

Dissolved and labile cobalt from the USCGC Healy HLY1502 in the Canada and Makarov Basins of the Arctic Ocean from August to October 2015 (U.S. GEOTRACES Arctic project)

Website: <https://www.bco-dmo.org/dataset/722472>

Data Type: Cruise Results

Version: 6

Version Date: 2021-05-06

Project

- » [U.S. Arctic GEOTRACES Study \(GN01\)](#) (U.S. GEOTRACES Arctic)
- » [Collaborative Research: GEOTRACES Arctic Section: Marine Cycling of Bioactive Trace Metals in the Arctic Ocean](#) (GEOTRACES Arctic Bioactive Trace Metals)

Program

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

Contributors	Affiliation	Role
Saito, Mak A.	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

Dissolved and labile cobalt from the USCGC Healy HLY1502 in the Canada and Makarov Basins of the Arctic Ocean from August to October 2015 (U.S. GEOTRACES Arctic project).

Table of Contents

- [Coverage](#)
 - [Dataset Description](#)
 - [Methods & Sampling](#)
 - [Data Processing Description](#)
 - [Data Files](#)
 - [Related Publications](#)
 - [Parameters](#)
 - [Instruments](#)
 - [Deployments](#)
 - [Project Information](#)
 - [Program Information](#)
 - [Funding](#)
-

Coverage

Spatial Extent: N:89.995 E:179.593 S:60.165 W:-179.808

Temporal Extent: 2015-08-12 - 2015-10-08

Dataset Description

Dissolved and labile cobalt from the US GEOTRACES Arctic cruise, HLY1502 (GN01).

Methods & Sampling

Samples were collected using the ODU GEOTRACES Carousel (GT-C), filtered through 0.2 um Acropak filters in the GEOTRACES clean van and immediately refrigerated. Acid-washed 60 mL LDPE bottles were filled entirely, leaving no headspace. Total dissolved cobalt samples were kept at ambient pH, preserved in a heat-sealed bag containing gas absorbing satchels immediately after sample collection and kept at 4 degrees C until analysis

upon return to the Woods Hole laboratory. Labile cobalt were kept at ambient pH, and sampled in separate bottles stored in plastic bags without gas absorbing satchels at 4 degrees C.

The carousel was used to collect samples from surface to near bottom waters. Additional samples were collected from a surface pump when sea ice conditions permitted. Pre-conditioned, teflon-coated 12L Go-Flo sampling bottles (General Oceanics, Miami, FL) were deployed on a polyurethane powder-coated aluminum rosette with titanium pilings and pressure housings (Sea-Bird Electronics, Inc., Bellevue, WA) attached to a Kevlar, non-metallic conducting cable. For more information regarding carousel deployment, please refer to the GEOTRACES Cookbook, cited below and located on the GEOTRACES Program website (<https://www.geotraces.org/>). Following carousel retrieval, Go-Flo bottles were moved to the GEOTRACES Program class-100 trace metal clean van, and pressurized with HEPA filtered air for sampling in accordance with published methods (Cutter and Bruland 2012). Surface pump samples were collected by zodiac, and a trace metal clean peristaltic pump following the GEOTRACES Program Cookbook sampling recommendations, and in accordance with previous collection protocols (Bruland et al. 2005).

Sample storage and reagent bottles were soaked for >1 week in the acidic detergent Citranox, rinsed thoroughly with 18.2 M-Ohm Milli-Q water (Millipore), filled with 10% HCl to soak for 10 days, and rinsed thoroughly with Milli-Q water adjusted to pH 2 with TM-grade HCl. Reagent purification protocols were identical to those previously published (Saito and Moffett 2001).

Concentrations of total dissolved cobalt and labile cobalt were determined using a previously described cathodic stripping voltammetry (CSV) method (Saito and Moffett 2001, Saito et al. 2004). Measurements were made using the Eco-Chemie μ AutolabIII systems connected to Metrohm 663 VA Stands equipped with hanging mercury drop electrodes and Teflon sampling cups. Sample preparation was modified slightly to accommodate use of a Metrohm 837 Sample processor, operated with NOVA 1.8 software (Metrohm Autolab B.V.).

