

Beryllium-7 Aerosol Concentration from USCGC Healy cruise HLY1502 in the Canada and Makarov Basins of the Arctic Ocean from August to October 2015 (US GEOTRACES Arctic)

Website: <https://www.bco-dmo.org/dataset/743554>

Data Type: Cruise Results

Version: 2

Version Date: 2018-08-14

Project

- » [U.S. Arctic GEOTRACES Study \(GN01\)](#) (U.S. GEOTRACES Arctic)
- » [GEOTRACES Arctic Section: Determining the Pathways, Fate, and Flux of Atmospherically Derived Trace Elements in the ocean/ice system](#) (GEOTRACES Arctic Atmospheric TE)

Program

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

| Contributors | Affiliation | Role |
|---------------------------------|---|------------------------|
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Coverage

Spatial Extent: N:89.94 E:174.96 S:56.07 W:-176.75

Temporal Extent: 2015-08-10 - 2015-10-09

Methods & Sampling

A total of fourteen 3-4 day integrated aerosol samples were collected during the US GEOTRACES Western Arctic research cruise (GN01, Marsay et al., 2016), which took place from 9th August to 12th October 2015 on the USCGC Healy (cruise HLY1502). Aerosol samples were obtained with a Tisch TE-5170V-BL high volume aerosol sampler, modified to collect 12 replicate samples on acid-washed (Wallace et al, 1977; Baker et al., 2006) 47mm diameter Whatman-41 (W-41) filters, using procedures of the US GEOTRACES aerosol program (Morton et al., 2013). In order to minimize the filter blanks for our experiment, the W-41 filters were pre-cleaned before deployment using three cycles of leaching with 0.5M HCl (Optima) then rinsing with ultra-high purity water (UHP water) according to trace element protocols in a HEPA-filtered laminar flow hood (Morton et al., 2013; similar to Baker et al., 2006).

For ^7Be , three of the 47mm aerosol samples were stacked in a plastic Petri dish and counted by gamma spectroscopy. ^7Be has a readily identifiable gamma peak at 478 keV. The counting system was calibrated for all samples by preparing a commercial standard in geometry identical to the samples.

Please refer to: Kadko & Olson (1996) and Kadko et al. (2016) (full citations below).

Data Processing Description

bd = below detection limit.

BCO-DMO Processing:

- changed date format from mm/dd/yyyy HH:MM to yyyy-mm-ddTHH:MM;
- replaced blanks (no data) with "nd";
- 05-Sept-2018: corrected longitude values by reversing sign.

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Data Files

| File |
|---|
| Aerosol_Be7.csv (Comma Separated Values (.csv), 1.44 KB) MD5:0125c58f8482463da1599b3e3e1a4295 |
| Primary data file for dataset ID 743554 |

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Related Publications

Baker, A. R., French, M., & Linge, K. L. (2006). Trends in aerosol nutrient solubility along a west-east transect of the Saharan dust plume. *Geophysical Research Letters*, 33(7). doi:10.1029/2005gl024764
<https://doi.org/10.1029/2005GL024764>

General

Kadko, D., & Olson, D. (1996). Beryllium-7 as a tracer of surface water subduction and mixed-layer history. *Deep Sea Research Part I: Oceanographic Research Papers*, 43(2), 89–116. doi:[10.1016/0967-0637\(96\)00011-8](https://doi.org/10.1016/0967-0637(96)00011-8)

Methods

Kadko, D., Galfond, B., Landing, W. M., & Shelley, R. U. (2016). Determining the pathways, fate, and flux of atmospherically derived trace elements in the Arctic ocean/ice system. *Marine Chemistry*, 182, 38–50. doi:[10.1016/j.marchem.2016.04.006](https://doi.org/10.1016/j.marchem.2016.04.006)

Results

Marsay, C. M., Kadko, D., Landing, W. M., Morton, P. L., Summers, B. A., & Buck, C. S. (2018). Concentrations, provenance and flux of aerosol trace elements during US GEOTRACES Western Arctic cruise GN01. *Chemical Geology*. doi:[10.1016/j.chemgeo.2018.06.007](https://doi.org/10.1016/j.chemgeo.2018.06.007)

Methods

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](https://doi.org/10.4319/lom.2013.11.62)

General

Wallace, G. T., Fletcher, I. S., & Duce, R. A. (1977). Filter washing, a simple means of reducing blank values and variability in trace metal environmental samples. *Journal of Environmental Science and Health . Part A: Environmental Science and Engineering*, 12(9), 493–506. doi:[10.1080/10934527709374775](https://doi.org/10.1080/10934527709374775)

