

# Activities of 210Po and 210Pb in aerosol samples collected on Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from September to October 2018

**Website:** <https://www.bco-dmo.org/dataset/878689>

**Data Type:** Cruise Results

**Version:** 1

**Version Date:** 2022-08-17

## Project

» [US GEOTRACES Pacific Meridional Transect \(GP15\)](#) (U.S. GEOTRACES PMT)

» [Collaborative Research: Lead-210 and Polonium-210 as tracers for scavenging and export: GEOTRACES Pacific Meridional Section](#) (PMT Lead-210 and Polonium-210)

## Program

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

Contributors	Affiliation	Role
<a href="#">Cochran, J. Kirk</a>	Stony Brook University (SUNY Stony Brook)	Principal Investigator
<a href="#">Kadko, David C.</a>	Florida International University (FIU)	Co-Principal Investigator
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## Abstract

This dataset includes activities of 210Po (Polonium-210) and 210Pb (Lead-210) in aerosol samples collected on Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from September to October 2018.

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## Coverage

**Spatial Extent:** N:55.08 E:-129.04 S:22 W:-155.72

**Temporal Extent:** 2018-09-20 - 2018-10-20

## Methods & Sampling

Aerosol samples were collected by Clifton Buck and colleagues, who were funded separately. Bulk aerosol samples were collected on 12-replicate acid-washed, 47-mm Whatman 41 (W41) ashless filter discs mounted in Advantec-MFS polypropylene open-face filter holders. Three filters with combined filter air volumes of ~360 to 1100 cubic meters were provided for 210Po and 210Pb. Aerosol filters were placed in microwave digestion vessels, spiked with 209Po tracer (1.76 dpm) and 10 mg stable Pb, and totally dissolved in a mixture of concentrated 5 mL of HCl, HNO<sub>3</sub>, and HF. Sample solutions were centrifuged, evaporated to dryness, redissolved in concentrated HCl, evaporated again, and picked up in 1.5N HCl for plating. Po was plated onto silver discs with heating for 3 hours. Residual Po was removed from the samples by suspending a piece of scrap Ag in them for 5 days, with periodic stirring, after which

they were transferred to polycarbonate bottles for storage and ingrowth of additional  $^{210}\text{Po}$ . An aliquot of each stored solution was analyzed for Pb concentration by Inductively-Coupled-Plasma Mass Spectroscopy to determine Pb recoveries. Recoveries generally ranged from 83-100% (average  $92 \pm 6\%$ ). A second plating was carried out after ~6 months of storage to determine  $^{210}\text{Pb}$  from ingrown  $^{210}\text{Po}$ . All activities were corrected as appropriate to the time of sample collection, as described in Rigaud et al. (2013), and complete details are given in Wei (2021). Detector backgrounds and blanks were subtracted from all samples, and blank activities were less than 8% those of the aerosol samples. Errors were propagated using standard error propagation formulas (Rigaud et al., 2013) and included counting errors on sample, background and blank  $^{210}\text{Po}$  and  $^{209}\text{Po}$ , spiking errors, weighing errors (for water samples) and uncertainty of the  $^{209}\text{Po}$  tracer activity. Due to the long time interval between sampling and initial  $^{210}\text{Po}$  plating, the ingrowth and decay corrections for  $^{210}\text{Po}$  were large. As a consequence, the initial  $^{210}\text{Po}/^{210}\text{Pb}$  activity ratio in most samples is small and scatters around  $0.0 \pm 0.2$ .

## Data Processing Description

### Data Processing:

Data were processed in Excel spreadsheets (according to the approach of Rigaud et al. (2013)).

Quality flags were applied following the GEOTRACES flag definitions (<https://www.geotraces.org/geotraces-quality-flag-policy/>) where 1 = "good data".

### BCO-DMO Processing:

- renamed fields to comply with BCO-DMO naming conventions;
- created start and end date-time fields in ISO8601 format;
- renamed StationID to GEOTRC\_SAMPNO.

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## Data Files

File
<b>Po210_Pb210_Aerosols_Leg1.csv</b> (Comma Separated Values (.csv), 1.52 KB) MD5:7715fe2c01bb3e85b9ce118f78c8abd8
Primary data file for dataset ID 878689

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## Related Publications

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  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  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*

Wei, Z. (2021)  $^{210}\text{Pb}$  and  $^7\text{Be}$  as Coupled Flux and Source Tracers for Aerosols in the Pacific Ocean. Master's Thesis, Stony Brook University, 34 pp.