For total dissolved cobalt analyses, samples were UV-irradiated for 1 h prior to analysis in a Metrohm 909 UV digester to degrade the organic ligands that bind cobalt, enabling full chelation by the added electroactive ligand, dimethylglyoxime (DMG). 11 ml of sample was pipetted into 15ml polypropylene tubes. Recrystallized DMG (0.1M in methanol) was added to a final concentration of 400 μ M and purified N-(2-hydroxyethyl)piperazine-N-(3-propanesulfonic acid) (EPPS) buffer (0.5 M in Milli-Q water) was added to a final concentration of 3.8 mM. Tubes were inverted several times before being placed in the autosampler queue, where 8.5 ml of the mixture was dosed into the teflon analysis cup using a 800 Dosino automated burette (Metrohm). 1.5 ml of purified sodium nitrite (1.5M in Milli-Q water) was added directly to the Teflon cup using a dedicated 800 Dosino burette. Once loaded, samples were purged with high purity (>99.99%) N₂ for 3 min and cobalt concentrations were determined by standard addition, with triplicate measurement of the sample followed by four 25 pM cobalt additions. 5 nM Co stock was diluted from a certified 1ppm reference (SPEX) and added to the analysis cup via a third Dosino burette.

For labile cobalt analyses, 11 ml of sample were pipetted into acid washed teflon vials, preconditioned with a small aliquot of sample water. DMG was added to a concentration of 400 μ M and allowed to equilibrate for 8-16hr in the dark prior to analysis (Saito et al. 2004). EPPS was added just prior to measurement using the same standard addition protocol described above. Previously, we determined that natural cobalt ligands in seawater have a conditional stability constant of $>10^{16.8}$ (Saito et al. 2005). This suggests that the cobalt is very strongly bound to ligands. Thus, we define labile cobalt as the fraction of total dissolved cobalt that is either bound to weak organic and inorganic ligands in seawater or present as free Co(II), and is then exchangeable with the complexing agent (DMG) used for analysis (Saito et al. 2004, Saito et al. 2005). The difference between the total dissolved cobalt and the labile cobalt can then be used as an estimation of the strong cobalt ligand concentration. The same electrode was used for both total and labile analyses. Before transitioning from labile analyses to total analyses, the autosampler tubing and Teflon cup were rinsed with Milli-Q water and pH2 HCl in Milli-Q water.

The analytical blank was determined by analyzing seawater that had been UV-irradiated for 1 h, equilibrated overnight with prepared Chelex 100 resin beads (Bio-Rad), and UV-irradiated a second time to degrade any leached synthetic ligands. For in lab analyses, mean blank was 2.5 +/- 0.7 pM (n=19), and the detection limit was 2.2 pM.

Intercalibration: GEOTRACES standard seawater and internal standard lab seawater were analyzed periodically. A large batch of UV oligotrophic seawater was generated prior to sample analyses and used as a primary standard during measurements. This standard seawater was run along with each sample batch, as were blanks, and values were consistent for the duration of analyses. Our laboratory has participated in the GEOTRACES intercalibration effort using this electrochemical Co method. Acidified standards were neutralized with concentrated ammonium hydroxide (Seastar), mixing the entire sample between drops, prior to UV digestion. We report our laboratory values for the GEOTRACES and SAFe standard analyses using this

electrochemical method to be: SAFe D1 = 47.9 +/- 2.1 (n=3), SAFe D2 = 45.2 +/- 2.1 (n=3), GEOTRACES GSP = 2.4 +/- 1.8 (n=3), GEOTRACES GSC = 77.9 +/- 2.8 (n=3). These results are in good agreement with those from the GEOTRACES intercalibration effort for Co and demonstrate that the methodologies employed to produce this dataset detect concentrations within the standard deviation of current consensus values for UV irradiated samples, which can be found on the International GEOTRACES Program website (<https://www.geotraces.org/>).

Data Processing Description

Peak heights were determined using an in-home Matlab script described thoroughly in Bundy et al. (2020).

Quality flags for both dissolved and labile cobalt:

- 1 = Good (r^2 of standard additions > 0.95)
- 2 = Not evaluated, not available, or unknown
- 3 = Questionable/suspect (r^2 of standard additions < 0.95)
- 4 = Bad (r^2 of standard additions < 0.90)
- 9 = Missing data
- 10 = Below detection limit (Measurement was determined but was found to be below the detection limit)

Problem report:

Some labile samples were kept with the total dissolved cobalt samples by mistake in the bags with the gas absorbing satchels. If the labile sample was mistakenly placed with the totals samples, it was not measured, and is denoted as nd with flag 2 in the data file.

