Concentrations of ultrapure water soluble aerosol trace elements collected from bulk aerosol samples on the 2015 US GEOTRACES Western Arctic Transect on USCGC Healy (HLY1502) August to October 2015

Website: https://www.bco-dmo.org/dataset/728472
Data Type: Cruise Results
Version: 2
Version Date: 2020-06-04

Project
» U.S. Arctic GEOTRACES Study (U.S. GEOTRACES Arctic)
» Collaborative Research: GEOTRACES Arctic Section: Sampling and Analysis of Atmospheric Deposition (GEOTRACES Arctic Atmospheric Deposition)

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

Contributors	Affiliation	Role
Buck, Clifton S.	Skidaway Institute of Oceanography (SkIO)	Principal Investigator
Gao, Yuan	Rutgers University	Co-Principal Investigator
Landing, William M.	Florida State University (FSU - EOAS)	Co-Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset contains concentrations of ultrapure water soluble aerosol trace elements collected from bulk aerosol samples on the 2015 US GEOTRACES Western Arctic Transect (USCG Healy GN01).

Table of Contents

Coverage

Spatial Extent: **N**:89.9447 **E**:-174.9595 **S**:56.0743 **W**:175.7522
Temporal Extent: 2015-08-10 - 2015-10-09

Dataset Description

This dataset contains concentrations of ultrapure water soluble aerosol trace elements collected from bulk aerosol samples on the 2015 US GEOTRACES Western Arctic Transect (USCG Healy GN01).

Acquisition Description

A total of fourteen 3-4 day integrated aerosol samples were collected during the US GEOTRACES Western Arctic research cruise (hereafter known as GN01), which took place from 9th August to 12th October 2015 on the USCGC Healy (cruise HLY1502). The cruise track consisted of a northward transect from Dutch Harbor, Alaska, across the Bering Sea, through the Bering Strait and across the Makarov Basin to the North Pole, followed by a return transect across the Canada Basin and back across the Bering Sea to Dutch Harbor.

Bulk aerosol samples for multiple trace element analyses were collected using one of five Tisch Environmental high-volume (~1 m^3 air min^{-1}) aerosol samplers (model 5170V-BL). For each deployment, 12 replicate 47 mm diameter Whatman 41 filters were loaded on open-face filter holders (Advantec MFS) installed on the aerosol sampler on a PVC adaptor plate (Shelley et al., 2015). Filters were acid-washed before use to reduce trace element blanks, following the procedure described by Morton et al. (2013). The samplers were deployed on the ship's flying bridge, ~23 m above sea level, to minimize the influence of sea spray on samples. Samplers were controlled by wind speed and direction, through a Campbell Scientific CR800 data-logger interfaced with an anemometer and wind vane set up in close proximity to the samplers, in order to eliminate contamination from the ship's stack exhaust. This setup was used to restrict sampling to periods when relative wind speed and direction were >0.5 m s^{-1} and from within ±60° of the bow of the ship, respectively, for at least five continuous minutes.

The soluble aerosol fraction was measured using a variation of the flow-through extraction technique described in Buck et al. (2006). The aerosol-laden filter was placed in a Teflon filter holder over a 0.2 um polycarbonate backing filter. While under vacuum, 100 mL of ultrapure deionized water (>18 MΩ·cm) was poured over the filter and the leachate solution collected in a 100 mL LDPE bottle. Following acidification with Teflon-distilled hydrochloric acid, the samples were analyzed for trace element concentration by a quadrupole inductively coupled mass spectrometer (Perkin Elmer Nexion 300D) coupled with a SeaFAST3 sample introduction and preconcentration system (Elemental Scientific) at the Skidaway Institute of Oceanography.

Processing Description

Data have been corrected for field and analytical blank. Reported aerosol trace element concentrations values have been normalized to the volume of air filtered during sample collection. Each sample collection period (n = 14) produced 36 replicate filters. Three of those filters were extracted with 100 mL of ultrapure water to produce three replicate measurements of soluble aerosol concentration. Data from the three replicates were averaged and reported along with the standard deviation. Outliers and replicate samples that were below the field blank value were not included in the mean. Data are marked as described in the datasheet.

Problem Report: The air volume sampled for Event 6197 was too low to produce reliable measurements. All data from this event are marked with the Flag=4.