*Methods*

Wei, Z., Cochran, J. K., Horowitz, E., Fitzgerald, P., Heilbrun, C., Kadko, D., Stephens, M., Marsay, C. M., Buck, C. S., & Landing, W. M. (2022).  $^{210}\text{Pb}$  and  $^7\text{Be}$  as Coupled Flux and Source Tracers for Aerosols in the Pacific Ocean. *Global Biogeochemical Cycles*, 36(8). Portico. <https://doi.org/10.1029/2022gb007378>

*Results*

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## Related Datasets

### IsContinuedBy

Cochran, J. K., Kadko, D. C. (2022) **Activities of  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  in aerosol samples collected on Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise**

**(GP15, RR1815) on R/V Roger Revelle from October to November 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-08-17 doi:10.26008/1912/bco-dmo.878703.1 [[view at BCO-DMO](#)]

*Relationship Description: GP15 was made up of two cruise legs, RR1814 (Leg 1) and RR1815 (Leg 2).*

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## Parameters

Parameter	Description	Units
GEOTRC_SAMPNO	GEOTRACES sample number	unitless
Start_ISO_DateTime_UTC	Date and time (UTC) at start of sample collection in ISO8601 format: YYYY-MM-DDThh:mmZ	unitless
End_ISO_DateTime_UTC	Date and time (UTC) at end of sample collection in ISO8601 format: YYYY-MM-DDThh:mmZ	unitless
Start_Latitude	Latitude at start of sample collection	degrees North
Start_Longitude	Longitude at start of sample collection	degrees East
End_Latitude	Latitude at end of sample collection	degrees North
End_Longitude	Longitude at end of sample collection	degrees East
Air_Volume_Total	Air volume sampled	cubic meters
Po_210_A_T_CONC_HIVOL_orqzd	210Po activity	mBq/m3
SD1_Po_210_A_T_CONC_HIVOL_orqzd	One standard deviation of Po_210_A_T_CONC_HIVOL_orqzd	mBq/m3
Flag_Po_210_A_T_CONC_HIVOL_orqzd	Quality flag for Po_210_A_T_CONC_HIVOL_orqzd	unitless
Pb_210_A_T_CONC_HIVOL_zxeaxo	210Pb activity	mBq/m3
SD1_Pb_210_A_T_CONC_HIVOL_zxeaxo	One standard deviation of Pb_210_A_T_CONC_HIVOL_zxeaxo	mBq/m3
Flag_Pb_210_A_T_CONC_HIVOL_zxeaxo	Quality flag for Pb_210_A_T_CONC_HIVOL_zxeaxo	unitless

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## Instruments

<b>Dataset-specific Instrument Name</b>	
<b>Generic Instrument Name</b>	Aerosol Sampler
<b>Dataset-specific Description</b>	Bulk aerosol samples were collected on 12-replicate acid-washed, 47-mm Whatman 41 (W41) ashless filter discs mounted in Advantec-MFS polypropylene open-face filter holders
<b>Generic Instrument Description</b>	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

<b>Dataset-specific Instrument Name</b>	Inductively-Coupled-Plasma Mass Spectroscopy
<b>Generic Instrument Name</b>	Inductively Coupled Plasma Mass Spectrometer
<b>Generic Instrument Description</b>	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.

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## Deployments

### RR1814

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/776913">https://www.bco-dmo.org/deployment/776913</a>
<b>Platform</b>	R/V Roger Revelle
<b>Report</b>	<a href="https://datadocs.bco-dmo.org/docs/geotraces/GEOTRACES_PMT/casciotti/data_docs/GP15_Cruise_Report_with_ODF_Report.pdf">https://datadocs.bco-dmo.org/docs/geotraces/GEOTRACES_PMT/casciotti/data_docs/GP15_Cruise_Report_with_ODF_Report.pdf</a>
<b>Start Date</b>	2018-09-18
<b>End Date</b>	2018-10-21
<b>Description</b>	Additional cruise information is available from the Rolling Deck to Repository (R2R): <a href="https://www.rvdata.us/search/cruise/RR1814">https://www.rvdata.us/search/cruise/RR1814</a>

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## Project Information

### US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)

**Website:** <http://www.geotraces.org/>

**Coverage:** Pacific Meridional Transect along 152W (GP15)

A 60-day research cruise took place in 2018 along a transect from Alaska to Tahiti at 152° W. A description of the project titled "*Collaborative Research: Management and implementation of the US GEOTRACES Pacific Meridional Transect*", funded by NSF, is below. Further project information is available on the [US GEOTRACES website](#) and on the [cruise blog](#). A detailed [cruise report is also available](#) as a PDF.

