Trace element concentrations (labile and total measurements) in particles collected with GO-Flo bottles and analyzed with ICP-MS from the US GEOTRACES Arctic cruise (HLY1502; GN01) from August to October 2015

Website: https://www.bco-dmo.org/dataset/771474
Data Type: Cruise Results
Version: 2
Version Date: 2019-07-02

Project
» U.S. Arctic GEOTRACES Study (GN01) (U.S. GEOTRACES Arctic)
» GEOTRACES Arctic Section: Collaborative Research: Biogeochemical cycling of particulate trace elements in the western Arctic basin (Arctic GEOTRACES bottle particles)

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

Contributors	Affiliation	Role
Twining, Benjamin	Bigelow Laboratory for Ocean Sciences	Principal Investigator
Morton, Peter L.	Florida State University - National High Magnetic Field Lab (FSU - NHMFL)	Co-Principal Investigator
Salters, Vincent J.	Florida State University - National High Magnetic Field Lab (FSU - NHMFL)	Co-Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Trace element concentrations in particles collected with GO-Flo bottles and analyzed with ICP-MS. Concentrations of labile and total metal fractions are reported. Samples were collected during the U.S. Arctic GEOTRACES cruise aboard USCGC Healy (GN01; HLY1502) from August to October 2015.

Table of Contents

Coverage

Spatial Extent: **N**:90 **E**:180 **S**:60 **W**:-180
Temporal Extent: 2015-08-12 - 2015-10-08

Dataset Description

Trace element concentrations in particles collected with GO-Flo bottles and analyzed with ICP-MS. Concentrations of labile and total metal fractions are reported. Samples were collected during the U.S. Arctic GEOTRACES cruise aboard USCGC Healy (GN01; HLY1502) from August to October 2015.

Methods & Sampling

Supor PES filters (25 mm or 47 mm diameters, 0.45 µm pore size) were acid-washed in 10% HCl and soaked repeatedly in fresh baths of ultrahigh purity (UHP) water, until the pH of the resulting rinse water was circumneutral. Particulate samples were collected directly from the GO-Flo sampling bottles (pressurized (<8 psi) with filtered air), drawing ~7 L of seawater over the filters loaded into Swinnex or Advantec cartridges, and stored frozen in new polystyrene petri dishes.

Before processing and analysis, filters were divided into halves: one half for Total digestion (total element concentrations) and one half for Labile digestion (using the Berger et al. (2008) method). Digest solutions (Total and Labile) included a 10 ppb In spike to correct for instrumental drift.

Total digestion: Filters were digested in 15-mL PFA digestion vials (Savillex), extensively cleaned using HNO_3, HCl, and trace HF acids (trace metal grade or better). Digestions were performed on enclosed Teflon-coated hotplates ("flowboxes") under double HEPA filtered air (effectively Class-1), inside a Class-1000 clean room. The total digestion procedure involved a two-step digestion, modified from Ohnemus et al. (2014). During the first digestion step, filter halves were submerged in 4 mL of a mixture of 4 M each of HNO_3, HCl, and HF acids (all Optima or double-distilled). Samples were capped and heated for 3 hours at 100-120°C in the flowbox. Each digest solution was then carefully decanted into a second PFA vial, the original vial and filter rinsed twice with 1.5 mL of ultrahigh purity (UHP) water, and the UHP water rinses transferred to the second vial while retaining the filter in the original vial. The digest solution in the second vial was then taken to dryness (uncapped) in the flowbox, by heating overnight at 100-120°C. During the second digestion step, 20 µL of concentrated H_2SO_4(Optima), 20 µL of H_2O_2 (Optima), and 2 mL of 8 M HNO_3 Optima or double-distilled) were added to the digest residue to breakdown any PES filter fragments, and the vials heated (capped) at 150°C for 30 minutes. The vials were uncapped and taken to dryness at 210-230°C. The final digest residue was redissolved in 4 mL of 0.32 M HNO_3(Optima or double-distilled) and stored in acid-washed 5 mL cryovials until analysis.

Labile digestion: Filters were digested in rigorously cleaned 22-mL PFA digestions vials (Savillex). All digestion steps were performed in a Class-100 clean room using standard clean techniques. Filters were digested in a solution of 25% Optima-grade acetic acid and 0.02 M hydroxylamine hydrochloride following the protocol of Berger et al. (2008). One milliliter of this solution was added to the filter stored in a 1.7-mL polypropylene vial. The solution was heated to 95°C in a water bath for 10 minutes and then allowed to cool to room temperature. The filter was in contact with the acetic acid leach for a total of two hours. The filter was removed to an acid-cleaned PFA bomb and the acetic acid/hydroxylamine leachate was centrifuged at 14,000 rpm for 10 minutes to sediment all particles. Without disturbing particles on the bottom of the tube, approximately 0.8 mL of leachate was transferred into a 7-mL PFA digestion vial. Optima-grade HNO_3 was added (100 µL) to the 7-mL digestion vial, which was then heated uncapped at 110ºC to near dryness. Vial contents were redissolved with 2% HNO_3 (Optima grade).