Notes on concentration averages:
This dataset reports all 3 replicate values, plus the average and standard deviation of replicates, for all events except 6495 (for which only 2 replicates are reported). The average values are averages of 3 separate replicate filter ultrapure water leaches, except when values were excluded because:
(a) a value varied from the mean of the other two replicates by more than a factor of three, or
(b) a value was below the analytical detection limit.

Quality Flags: Quality flag definitions follow the SeaDataNet Scheme. More information on SeaDataNet flags is available from GEOTRACES at http://www.geotraces.org/library-88/geotraces-policies/1577-geotraces-quality-flag-policy and from SeaDataNet at https://www.seadatanet.org/Standards/Data-Quality-Control. In summary:

BDL - below detection limit,
0 - No QC performed,
1 - Good data,
2 - Probably good data,
3 - Probably bad data that is potentially correctable,
4 - Bad data,
5 - Value changed,
6 - Sample < blank,
8 - Interpolated value,
9 - Missing value.

BCO-DMO Processing Notes:
- replaced blanks (missing data) with "nd";
- modified parameter names to conform with BCO-DMO naming conventions (replaced spaces with underscores);
- added ISO_DateTime_UTC columns;
- 04 June 2020: updated to v2 (GEOTRACES IDP DOoR-formatted version).

[table of contents | back to top]

Related Publications

Buck, C. S., Landing, W. M., Resing, J. A., & Lebon, G. T. (2006). Aerosol iron and aluminum solubility in the northwest Pacific Ocean: Results from the 2002 IOC cruise. Geochemistry, Geophysics, Geosystems, 7(4), n/a–n/a. doi:10.1029/2005gc000977 https://doi.org/10.1029/2005GC000977
Methods

Kadko, D., Aguilar-Islas, A., Bolt, C., Buck, C. S., Fitzsimmons, J. N., Jensen, L. T., … Anderson, R. F. (2019). The residence times of trace elements determined in the surface Arctic Ocean during the 2015 US Arctic GEOTRACES expedition. Marine Chemistry, 208, 56–69. doi:10.1016/j.marchem.2018.10.011
Results

Morton, P. L., Landing, W. M., Hsu, S.-C., Milne, A., Aguilar-Islas, A. M., Baker, A. R., … Zamora, L. M. (2013). Methods for the sampling and analysis of marine aerosols: results from the 2008 GEOTRACES aerosol intercalibration experiment. Limnology and Oceanography: Methods, 11(2), 62–78. doi:10.4319/lom.2013.11.62
Methods

Shelley, R. U., Morton, P. L., & Landing, W. M. (2015). Elemental ratios and enrichment factors in aerosols from the US-GEOTRACES North Atlantic transects. Deep Sea Research Part II: Topical Studies in Oceanography, 116, 262–272. doi:10.1016/j.dsr2.2014.12.005
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
Station_ID	Station number; not applicable	unitless
Start_Date_UTC	Sampling start day (UTC); format: MM/DD/YY	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	unitless
End_Date_UTC	Sampling end day (UTC); format: MM/DD/YY	unitless

End_Time_UTC	Sampling end time (UTC); format: hh:mm	unitless
End_ISO_DateTime_UTC	Sampling end 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; not applicable	meters (m)
Al_A_SMLH2O_CONC_HIVOL_pgewna	Total particulate aerosol Aluminum (Al) concentration; detection limit: 1.17 pmol/m3 (detection limit air volume = 200 m3)	picomoles per cubic meter (pmol/m3)
SD1_Al_A_SMLH2O_CONC_HIVOL_pgewna	One standard deviation of Al_A_SMLH2O_CONC_HIVOL_pgewna	picomoles per cubic meter (pmol/m3)
Flag_Al_A_SMLH2O_CONC_HIVOL_pgewna	Quality flag for Al_A_SMLH2O_CONC_HIVOL_pgewna	None
Cd_A_SMLH2O_CONC_HIVOL_eptd5x	Total particulate aerosol Cadmium (Cd) concentration; detection limit: 0.00065 pmol/m3 (detection limit air volume = 200 m3)	picomoles per cubic meter (pmol/m3)
SD1_Cd_A_SMLH2O_CONC_HIVOL_eptd5x	One standard deviation of Cd_A_SMLH2O_CONC_HIVOL_eptd5x	picomoles per cubic meter (pmol/m3)
Flag_Cd_A_SMLH2O_CONC_HIVOL_eptd5x	Quality flag for Cd_A_SMLH2O_CONC_HIVOL_eptd5x	None
Co_A_SMLH2O_CONC_HIVOL_ehznjw	Total particulate aerosol Cobalt (Co) concentration; detection limit: 0.002 pmol/m3 (detection limit air volume = 200 m3)	picomoles per cubic meter (pmol/m3)
SD1_Co_A_SMLH2O_CONC_HIVOL_ehznjw	One standard deviation of Co_A_SMLH2O_CONC_HIVOL_ehznjw	picomoles per cubic meter (pmol/m3)
Flag_Co_A_SMLH2O_CONC_HIVOL_ehznjw	Quality flag for Co_A_SMLH2O_CONC_HIVOL_ehznjw	None