BCO-DMO Processing:

- renamed fields;
- added date/time fields in ISO8601 format;
- 2020-07-07: replaced with GEOTRACES DOoR-formatted/IDP version;
- 2020-10-29: replaced version 2 with version 3, which includes corrections to the depths reported for event number 6009;
- 2021-04-13: displayed the "Co_D_CONC_SUBICE_PUMP" columns, which were previously removed;
- 2021-05-05: replaced entire dataset with new version which contains corrections to the standard deviation columns.
- 2021-05-06: removed "2" in the "SD1_Co_DL_CONC_BOTTLE_8zqltr" column for sample 11882.

[[table of contents](#) | [back to top](#)]

Data Files

File
Co_diss_and_labile.csv (Comma Separated Values (.csv), 56.19 KB) MD5:7cf9fd1d50f20ecd88379262943923dc Primary data file for dataset ID 722472

[[table of contents](#) | [back to top](#)]

Related Publications

Bruland, K. W., Rue, E. L., Smith, G. J., & DiTullio, G. R. (2005). Iron, macronutrients and diatom blooms in the Peru upwelling regime: brown and blue waters of Peru. *Marine Chemistry*, 93(2-4), 81-103.

doi:[10.1016/j.marchem.2004.06.011](https://doi.org/10.1016/j.marchem.2004.06.011)

Methods

Bundy, R. M., Tagliabue, A., Hawco, N. J., Morton, P. L., Twining, B. S., Hatta, M., ... Saito, M. A. (2020). Elevated sources of cobalt in the Arctic Ocean. *Biogeosciences*, 17(19), 4745-4767. doi:[10.5194/bg-17-4745-2020](https://doi.org/10.5194/bg-17-4745-2020)

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](https://doi.org/10.4319/lom.2012.10.425)
Methods

Cutter, G.A., Andersson, P., Codispoti, L., Croot, P., Francois, R., Lohan, M., Obata, H., van der Loeff, M. R. (2014) Sampling and Sample-Handling Protocols for GEOTRACES Cruises (cookbook) Version 2.0; December 2014. http://www.geotraces.org/images/stories/documents/intercalibration/Cookbook_v2.pdf
Methods

Noble, A. E., Saito, M. A., Maiti, K., & Benitez-Nelson, C. R. (2008). Cobalt, manganese, and iron near the Hawaiian Islands: A potential concentrating mechanism for cobalt within a cyclonic eddy and implications for the hybrid-type trace metals. *Deep Sea Research Part II: Topical Studies in Oceanography*, 55(10-13), 1473–1490. doi:[10.1016/j.dsr2.2008.02.010](https://doi.org/10.1016/j.dsr2.2008.02.010)
General

Saito, M. A., & Moffett, J. W. (2001). Complexation of cobalt by natural organic ligands in the Sargasso Sea as determined by a new high-sensitivity electrochemical cobalt speciation method suitable for open ocean work. *Marine Chemistry*, 75(1-2), 49–68. doi:[10.1016/s0304-4203\(01\)00025-1](https://doi.org/10.1016/s0304-4203(01)00025-1)
Methods

Saito, M. A., Moffett, J. W., & DiTullio, G. R. (2004). Cobalt and nickel in the Peru upwelling region: A major flux of labile cobalt utilized as a micronutrient. *Global Biogeochemical Cycles*, 18(4), n/a–n/a. doi:[10.1029/2003gb002216](https://doi.org/10.1029/2003gb002216)
Methods

Saito, M. A., Rocap, G., & Moffett, J. W. (2005). Production of cobalt binding ligands in a *Synechococcus* feature at the Costa Rica upwelling dome. *Limnology and Oceanography*, 50(1), 279–290. doi:[10.4319/lo.2005.50.1.0279](https://doi.org/10.4319/lo.2005.50.1.0279)
Methods

[[table of contents](#) | [back to top](#)]