General

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Parameters

| Parameter | Description | Units |
|-------------------------|--|--|
| GEOTRC_EVENTNO | GEOTRACES event number | unitless |
| GEOTRC_SAMPNO | Unique GEOTRACES sample number | unitless |
| SAMPLE_ID | Aerosol sample number | unitless |
| ISO_DateTime_UTC_Start | Date and time, formatted to the ISO 8601 standard, at the start of the sampling event. Format: YYYY-MM-DDTHH:MM:SS[.xx]Z | unitless |
| START_LAT | Latitude at the start of the sampling event; north is positive | decimal degrees |
| START_LONG | Longitude at the start of the sampling event; east is positive | decimal degrees |
| ISO_DateTime_UTC_End | Date and time, formatted to the ISO 8601 standard, at the end of the sampling event. Format: YYYY-MM-DDTHH:MM:SS[.xx]Z | unitless |
| END_LAT | Latitude at the end of the sampling event; north is positive | decimal degrees |
| END_LONG | Longitude at the end of the sampling event; east is positive | decimal degrees |
| AIR_VOL | Volume of air sampled | cubic meters |
| Be_7_A_T_CONC_HIVOL | Beryllium-7 Aerosol Concentration | milliBecquerel per cubic meter (mBq/m ³) |
| Be_7_A_T_CONC_HIVOL_ERR | Beryllium-7 Aerosol error | milliBecquerel per cubic meter (mBq/m ³) |

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Instruments

| | |
|---|--|
| Dataset-specific Instrument Name | Tisch TE-5170V-BL |
| Generic Instrument Name | Aerosol Sampler |
| Dataset-specific Description | Aerosol samples were obtained with a Tisch TE-5170V-BL high volume aerosol sampler. |
| Generic Instrument Description | A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere. |

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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 |

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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 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.

GEOTRACES Arctic Section: Determining the Pathways, Fate, and Flux of Atmospherically Derived Trace Elements in the ocean/ice system (GEOTRACES Arctic Atmospheric TE)

Coverage: Western Arctic Ocean

NSF Award Abstract:

In this project, a group of investigators participating in the 2015 U.S. Arctic GEOTRACES expedition will study the areal and depth distribution of Beryllium-7 in the western and central Arctic Ocean. Beryllium-7 (chemical symbol ^7Be) is a harmless, naturally-occurring radioisotope (half-life = 53 days) generated worldwide in the upper atmosphere by cosmic ray interaction with certain atmospheric gases. It continuously falls to the Earth's surface, especially during precipitation events, where it can be used as a convenient tracer for a wide variety of environmental processes. It is expected to be very useful in helping to meet the goals of the U.S. Arctic GEOTRACES expedition: namely, 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. Working alongside a multi-institutional team of ocean trace element experts, the work of the ^7Be research group should enable the team to determine the importance of atmospheric deposition of aerosols as a pathway for delivering trace elements from the continents to the deep Arctic Ocean and also to study how the presence or absence of surface sea ice influences the behavior of trace elements in the water column. Like many other participants in the expedition, the ^7Be researchers plan to train graduate students in their research and to be involved in public educational outreach efforts in coastal communities in Alaska.

This project will address three priority tasks formulated within the International GEOTRACES Science and Arctic Implementation Plans. First, it will provide realistic estimates of the underlying transport processes influencing distributions of many trace elements of interest (TEIs). Water column measurements of ^7Be will be used as a tracer of physical mixing processes, which redistribute biologically active species in the upper water column. Quantitative knowledge of the circulation, mixing, and ventilation of the water masses within which TEIs reside allows an assessment of the time- and space-integrated in situ biogeochemical behavior of these elements. Secondly, ^7Be will be used to trace the partitioning of atmospherically deposited elements within the Arctic catchments. The Arctic is unique to other GEOTRACES basins studied to date. For numerous TEIs, measurement not only in the water column, but also in the additional repositories of ice, snow and melt ponds is critical. The inventory of ^7Be within these catchments will be used to trace the partitioning of atmospherically deposited elements within the Arctic ocean/ice system. Thirdly, ^7Be data will be used to improve methods for quantifying the atmospheric deposition of TEIs. Measurements of ^7Be in the surface waters and in the lower atmosphere will be used to develop estimates of the atmospheric input of relevant TEIs. In the Arctic, aerosol deposition is an important pathway for delivering trace element species, but assessment of this input has heretofore proven to be difficult.

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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-1434085 |

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