

# Small particulate Polonium 210 and Lead 210 measurements from the Western Arctic Ocean, which were sampled as part of the 2015 US GEOTRACES Cruise, HLY1502 (GN01), on USCGC Healy

**Website:** <https://www.bco-dmo.org/dataset/808502>

**Data Type:** Cruise Results

**Version:** 1

**Version Date:** 2020-04-07

## Project

» [U.S. Arctic GEOTRACES Study \(GN01\)](#) (U.S. GEOTRACES Arctic)

» [GEOTRACES Arctic Section: Disequilibria between Radium-226, Lead-210 and Polonium-210 in the Arctic Ocean and their implications for trace metal distribution](#) (GEOTRACES Arctic Trace Metal Disequilibria)

## Program

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

Contributors	Affiliation	Role
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<a href="#">Bam, Wokil</a>	Louisiana State University (LSU)	Co-Principal Investigator
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## Abstract

This dataset includes small particulate Polonium 210 and Lead 210 measurements from the Western Arctic Ocean, which were sampled as part of the 2015 US GEOTRACES Cruise (GN01; HLY1502). These data have been published in Bam et al., 2020.

## 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:80.473 E:-148.939 S:60.224 W:-179.049

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

## Dataset Description

This dataset includes small particulate Polonium 210 and Lead 210 measurements from the Western Arctic Ocean, which were sampled as part of the 2015 US GEOTRACES Cruise (GN01; HLY1502). These data have been published in Bam et al., 2020.

## Methods & Sampling

Both the sample collection and analytical methods were done following the GEOTRACES Cookbook (Cutter et al., 2017).

Particulate Po-210 and Pb-210 was collected using large volume McLane pumps. Samples were collected on two different filter sizes, small particles (1- 51  $\mu\text{m}$ ) and large particles ( $>51 \mu\text{m}$ ) filtering 500-800 L seawater. This dataset contains data on the small particles.

Analytical procedures were performed at Louisiana State University, following the protocol described in GEOTRACES Cookbook, Flynn (1968) and Fleer and Bacon (1984). The counting for Po-210 was done using Canberra Alpha Analyst high-resolution silicon-surface barrier (PIPS). The counting error was less than 10% for all the samples including the tracer.

## Data Processing Description

**Data Processing:** Followed Baskaran et al (2013) and Rigaud et al. (2013) for the data calculation.

Data were flagged using the SeaDataNet quality flag scheme. For more information on SeaDataNet flags, see: <https://www.geotraces.org/geotraces-quality-flag-policy/> and <https://www.seadatanet.org/Standards/Data-Quality-Control>

### SeaDataNet quality flag definitions:

0 = No quality control;  
1 = Good value;  
2 = Probably good value;  
3 = Probably bad value;  
4 = Bad value;  
5 = Changed value;  
6 = Value below detection;  
7 = Value in excess;  
8 = Interpolated value;  
9 = Missing value;  
A = Value phenomenon uncertain.

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

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## Data Files

File
<b>Po-Pb_SPT.csv</b> (Comma Separated Values (.csv), 10.46 KB) MD5:3351eeb5ab7250786807bc7ab3445709 Primary data file for dataset ID 808502

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

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## Related Publications

Bam, W., Maiti, K., Baskaran, M., Krupp, K., Lam, P. J., & Xiang, Y. (2020). Variability in  $^{210}\text{Pb}$  and  $^{210}\text{Po}$  partition coefficients ( $K_d$ ) along the US GEOTRACES Arctic transect. *Marine Chemistry*, 219, 103749. doi:[10.1016/j.marchem.2020.103749](https://doi.org/10.1016/j.marchem.2020.103749)  
*Results*

Baskaran, M., Church, T., Hong, G., Kumar, A., Qiang, M., Choi, H., ... Maiti, K. (2013). Effects of flow rates and composition of the filter, and decay/ingrowth correction factors involved with the determination of in situ particulate  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  in seawater. *Limnology and Oceanography: Methods*, 11(3), 126-138. doi:[10.4319/lom.2013.11.126](https://doi.org/10.4319/lom.2013.11.126)  
*Methods*