Process blanks and reference materials were digested alongside samples for both chemical treatments. All samples were analyzed at NHMFL/FSU by HR-ICP-MS in both Low and Medium Resolution modes. Concentrations were quantified by multi-element external calibration (seven standards, up to 500 ppb), and drift corrected using a 10 ppb In spike added to each sample.

Data Processing Description

Quality Flags:
Particulate data are flagged with the following:
1: Good data, passed QC;
2: Probably good, but no QC;
3: Questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total;
4: Bad;
6: Below detection limit;
9: Missing.

BTLNBR are flagged with the following:
0: Not sure how to QF this comment;
1: Bottle information unavailable;
2: No problems noted;
3: Leaking;
4: Did not trip correctly;
5: Not reported;
6: Significant discrepancy in measured values between Gerard and Niskin bottles;
7: Unknown problem;
8: Pair did not trip correctly. Note that the Niskin bottle can trip at an unplanned depth while the Gerard trips correctly and vice versa;
9: Samples not drawn from this bottle.

QC: Refer to the GN01 Bottle Particles CRM and blanks Supplement File: "GTArc_metadata_CRM_and_blanks_FINAL.xlsx"

Note: Portions of these data were published in Marsay et al. (2018), Tables 3 and 6, Figure 7.

BCO-DMO Processing:
- modified parameter names (replaced spaces with underscores; labeled flag columns as such; renamed "sample number" to "GEOTRC_SAMPNO");
- filled blank cells (missing data) with "nd"; replaced "NA" with "nd".
- 02-July-2019: replaced version 1 of data with version 2 (GEOTRACES parameter names & units applied; additional metadata columns added)

[table of contents | back to top]

Data Files

File
bottle_particulates_v2.csv (Comma Separated Values (.csv), 129.14 KB) MD5:e6c667775946568b1789d88332c49b16 Primary data file for dataset ID 771474

[table of contents | back to top]

Supplemental Files

File
GN01 Bottle Particles CRM and blanks filename: GTArc_metadata_CRM_and_blanks_FINAL.xlsx (Microsoft Excel, 21.36 KB) MD5:d58d5f88bca3073bf4c1dfb1f791089d Certified reference materials (CRMs), blanks, and detection limits associated with the dataset "Arctic GEOTRACES GN01 Bottle Particles" (PIs: Twining, Morton, & Salters)

[table of contents | back to top]

Related Publications

Berger, C. J. M., Lippiatt, S. M., Lawrence, M. G., & Bruland, K. W. (2008). Application of a chemical leach technique for estimating labile particulate aluminum, iron, and manganese in the Columbia River plume and coastal waters off Oregon and Washington. Journal of Geophysical Research, 113. doi:10.1029/2007jc004703
https://doi.org/10.1029/2007JC004703
Methods

Marsay, C. M., Aguilar-Islas, A., Fitzsimmons, J. N., Hatta, M., Jensen, L. T., John, S. G., ... Buck, C. S. (2018). Dissolved and particulate trace elements in late summer Arctic melt ponds. Marine Chemistry, 204, 70–85. doi:10.1016/j.marchem.2018.06.002

Results

Ohnemus, D. C., Auro, M. E., Sherrell, R. M., Lagerström, M., Morton, P. L., Twining, B. S., ... Lam, P. J. (2014). Laboratory intercomparison of marine particulate digestions including Piranha: a novel chemical method for dissolution of polyethersulfone filters. Limnology and Oceanography: Methods, 12(8), 530–547. doi:10.4319/lom.2014.12.530
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
cruise_id	Cruise ID number	unitless
EXPOCODE	Cruise EXPO code	unitless
SECT_ID	GEOTRACES section ID	unitless
STNNBR	GEOTRACES station number	unitless
CASTNO	Cast number	unitless
GEOTRC_EVENTNO	GEOTRACES event number	unitless
DATE	Date; format: yyyymmdd	unitless
TIME	Time; format: hhmm	unitless
ISO_DateTime_UTC	Date and time formatted to ISO8601 standard: yyyy-mm-ddTHH:MM:SS.ssZ	yyyy-MM-dd'T'HH:mm:ss.SS'Z'
LATITUDE	Latitude	degrees North
LONGITUDE	Longitude	degrees East
SAMPNO	Sequential sample number within a cast	unitless
BTLNBR	Bottle number	unitless
BTL_FLAG_ODU	Bottle quality flag (see metadata for flag definitions)	unitless
CTDPRS	CTD pressure	decibars
CTDDEPTH	CTD depth	meters
Station	Station number	unitless
GEOTRC_SAMPNO	GEOTRACES sample number	unitless
Mo_TP_CONC_BOTTLE	Total particulate molybdenum	pmol/kg
Mo_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Cd_TP_CONC_BOTTLE	Total particulate cadmium	pmol/kg
Cd_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Ba_TP_CONC_BOTTLE	Total particulate barium	pmol/kg