Cu_A_SMLH2O_CONC_HIVOL_2cnllt	Total particulate aerosol Copper (Cu) concentration; detection limit: 0.1238 pmol/m3 (detection limit air volume = 200 m3)	picomoles per cubic meter (pmol/m3)
SD1_Cu_A_SMLH2O_CONC_HIVOL_2cnllt	One standard deviation of Cu_A_SMLH2O_CONC_HIVOL_2cnllt	picomoles per cubic meter (pmol/m3)
Flag_Cu_A_SMLH2O_CONC_HIVOL_2cnllt	Quality flag for Cu_A_SMLH2O_CONC_HIVOL_2cnllt	None
Fe_A_SMLH2O_CONC_HIVOL_scryoi	Total particulate aerosol Iron (Fe) concentration; detection limit: 0.71 pmol/m3 (detection limit air volume = 200 m3)	picomoles per cubic meter (pmol/m3)
SD1_Fe_A_SMLH2O_CONC_HIVOL_scryoi	One standard deviation of Fe_A_SMLH2O_CONC_HIVOL_scryoi	picomoles per cubic meter (pmol/m3)
Flag_Fe_A_SMLH2O_CONC_HIVOL_scryoi	Quality flag for Fe_A_SMLH2O_CONC_HIVOL_scryoi	None
Mn_A_SMLH2O_CONC_HIVOL_tvrtax	Total particulate aerosol Manganese (Mn) concentration; detection limit: 0.016 pmol/m3 (detection limit air volume = 200 m3)	picomoles per cubic meter (pmol/m3)
SD1_Mn_A_SMLH2O_CONC_HIVOL_tvrtax	One standard deviation of Mn_A_SMLH2O_CONC_HIVOL_tvrtax	picomoles per cubic meter (pmol/m3)
Flag_Mn_A_SMLH2O_CONC_HIVOL_tvrtax	Quality flag for Mn_A_SMLH2O_CONC_HIVOL_tvrtax	None
Ni_A_SMLH2O_CONC_HIVOL_xyzhfj	Total particulate aerosol Nickel (Ni) concentration; detection limit: 0.069 pmol/m3 (detection limit air volume = 200 m3)	picomoles per cubic meter (pmol/m3)
SD1_Ni_A_SMLH2O_CONC_HIVOL_xyzhfj	One standard deviation of SD1_Ni_A_SMLH2O_CONC_HIVOL_xyzhfj	picomoles per cubic meter (pmol/m3)
Flag_Ni_A_SMLH2O_CONC_HIVOL_xyzhfj	Quality flag for SD1_Ni_A_SMLH2O_CONC_HIVOL_xyzhfj	None
Pb_A_SMLH2O_CONC_HIVOL_6hludc	Total particulate aerosol Lead (Pb) concentration; detection limit: 0.00042 pmol/m3 (detection limit air volume = 200 m3)	picomoles per cubic meter (pmol/m3)
SD1_Pb_A_SMLH2O_CONC_HIVOL_6hludc	One standard deviation of Pb_A_SMLH2O_CONC_HIVOL_6hludc	picomoles per cubic meter (pmol/m3)
Flag_Pb_A_SMLH2O_CONC_HIVOL_6hludc	Quality flag for Pb_A_SMLH2O_CONC_HIVOL_6hludc	None