Cutter, Gregory, Casciotti, Karen, Croot, Peter, Geibert, Walter, Heimbürger, Lars-Eric, Lohan, Maeve, Planquette, Hélène, van de Flierdt, Tina (2017) Sampling and Sample-handling Protocols for GEOTRACES Cruises. Version 3, August 2017. Toulouse, France, GEOTRACES International Project Office, 139pp. & Appendices. DOI: <http://dx.doi.org/10.25607/OBP-2>  
*Methods*

Fleer, A. P., & Bacon, M. P. (1984). Determination of <sup>210</sup>Pb and <sup>210</sup>Po in seawater and marine particulate matter. Nuclear Instruments and Methods in Physics Research, 223(2-3), 243–249. doi:[10.1016/0167-5087\(84\)90655-0](https://doi.org/10.1016/0167-5087(84)90655-0)  
*Methods*

Flynn, W. W. (1968). The determination of low levels of polonium-210 in environmental materials. Analytica Chimica Acta, 43, 221–227. doi:10.1016/s0003-2670(00)89210-7 [https://doi.org/10.1016/S0003-2670\(00\)89210-7](https://doi.org/10.1016/S0003-2670(00)89210-7)  
*Methods*

Rigaud, S., Puigcorbé, V., Cámara-Mor, P., Casacuberta, N., Roca-Martí, M., Garcia-Orellana, J., ... Church, T. (2013). A methods assessment and recommendations for improving calculations and reducing uncertainties in the determination of <sup>210</sup>Po and <sup>210</sup>Pb activities in seawater. Limnology and Oceanography: Methods, 11(10), 561–571. doi:[10.4319/lom.2013.11.561](https://doi.org/10.4319/lom.2013.11.561)  
*Methods*

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

## Parameters

Parameter	Description	Units
Station_ID	Station identifier	unitless
Start_Date_UTC	Date (UTC) at start of sampling; format: yyyy-mm-dd	unitless
Start_Time_UTC	Time (UTC) at start of sampling; format: HH:MM	unitless
End_Date_UTC	Date (UTC) at end of sampling; format: yyyy-mm-dd	unitless
End_Time_UTC	Time (UTC) at end of sampling; format: HH:MM	unitless
Start_Latitude	Latitude at start of sampling	degrees North
Start_Longitude	Longitude at start of sampling	degrees East
End_Latitude	Latitude at end of sampling	degrees North
End_Longitude	Longitude at end of sampling	degrees East
Event_ID	GEOTRACES event number	unitless
Sample_ID	GEOTRACES sample number	unitless

Sample_Depth	Sample depth	meters (m)
Pb_210_SPT_CONC_PUMP_cbmm3u	Concentration (or activity) of 210Pb in small particles	mBq/kg
SD1_Pb_210_SPT_CONC_PUMP_cbmm3u	One standard deviation for Pb_210_SPT_CONC_PUMP_cbmm3u	mBq/kg
Flag_Pb_210_SPT_CONC_PUMP_cbmm3u	Quality flag for Pb_210_SPT_CONC_PUMP_cbmm3u	None
Po_210_SPT_CONC_PUMP_5c1vo9	Concentration (or activity) of 210Po in small particles	mBq/kg
SD1_Po_210_SPT_CONC_PUMP_5c1vo9	One standard deviation for Po_210_SPT_CONC_PUMP_5c1vo9	mBq/kg
Flag_Po_210_SPT_CONC_PUMP_5c1vo9	Quality flag for Po_210_SPT_CONC_PUMP_5c1vo9	None
Start_ISO_DateTime_UTC	Date and time (UTC) at start of sampling formatted to ISO 8601 standard; format: yyyy-mm-ddT:HH:MMZ	unitless
End_ISO_DateTime_UTC	Date and time (UTC) at end of sampling formatted to ISO 8601 standard; format: yyyy-mm-ddT:HH:MMZ	unitless

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

## Instruments

<b>Dataset-specific Instrument Name</b>	large volume McLane pumps
<b>Generic Instrument Name</b>	McLane Pump
<b>Generic Instrument Description</b>	McLane pumps sample large volumes of seawater at depth. They are attached to a wire and lowered to different depths in the ocean. As the water is pumped through the filter, particles suspended in the ocean are collected on the filters. The pumps are then retrieved and the contents of the filters are analyzed in a lab.

