	https://www.bco-dmo.org/deployment/776913
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	2018-09-18
End Date	2018-10-21
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RR1814

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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.

U.S. GEOTRACES PMT: Measurement of the organic complexation and chemical lability of dissolved copper using multiple techniques (PMT Copper)

Coverage: GEOTRACES GB16 Transect, Eastern Tropical Pacific

NSF Award Abstract:
Copper (Cu) is an element in the ocean that is essential for life. Like many elements taken up by marine life, its concentrations in seawater are very low; however, Cu has a distribution in the water column that is different from other biologically essential elements. This difference may be attributed to the presence of a residual fraction in seawater that is virtually inert. This project seeks to understand what this material is, why it is so unreactive, and how it can eventually be "cracked" and re-enter the biological cycle. A scientist from the University of Southern California (USC) will characterize the Cu chemistry during the US GEOTRACES Pacific Meridional Transect (PMT) cruise. This cruise is a north-south transect from Alaska to Tahiti that spans a wide range of water depths, temperatures, biology, and chemistry. The Cu measurements will be made alongside many other trace elements that have different

chemistries. By comparing their behavior, coupled with the knowledge of each element?s chemical properties, the scientist will further our knowledge of what controls the behavior of Cu in the ocean. Training of graduate students and outstanding undergraduates in the speciation techniques is planned. The graduate students will also mentor high school students from inner city schools through the USC Young Investigators Program. The cruise and its findings will be incorporated into outreach activities and courses taught at USC, including a general education class for non-science majors.

A scientist from USC hypothesizes that non-labile complexes will predominate in high-scavenging regimes and that labile forms will accumulate in older deep waters above a non-labile background pool. To quantify the distribution and chemical properties, two different speciation techniques will be used based on competitive ligand exchange. The first, adsorptive cathodic stripping voltammetry, was used on previous GEOTRACES sections. The second is based on a ligand exchange, liquid/liquid partition methodology developed by the researcher. Partitioning leads to physical separation of fractions that are reactive or not with the competitive ligand allowing the exchangeability of strongly complexed copper by using Cu-65 as a tracer. The tracer enables much slower reactions to be studied experimentally. Samples will be analyzed using isotope dilution by inductively coupled plasma-mass spectrometry. Samples will also be prepared for natural Cu isotope analysis of non-labile Cu by a colleague at USC (Seth John) to test the hypothesis that non-labile or semi-labile complexes contribute to the heavy isotope signature of dissolved Cu in seawater. The PMT enables high volume sample collection from deep waters at the terminus of the oceanic conveyor belt, along with data for particulate metals and isotope tracers of scavenging. Moreover, the relationship between labile and non-labile Cu can be studied over several distinct biomes, including high-nutrient, low chlorophyll regions and oligotrophic subtropical gyres along the PMT.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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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-1756415

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