Parameters

Parameter	Description	Units
Station_ID	Station number	unitless
Start_Date_UTC	Sampling start date (UTC); format: MM/DD/YYYY	unitless
Start_Time_UTC	Sampling start time (UTC); format: hh:mm	unitless
Start_ISO_DateTime_UTC	Sampling start date/time (UTC) formatted to ISO8601 standard: YYYY-MM-DDThh:mmz	yyyy-MM-dd'THH:mm'Z'
End_Date_UTC	Sampling end date (UTC); format: MM/DD/YYYY	unitless
End_Time_UTC	Sampling end time (UTC); format: hh:mm	unitless
End_ISO_DateTime_UTC	Sampling endt date/time (UTC) formatted to ISO8601 standard: YYYY-MM-DDThh:mmz	unitless
Start_Latitude	Sampling start latitude	decimal degrees North
Start_Longitude	Sampling start longitude	decimal degrees East
End_Latitude	Sampling end latitude	decimal degrees North
End_Longitude	Sampling end longitude	decimal degrees East
Event_ID	GEOTRACES event number	unitless
Sample_ID	GEOTRACES sample number	unitless
Sample_Depth	Sample depth	meters (m)

Co_D_CONC_BOTTLE_iojqqp	Concentration of dissolved Cobalt in bottle samples	picomoles per liter (pmol/L)
SD1_Co_D_CONC_BOTTLE_iojqqp	One standard deviation of Co_D_CONC_BOTTLE_iojqqp	picomoles per liter (pmol/L)
Flag_Co_D_CONC_BOTTLE_iojqqp	Quality flag for Co_D_CONC_BOTTLE_iojqqp	unitless
Co_DL_CONC_BOTTLE_8zqltr	Concentration of dissolved labile Cobalt in bottle samples	picomoles per liter (pmol/L)
SD1_Co_DL_CONC_BOTTLE_8zqltr	One standard deviation of Co_DL_CONC_BOTTLE_8zqltr	picomoles per liter (pmol/L)
Flag_Co_DL_CONC_BOTTLE_8zqltr	Quality flag for Co_DL_CONC_BOTTLE_8zqltr	unitless
Co_D_CONC_BOAT_PUMP_cs8ogw	Concentration of dissolved Cobalt in samples collected from a small boat using a pump	picomoles per liter (pmol/L)
SD1_Co_D_CONC_BOAT_PUMP_cs8ogw	One standard deviation of Co_D_CONC_BOAT_PUMP_cs8ogw	picomoles per liter (pmol/L)
Flag_Co_D_CONC_BOAT_PUMP_cs8ogw	Quality flag for Co_D_CONC_BOAT_PUMP_cs8ogw	unitless
Co_DL_CONC_BOAT_PUMP_lthdda	Concentration of dissolved labile Cobalt in samples collected from a small boat using a pump	picomoles per liter (pmol/L)
SD1_Co_DL_CONC_BOAT_PUMP_lthdda	One standard deviation of Co_DL_CONC_BOAT_PUMP_lthdda	picomoles per liter (pmol/L)
Flag_Co_DL_CONC_BOAT_PUMP_lthdda	Quality flag for Co_DL_CONC_BOAT_PUMP_lthdda	unitless
Co_D_CONC_SUBICE_PUMP_ojcczo	Concentration of dissolved Cobalt in samples collected from an ice floe using a pump	picomoles per liter (pmol/L)
SD1_Co_D_CONC_SUBICE_PUMP_ojcczo	One standard deviation of Co_D_CONC_SUBICE_PUMP_ojcczo	picomoles per liter (pmol/L)
Flag_Co_D_CONC_SUBICE_PUMP_ojcczo	Quality flag for Co_D_CONC_SUBICE_PUMP_ojcczo	unitless

[[table of contents](#) | [back to top](#)]

Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	GO-FLO Bottle
Dataset-specific Description	Pre-conditioned, teflon-coated 12L Go-Flo sampling bottles (General Oceanics, Miami, FL) were deployed on a polyurethane powder-coated aluminum rosette with titanium pilings and pressure housings (Sea-Bird Electronics, Inc., Bellevue, WA) attached to a Kevlar, non-metallic conducting cable.
Generic Instrument Description	GO-FLO bottle cast used to collect water samples for pigment, nutrient, plankton, etc. The GO-FLO sampling bottle is specially designed 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	
Generic Instrument Name	Metrohm 663 VA Stand mercury electrode
Dataset-specific Description	Measurements were made using the Eco-Chemie μ AutolabIII systems connected to Metrohm 663 VA Stands equipped with hanging mercury drop electrodes and Teflon sampling cups.
Generic Instrument Description	The Metrohm 663 VA stand forms the wet chemical part of a polarographic and voltammetric analytical system. It features a mercury electrode, an Ag/AgCl reference electrode and a glassy carbon counter electrode. The size of the mercury drop and the stirrer speed are set manually on the VA Stand. The VA Stand can be operated in Dropping Mercury Electrode (DME), Hanging Mercury Drop Electrode (HMDE) and Static Mercury Drop Electrode (SMDE) modes. The VA Stand can be controlled by a potentiostat in conjunction with the Metrohm IME663 interface.

Dataset-specific Instrument Name	
Generic Instrument Name	Pump surface
Dataset-specific Description	Surface pump samples were collected by zodiac, and a trace metal clean peristaltic pump following the GEOTRACES Program Cookbook sampling recommendations, and in accordance with previous collection protocols (Bruland et al. 2004).
Generic Instrument Description	A source of uncontaminated near-surface seawater pumped onto the deck of the research vessel that can be sampled and analyzed. This pumped seawater supply is from an over-the-side pumping system, and is therefore different from the vessel underway seawater system.

Dataset-specific Instrument Name	
Generic Instrument Name	Voltammetry Analyzers
Dataset-specific Description	Concentrations of total dissolved cobalt and labile cobalt were determined using a previously described cathodic stripping voltammetry (CSV) method (Saito and Moffett 2001, Saito et al. 2004). Measurements were made using the Eco-Chemie μ AutolabIII systems connected to Metrohm 663 VA Stands equipped with hanging mercury drop electrodes and Teflon sampling cups.
Generic Instrument Description	Instruments that obtain information about an analyte by applying a potential and measuring the current produced in the analyte.

[[table of contents](#) | [back to top](#)]

Deployments

HL1502

Website	https://www.bco-dmo.org/deployment/638807
Platform	USCGC Healy
Report	https://datadocs.bco-dmo.org/docs/302/geotraces/GEOTRACES_ARCTIC/data_docs/cruise_reports/healy1502.pdf
Start Date	2015-08-09
End Date	2015-10-12
Description	Arctic transect encompassing Bering and Chukchi Shelves and the Canadian, Makarov and Amundsen sub-basins of the Arctic Ocean. The transect started in the Bering Sea (60°N) and traveled northward across the Bering Shelf, through the Bering Strait and across the Chukchi shelf, then traversing along 170-180°W across the Alpha-Mendelev and Lomonosov Ridges to the North Pole (Amundsen basin, 90°N), and then back southward along ~150°W to terminate on the Chukchi Shelf (72°N). Additional cruise information is available in the GO-SHIP Cruise Report (PDF) and from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/HLY1502

[[table of contents](#) | [back to top](#)]

Project Information

U.S. Arctic GEOTRACES Study (GN01) (U.S. GEOTRACES Arctic)

Website: <https://www.geotraces.org/>

Coverage: Arctic Ocean; Sailing from Dutch Harbor to Dutch Harbor (GN01)

Description from NSF award abstract:

In pursuit of its goal "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", in 2015 the International GEOTRACES Program will embark on several years of research in the Arctic Ocean. In a region where climate warming and general environmental change are occurring at amazing speed, research such as this is important for understanding the current state of Arctic Ocean geochemistry and for developing predictive capability as the regional ecosystem continues to warm and influence global oceanic and climatic conditions. The three investigators funded on this award, will manage a large team of U.S. scientists who will compete through the regular NSF proposal process to contribute their own unique expertise in marine trace metal, isotopic, and carbon cycle geochemistry to the U.S. effort. The three managers will be responsible for arranging and overseeing at-sea technical services such as hydrographic measurements, nutrient analyses, and around-the-clock management of on-deck sampling activities upon which all participants depend, and for organizing all pre- and post-cruise technical support and scientific meetings. The management team will also lead educational outreach activities for the general public in Nome and Barrow, Alaska, to explain the significance of the study to these communities and to learn from residents' insights on observed changes in the marine system. The project itself will provide for the support and training of a number of pre-doctoral students and post-doctoral researchers. Inasmuch as the Arctic Ocean is an epicenter of global climate change, findings of this study are expected to advance present capability to forecast changes in regional and global ecosystem and climate system functioning.