<b>Dataset-specific Instrument Name</b>	Alpha Spectroscopy Passivated Implanted Planar Silicon (PIPS) detector
<b>Generic Instrument Name</b>	Spectrometer
<b>Dataset-specific Description</b>	Canberra Alpha Analyst high-resolution 142 silicon-surface barrier (PIPS)
<b>Generic Instrument Description</b>	A spectrometer is an optical instrument used to measure properties of light over a specific portion of the electromagnetic spectrum.

## Deployments

### HLY1502

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/638807">https://www.bco-dmo.org/deployment/638807</a>
<b>Platform</b>	USCGC Healy
<b>Report</b>	<a href="https://datadocs.bco-dmo.org/docs/302/geotraces/GEOTRACES_ARCTIC/data_docs/cruise_reports/healy1502.pdf">https://datadocs.bco-dmo.org/docs/302/geotraces/GEOTRACES_ARCTIC/data_docs/cruise_reports/healy1502.pdf</a>
<b>Start Date</b>	2015-08-09
<b>End Date</b>	2015-10-12
<b>Description</b>	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): <a href="https://www.rvdata.us/search/cruise/HLY1502">https://www.rvdata.us/search/cruise/HLY1502</a>

## 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: Disequilibria between Radium-226, Lead-210 and Polonium-210 in the Arctic Ocean and their implications for trace metal distribution (GEOTRACES Arctic Trace Metal Disequilibria)**

**Coverage:** Canadian Arctic

### *NSF Award Abstract:*

This project will form part of the 2015 U.S. GEOTRACES Arctic expedition. 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 (TEIs) 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. Within this broader framework, the goal of this project is to measure the naturally occurring radionuclides radium-226 (half-life 1600 years), lead-210 (half-life 22.1 y) and polonium-210 (half-life 138 days) to determine removal rates of particle reactive TEIs from the water column and to study the processes responsible for their scavenging, lateral and vertical transport and accumulation in bottom sediments. A wide range of processes will be encountered along the proposed ARCTIC GEOTRACES section and the proposed study will play a key role in the interpretation of observed TEI distributions and address the following questions: (1) What is the variability in scavenging intensity of polonium and lead between the Pacific waters and that of particle dominated areas of the shelf? (2) How does the scavenging intensity of polonium and lead change across areas of varying nutrient concentrations in the Chukchi Sea? (3) How does the scavenging intensity vary between Canadian Basin and the Makarov Basin? (4) Which are the areas of enhanced sediment focusing in this region and how important is the role of boundary scavenging and lateral transport of particles with respect to lead-210 distribution in water column and sediments? (5) What are the seasonal scale vertical fluxes of particulate organic matter in this region and the relative importance of lateral versus vertical transport of organic matter and other TEIs? (6) How do particle mixing rates vary across the basin and impact reduction rates? (7) Are the bottom waters in the shelf region enriched in polonium-210 due to sediment remobilization? The ability to address these questions will allow better understanding of processes controlling the distribution in this region of other TEIs that will be measured by other investigators. The broader impacts of the research include the involvement of 1 Ph.D. student and at least 2 undergraduate students. The lead investigator is an early-career scientist and this project will help him in extending his expertise in the Arctic region and further development of his career. The investigator is involved in numerous local outreach activities that will provide opportunities for education of the general public and high school students about marine ecosystems and how it affects their environmental well-being. Moreover this research will also be a part of the broader Arctic GEOTRACES outreach program which plans to support the participation of a high-school science teacher on the cruise through partnership with PolarTREC and COSEE-Alaska.

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

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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.

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

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## Funding

Funding Source	Award
<a href="#">NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)</a>	<a href="#">OPP-1435376</a>

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