*Description from NSF award abstract:*

GEOTRACES is a global effort in the field of Chemical Oceanography in which the United States plays a major role. The goal of the GEOTRACES program is to understand the distributions of many elements and their isotopes in the ocean. Until quite recently, these elements could not be measured at a global scale. Understanding the distributions of these elements and isotopes will increase the understanding of processes that shape their distributions and also the

processes that depend on these elements. For example, many "trace elements" (elements that are present in very low amounts) are also important for life, and their presence or absence can play a vital role in the population of marine ecosystems. This project will launch the next major U.S. GEOTRACES expedition in the Pacific Ocean between Alaska and Tahiti. The award made here would support all of the major infrastructure for this expedition, including the research vessel, the sampling equipment, and some of the core oceanographic measurements. This project will also support the personnel needed to lead the expedition and collect the samples.

This project would support the essential sampling operations and infrastructure for the U.S. GEOTRACES Pacific Meridional Transect along 152° W to support a large variety of individual science projects on trace element and isotope (TEI) biogeochemistry that will follow. Thus, the major objectives of this management proposal are: (1) plan and coordinate a 60 day research cruise in 2018; (2) obtain representative samples for a wide variety of TEIs using a conventional CTD/rosette, GEOTRACES Trace Element Sampling Systems, and in situ pumps; (3) acquire conventional CTD hydrographic data along with discrete samples for salinity, dissolved oxygen, algal pigments, and dissolved nutrients at micro- and nanomolar levels; (4) ensure that proper QA/QC protocols are followed and reported, as well as fulfilling all GEOTRACES intercalibration protocols; (5) prepare and deliver all hydrographic data to the GEOTRACES Data Assembly Centre (via the US BCO-DMO data center); and (6) coordinate all cruise communications between investigators, including preparation of a hydrographic report/publication. This project would also provide baseline measurements of TEIs in the Clarion-Clipperton fracture zone (~7.5°N-17°N, ~155°W-115°W) where large-scale deep sea mining is planned. Environmental impact assessments are underway in partnership with the mining industry, but the effect of mining activities on TEIs in the water column is one that could be uniquely assessed by the GEOTRACES community. In support of efforts to communicate the science to a wide audience the investigators will recruit an early career freelance science journalist with interests in marine science and oceanography to participate on the cruise and do public outreach, photography and/or videography, and social media from the ship, as well as to submit articles about the research to national media. The project would also support several graduate students.

### **Collaborative Research: Lead-210 and Polonium-210 as tracers for scavenging and export: GEOTRACES Pacific Meridional Section (PMT Lead-210 and Polonium-210)**

#### *NSF Award Abstract:*

The goal of the international GEOTRACES program is to understand the distributions of trace chemical elements and their isotopes in the oceans. These chemical species play important roles in the ocean as nutrients, tracers of current and past oceanographic processes, and as contaminants from human activity. Their biogeochemical cycling has direct implications for research in such diverse areas as the carbon cycle, climate change, and ocean ecosystems. This project will use measurement of two natural radionuclides -- lead-210 and polonium-210 -- to provide important information about the rates of processes that affect trace elements and isotopes (TEIs) that will be measured during a U.S. GEOTRACES expedition in the Pacific Ocean in 2018. The research proposed here will address key tasks formulated within the GEOTRACES Science Plan.

Many processes in the ocean cannot be observed directly but tracers such as polonium-210 (half-life = 138 days) and lead-210 (half-life = 22.3 years) that have unique chemical properties and relevant decay timescales can be used to provide important constraints on their rates and pathways. The goals of this research are to: 1) use Pb-210, along with another project measuring Be-7, in aerosols and precipitation to characterize aerosol and TEI sources, 2) determine scavenging rates of particle-reactive TEIs through the water column using Po-210 and Pb-210, 3) use Po-210 / Pb-210 disequilibrium in the upper water column as a proxy for the sinking flux of particulate organic carbon (POC), and 4) use Pb-210 as a tracer of the influence of hydrothermal processes on water column distributions of TEIs. This work will build on a database of Po/Pb distributions in the world ocean (and the Pacific Ocean, in particular) obtained through programs such as GEOSECS, GEOTRACES, and independent studies. A graduate student will be trained as part of this project. The lead investigator, Cochran, plans to incorporate information about GEOTRACES sampling strategies in the planning for a travelling exhibition on "The Oceans" through his adjunct appointment at the American Museum of Natural History (New York). Project partner Kadko plans to incorporate GEOTRACES work in an international graduate course through the Nippon Foundation, Partnership for Observation of the Global Oceans Center of Excellence.

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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
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1736591</a>
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1736612</a>

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