V_A_SMLH2O_CONC_HIVOL_akpost	Total particulate aerosol Vanadium (V) concentration; detection limit: 0.0028 pmol/m3 (detection limit air volume = 200 m3)	picomoles per cubic meter (pmol/m3)
SD1_V_A_SMLH2O_CONC_HIVOL_akpost	One standard deviation of V_A_SMLH2O_CONC_HIVOL_akpost	picomoles per cubic meter (pmol/m3)
Flag_V_A_SMLH2O_CONC_HIVOL_akpost	Quality flag for V_A_SMLH2O_CONC_HIVOL_akpost	None
Zn_A_SMLH2O_CONC_HIVOL_wpsnkf	Total particulate aerosol Zinc (Zn) concentration; detection limit: 0.529 pmol/m3 (detection limit air volume = 200 m3)	picomoles per cubic meter (pmol/m3)
SD1_Zn_A_SMLH2O_CONC_HIVOL_wpsnkf	One standard deviation of Zn_A_SMLH2O_CONC_HIVOL_wpsnkf	picomoles per cubic meter (pmol/m3)
Flag_Zn_A_SMLH2O_CONC_HIVOL_wpsnkf	Quality flag for Zn_A_SMLH2O_CONC_HIVOL_wpsnkf	None

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Perkin Elmer Nexion 300D ICP-Mass Spectrometer
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	Soluble aerosol trace element measurements were analyzed by ICP-MS.
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	Tisch Environmental high-volume aerosol samplers
Generic Instrument Name	Aerosol Sampler
Dataset-specific Description	Bulk aerosol samples for multiple trace element analyses were collected using one of five Tisch Environmental high-volume (~1 m3 air min-1) aerosol samplers (model 5170V-BL).
Generic Instrument Description	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

[table of contents | back to top]

Deployments

HLY1502

Website	https://www.bco-dmo.org/deployment/638807
Platform	USCGC Healy
Report	http://dmoserv3.whoi.edu/data_docs/GEOTRACES/Arctic/ARC01-report.pdf
Start Date	2015-08-09
End Date	2015-10-12
Description	US GEOTRACES Arctic cruise: The cruise began in Dutch Harbor, Alaska on 08 October 2015. After a station in the Bering Sea, Healy cruised to the North Pole on a westerly track before returning to the Canadian margin on an easterly track, returning to Dutch Harbor on 10 October 2015.

[table of contents | back to top]

Project Information

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

Coverage: Arctic Ocean; Sailing from Dutch Harbor to Dutch Harbor

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.

Collaborative Research: GEOTRACES Arctic Section: Sampling and Analysis of Atmospheric Deposition (GEOTRACES Arctic Atmospheric Deposition)

NSF Award Abstract: In this project, a group of investigators participating in the 2015 U.S. GEOTRACES Arctic Ocean expedition will study the distribution of a variety of trace elements in seawater, sea ice, and marine air. It is important to understand where they are and how they move in the Arctic because 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. 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. This multi-institutional team of ocean trace element experts will focus its attention on the importance of aerosol, precipitation, and sea ice melt water in trace element cycling. Results from this work will be disseminated through public educational initiatives, such as web communications and outreach to members of the public, including indigenous populations in Alaska. The project will also provide training for graduate and undergraduate students in biology and chemistry. Atmospheric deposition is an important pathway and transport mechanism of both natural aerosols and contaminants to the ocean. Relative to other regions, atmospheric deposition rates in the Arctic are low and aerosols and dissolved chemicals in precipitation may be deposited directly to the sea surface or, unique to polar regions, onto sea ice. Given the unique biogeochemical processes of the region and its rapid changes in response to global climate change, quantifying the current atmospheric deposition of trace elements and isotopes to differing catchments (ocean, sea ice, and melt ponds) in the Arctic is critical to our ability to predict how their distribution may evolve over time. In this study, aerosol, precipitation, and melt water samples will be collected and analyzed for trace elements and isotopes in order to evaluate the impacts on the surface ocean and sea ice chemistry from natural and anthropogenic aerosols. Through this project, collected atmospheric samples from the Arctic will also be made available for distribution to the broader scientific community.

[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-1438047
NSF Division of Ocean Sciences (NSF OCE)	OCE-1435871
NSF Division of Ocean Sciences (NSF OCE)	OCE-1437266

[table of contents | back to top]