Ba_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Al_TP_CONC_BOTTLE	Total particulate aluminum	nmol/kg
Al_TPQ_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
P_TP_CONC_BOTTLE	Total particulate phosphorus	nmol/kg
P_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Ti_TP_CONC_BOTTLE	Total particulate titanium	nmol/kg
Ti_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
V_TP_CONC_BOTTLE	Total particulate vanadium	pmol/kg
V_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Mn_TP_CONC_BOTTLE	Total particulate manganese	nmol/kg
Mn_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Fe_TP_CONC_BOTTLE	Total particulate iron	nmol/kg
Fe_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Co_TP_CONC_BOTTLE	Total particulate cobalt	pmol/kg
Co_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Ni_TP_CONC_BOTTLE	Total particulate nickel	pmol/kg
Ni_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless

Cu_TP_CONC_BOTTLE	Total particulate copper	pmol/kg
Cu_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Zn_TP_CONC_BOTTLE	Total particulate zinc	pmol/kg
Zn_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
La_TP_CONC_BOTTLE	Total particulate lanthanum	pmol/kg
La_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Ce_TP_CONC_BOTTLE	Total particulate cerium	pmol/kg
Ce_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Pr_TP_CONC_BOTTLE	Total particulate praseodymium	pmol/kg
Pr_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Pb_TP_CONC_BOTTLE	Total particulate lead	pmol/kg
Pb_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Th_TP_CONC_BOTTLE	Total particulate thorium	pmol/kg
Th_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Cr_TP_CONC_BOTTLE	Total particulate chromium	pmol/kg
Cr_TP_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Mo_TPL_CONC_BOTTLE	Labile particulate molybdenum	pmol/kg

Mo_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Cd_TPL_CONC_BOTTLE	Labile particulate cadmium	pmol/kg
Cd_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Ba_TPL_CONC_BOTTLE	Labile particulate barium	pmol/kg
Ba_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Al_TPL_CONC_BOTTLE	Labile particulate aluminum	nmol/kg
Al_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
P_TPL_CONC_BOTTLE	Labile particulate phosphorus	nmol/kg
P_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Ti_TPL_CONC_BOTTLE	Labile particulate titanium	pmol/kg
Ti_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
V_TPL_CONC_BOTTLE	Labile particulate vanadium	pmol/kg
V_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Mn_TPL_CONC_BOTTLE	Labile particulate manganese	nmol/kg
Mn_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Fe_TPL_CONC_BOTTLE	Labile particulate iron	nmol/kg
Fe_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless

Co_TPL_CONC_BOTTLE	Labile particulate cobalt	pmol/kg
Co_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Ni_TPL_CONC_BOTTLE	Labile particulate nickel	pmol/kg
Ni_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Cu_TPL_CONC_BOTTLE	Labile particulate copper	pmol/kg
Cu_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless
Zn_TPL_CONC_BOTTLE	Labile particulate zinc	pmol/kg
Zn_TPL_CONC_BOTTLE_FLAG	Particulate quality flag: 1 = good; 2 = probably good, but no QC; 3 = questionable; value is oceanographically inconsistent based on adjacent depths and/or comparison of leach vs total; 4 = Bad; 5 = Below DL; 9 = Missing value.	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	GO-FLO Bottle
Dataset-specific Description	Particulate samples were collected directly from the GO-Flo sampling bottles.
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	Thermo ELEMENT 2 HR-ICP-MS
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	Thermo ELEMENT 2 HR-ICP-MS: Scott-type Teflon spray chamber (Savillex), 100 µL/min PFA-ST nebulizer (Elemental Scientific Inc.), Quartz torch and injector (Thermo), Ni-coated Cu cones (Thermo); Geochemistry, National High Magnetic Field Laboratory, Tallahassee, Florida 32310
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.

[table of contents | back to top]

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

[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 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: Collaborative Research: Biogeochemical cycling of particulate trace elements in the western Arctic basin (Arctic GEOTRACES bottle particles)

Coverage: Arctic Ocean

NSF Award Abstract:
As part of this project, two investigators will participate in the 2015 U.S. GEOTRACES Arctic expedition to determine the trace element composition of different suspended particles in the water column of the Arctic Ocean to identify the sources and scavenging capabilities of these particles. 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. This team of trace element scientists will focus on the measurement of particulate trace elements, which will enable scientists to better estimate the sources of particulate metals to the Arctic Ocean and to better understand their contribution to biological processes. This project will also provide educational opportunities for undergraduate students, K-12 teachers, and the general public.

Particulate trace element distributions, sources, sinks and cycling are predicted to be controlled by physical, biological, anthropogenic and geochemical processes in the Arctic. Furthermore, many trace elements are required nutrients for marine phytoplankton, playing a key role in oceanic primary productivity. However, few integrated oceanographic studies have been conducted to specifically investigate these relationships in this region, despite the changing conditions and global significance of the Arctic. This project will significantly advance understanding of the complete geochemical cycles of a number of trace elements in the Arctic Ocean basin by measuring the concentrations of particulate trace elements in bulk particles collected through the water column and in sediments, as well as in phytoplankton from the upper water column. These measurements will enable scientists to constrain the inputs of particulate elements from rivers, shelves and ice, and to assess the removal of dissolved trace elements via passive scavenging and biological uptake.

[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-1435862
NSF Division of Ocean Sciences (NSF OCE)	OCE-1436019

[table of contents | back to top]