Selenium speciation depth profiles, including Selenite (SeIV), Selenate (SeVI), Organic selenide (Org Se-II), and Total Se, from the US GEOTRACES Arctic cruise (HLY1502, GN01) from August to October 2015

Website: https://www.bco-dmo.org/dataset/778741
Data Type: Cruise Results
Version: 1
Version Date: 2019-10-07

Project
» U.S. Arctic GEOTRACES Study (GN01) (U.S. GEOTRACES Arctic)
» GEOTRACES Arctic Section: Processes affecting the biogeochemical cycling of essential and toxic metalloids in the Arctic Ocean (GEOTRACES Arctic Arsenic and Selenium)

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

Contributors	Affiliation	Role
Cutter, Gregory A.	Old Dominion University (ODU)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Coverage

Spatial Extent: **N**:87.512 **E**:-147.8504 **S**:60.2503 **W**:-179.8042
Temporal Extent: 2015-08-13 - 2015-10-08

Dataset Description

Data have been submitted to BCO-DMO and are currently being processed (2019-10-08).

Methods & Sampling

For dissolved samples: 0.45 µm Supor membrane filtered seawater samples from the GEOTRACES Carousel/GO-FLO bottles were placed into 1 L borosilicate glass bottles and acidified to pH < 2 by addition of 4 mL 6 M HCl. Samples were stored at room temperature in the dark.

Dissolved selenite, selenite+ selenite, and total dissolved selenium concentrations were determined in triplicate using selective hydride generation/atomic absorption spectrometry following Cutter (1978), Cutter (1983), and Cutter and Bruland (1984). The standard addition method of calibration was used to assure accuracy (one

sample on an analysis day was used and its slope applied to the other samples on that day). Selenate was calculated as the difference between selenite+selenate and selenite determinations, while organic selenide was the difference between total dissolved selenium and selenite+selenate determinations. Precision was always less than 10% RSD, but typically less than 5% RSD at the observed concentrations. Detection limits were 0.02 nmol/L for all selenium species.

Data Processing Description

Samples analyzed in triplicate and means computed. Standard additions of selenite were used for daily calibration on a representative sample and its slope applied to subsequent samples.

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Related Publications

Cutter, G. A. (1978). Species determination of selenium in natural waters. Analytica Chimica Acta, 98(1), 59–66. doi:10.1016/s0003-2670(01)83238-4 https://doi.org/10.1016/S0003-2670(01)83238-4
Methods

Cutter, G. A. (1983). Elimination of nitrite interference in the determination of selenium by hydride generation. Analytica Chimica Acta, 149, 391–394. doi:10.1016/s0003-2670(00)83200-6 https://doi.org/10.1016/S0003-2670(00)83200-6
Methods

Cutter, G. A., & Bruland, K. W. (1984). The marine biogeochemistry of selenium: A re-evaluation1. Limnology and Oceanography, 29(6), 1179–1192. doi:10.4319/lo.1984.29.6.1179
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

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Parameters

Parameter	Description	Units
STNNBR	Station number	unitless
GEOTRC_INSTR	Sampling device	unitless
GEOTRC_EVENTNO	GEOTRACES event number	unitless
GEOTRC_CASTNO	Cast number	unitless
GEOTRC_SAMPNO	GEOTRACES sample number	unitless
ISO_DATETIME_GMT	Date and time (GMT) in ISO8601 format: yyyy-mm-ddTHH:MM:SS.xx	unitless

LATITUDE	Latitude; positive values = North	decimal degrees
LONGITUDE	Longitude; positive values = East	decimal degrees
DEPTH	Sample depth	meters
Se_D_CONC_BOTTLE	Total dissolved selenium	nanomoles per liter (nmol/L)
Se_D_CONC_BOTTLE_ERR	Standard error for Se_D_CONC_BOTTLE	nanomoles per liter (nmol/L)
Se_D_CONC_BOTTLE_FLAG	Quality flag for Se_D_CONC_BOTTLE	unitless
Se_IV_D_CONC_BOTTLE	Selenite	nanomoles per liter (nmol/L)
Se_IV_D_CONC_BOTTLE_ERR	Standard error for Se_IV_D_CONC_BOTTLE	nanomoles per liter (nmol/L)
Se_IV_D_CONC_BOTTLE_FLAG	Quality flag for Se_IV_D_CONC_BOTTLE	unitless
Se_VI_D_CONC_BOTTLE	Selenate	nanomoles per liter (nmol/L)
Se_VI_D_CONC_BOTTLE_ERR	Standard error for Se_VI_D_CONC_BOTTLE	nanomoles per liter (nmol/L)
Se_VI_D_CONC_BOTTLE_FLAG	Quality flag for Se_VI_D_CONC_BOTTLE	unitless
Se_II_D_CONC_BOTTLE	Organic selenide	nanomoles per liter (nmol/L)
Se_II_D_CONC_BOTTLE_ERR	Standard error for Se_II_D_CONC_BOTTLE	nanomoles per liter (nmol/L)
Se_II_D_CONC_BOTTLE_FLAG	Quality flag for Se_II_D_CONC_BOTTLE	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	GO-FLO Bottle
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.

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Deployments

HLY1502

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-Mendeleev 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

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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 activites 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 globlal 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.

GEOTRACES Arctic Section: Processes affecting the biogeochemical cycling of essential and toxic metalloids in the Arctic Ocean (GEOTRACES Arctic Arsenic and Selenium)

NSF Award Abstract:
In this project, an investigator participating in the 2015 U.S. GEOTRACES Arctic expedition will establish the concentrations, chemical speciation, and cycling processes of arsenic and selenium in the Arctic Ocean. In common with 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. Some trace elements are essential to life, others are known biological toxins, and still others are important because they can be used as tracers of a variety of physical, chemical, and biological processes in the sea. The metalloid elements arsenic and selenium to be studied in this project are toxic to many marine plants and animals, and their cycling in the Arctic is not well known. Thus, this project will have important implications for increased knowledge on the chemistry of these potentially toxic elements. Results from the project will be shared through outreach to Arctic residents and through a PolarTREC teacher who will participate in the cruise.

The metalloid elements arsenic and selenium have dynamic marine cycles that affect the microbiology of the water column and in turn are affected by it. Both exist in multiple oxidation states and inorganic and organic species within an oxidation state. This chemical speciation affects their reactivity and biotic uptake and toxicity. As shown in lower latitude waters, the concentration and speciation of dissolved arsenic can control the abundance and types of primary producers. In the Arctic virtually nothing is known about arsenic cycling, although there are possibly enhanced anthropogenic inputs from Canadian rivers and atmospheric deposition. In contrast, data from the high latitude North Pacific Ocean and Bering Sea strongly suggest that anthropogenic selenium from coal combustion is entering the Arctic and enriching its concentration in at least one top predator. The goal of this project is to qualitatively describe the input, removal, and internal cycling processes affecting the speciation and concentrations of arsenic and selenium, and determine rates of inputs and outputs of these processes using both direct measurements and computations. The study will greatly expand knowledge about arsenic and selenium cycling, with strong implications for the changing Arctic.

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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-1435708

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