As the United States' contribution to the International GEOTRACES Arctic Ocean initiative, this project will be part of an ongoing multi-national effort to further scientific knowledge about trace elements and isotopes in the world ocean. This U.S. expedition will focus on the western Arctic Ocean in the boreal summer of 2015. The scientific team will consist of the management team funded through this award plus a team of scientists from U.S. academic institutions who will have successfully competed for and received NSF funds for specific science projects in time to participate in the final stages of cruise planning. The cruise track segments will include the Bering Strait, Chukchi shelf, and the deep Canada Basin. Several stations will be designated as so-called super stations for intense study of atmospheric aerosols, sea ice, and sediment chemistry as well as water-column processes. In total, the set of coordinated international expeditions will involve the deployment of ice-capable research ships from 6 nations (US, Canada, Germany, Sweden, UK, and Russia) across different parts of the

Arctic Ocean, and application of state-of-the-art methods to unravel the complex dynamics of trace metals and isotopes that are important as oceanographic and biogeochemical tracers in the sea.

Collaborative Research: GEOTRACES Arctic Section: Marine Cycling of Bioactive Trace Metals in the Arctic Ocean (GEOTRACES Arctic Bioactive Trace Metals)

Coverage: Arctic Ocean

NSF Award Abstract:

In this project, a group of investigators participating in the 2015 U.S. GEOTRACES Arctic expedition will study the chemistry and regional distribution of seven trace metals in the Arctic Ocean: iron, manganese, zinc, cadmium, copper, nickel, and cobalt. These so-called bioactive metals are of special scientific interest because of their role in multiple biogeochemical processes including biological production of the sea and the planetary cycling of carbon and nitrogen. Like other multinational initiatives in the International GEOTRACES Program, the goals of the U.S. Arctic expedition are 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. This study in particular would contribute to our understanding of the sources and sinks of these seven bioactive metals as well as examine their interaction with biological processes. The project will focus on two major overarching research questions: (1) What are the sources and sinks for micronutrients and macronutrients in the Arctic? And (2) How does bioactive trace element nutrition influence productivity and species composition in the Arctic, and conversely, how do biological processes influence the cycling of these metals? In terms of broader impacts, the PIs on this project will be actively involved in educational outreach efforts, and the research team itself will include two postdoctoral researchers and a graduate student. The team leaders also plan to publish a children's ocean education book based on the expedition with the aim of generating next-generation excitement about modern ocean science

With regard to technical specifics, the research team will measure the dissolved seawater phases of the bioactive metals Fe, Mn, Zn, Cd, Cu, Ni, and Co, the dissolved stable metal isotopes ^{56}Fe , ^{66}Zn , and ^{114}Cd , and the chemical speciation of Co. The recent development of methods for multi-element and multi-isotope analysis methods, in conjunction with the high-resolution sampling of the GEOTRACES program, make it possible to efficiently produce this dense dataset of metals and metal isotopes. This will be a team-based approach to achieve comprehensive duplication for analysis of the key parameters of dissolved metal concentrations. Each investigator will further conduct specialized additional measurements of metal isotopes and dissolved Co (which has unique analytical challenges) and Co speciation. Interpretation of these rich datasets would be directed toward determination of sources and sinks as well as their ecological stoichiometry, in collaboration with other U.S. GEOTRACES participants measuring synergistic parameters. Together, this Arctic Ocean bioactive trace metal dataset is expected to provide an important contribution to the understanding of micronutrient roles in Arctic biogeochemical processes. These results should also be highly relevant to research studies of the ancient ocean, in which trace-metal analyses are commonly used to trace a wide variety of processes including paleo-ocean circulation and biological productivity. Finally, understanding the sources and sinks for elements in the modern ocean is key to predicting how the concentrations of bioactive elements might vary in a changing future climate.

[[table of contents](#) | [back to top](#)]

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.

[[table of contents](#) | [back to top](#)]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1435056

[[table of contents](#) | [back to top](#)]