

Aerosol and seawater beryllium-7 concentrations from 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/781794>

Data Type: Cruise Results

Version: 1

Version Date: 2020-04-20

Project

- » [US GEOTRACES Pacific Meridional Transect](#) (U.S. GEOTRACES PMT)
- » [GEOTRACES Pacific Meridional Transect: Measurement of Beryllium-7 as a Tracer of Upper Ocean Processes](#) (PMT Be-7)

Program

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

Contributors	Affiliation	Role
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Abstract

Aerosol and seawater beryllium-7 concentrations from 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

Acquisition Description

Be-7 Aerosol:

Aerosol samples were collected between Sept 20, 2018 and Nov 23, 2018 during the U.S. GEOTRACES PMT cruise, R/V Roger Revelle (RR1814), 18 September 2018 - 24 November 2018, Seattle, Washington - Papeete, Tahiti, French Polynesia (with a port stop in Hilo, Hawaii, 21-25, October 2018). 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.

Be-7 Seawater:

A weighted sampling hose, attached to a submersible pump with a portable ctd was deployed over the aft of the ship to collect seawater for ^7Be analysis. The seawater was collected in plastic 700 liter holding tanks and then passed through iron-oxide impregnated acrylic fiber filters (adsorbs ^7Be). The efficiency of the fiber for extraction of ^7Be from seawater was determined by adding stable ^9Be atomic absorption standards to a drum containing seawater, pumping the water through an iron fiber cartridge, and at every 100 L measuring the ^9Be content of the cartridge effluent. Based on several trials, it was found that for sample volumes in the range 400-700L, extraction efficiencies are respectively, $82 \pm 3\%$ to $76 \pm 2\%$.

All fibers were returned to the lab where they were dried and ashed. Fiber samples were pressed into pellets. All samples were then placed over a low background germanium gamma detector. ^7Be has a readily identifiable peak at 478keV. The detector is calibrated for these samples by adding a commercially prepared mixed solution of known gamma activities to ashed fiber and counting in the appropriate geometry.

Processing Description

Please refer to: Kadko, D. and D. Olson (1996) ^7Be as a tracer of surface water subduction and mixed layer history. Deep Sea Res. 43, 89-116.

Data quality flags:

SeaDataNet data quality flags have been assigned to these data. More information 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:

- 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 (BDL)
- 7 = value in excess
- 8 = interpolated value
- 9 = missing value

BCO-DMO Processing:

- renamed columns (replaced special symbols with underscores);

- added date/time fields in ISO8601 format;
- converted longitude values to negative to indicate West.

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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> [details]

Kadko, D. (2017). Upwelling and primary production during the U.S. GEOTRACES East Pacific Zonal Transect. *Global Biogeochemical Cycles*. doi:10.1002/2016gb005554 <https://doi.org/10.1002/2016GB005554> [details]

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) [details]

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) [details]

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) [details]

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Parameters

Parameter	Description	Units
Station_ID	Station number	unitless
Start_Date_UTC	Start date (UTC); format: YYYY-mm-dd	unitless
Start_Time_UTC	Start time (UTC); format: HH:MM	unitless
Start_ISO_DateTime_UTC	Start date and time (UTC) formatted to ISO8601 standard; format: YYYY-mm-ddTHH:MMZ	unitless
End_Date_UTC	End date (UTC); format: YYYY-mm-dd	unitless
End_Time_UTC	End time (UTC); format: HH:MM	unitless
End_ISO_DateTime_UTC	End date and time (UTC) formatted to ISO8601 standard; format: YYYY-mm-ddTHH:MMZ	unitless
Start_Latitude	Start latitude; positive values = North	decimal degrees
Start_Longitude	Start longitude; positive values = East	decimal degrees
End_Latitude	End latitude; positive values = North	decimal degrees
End_Longitude	End longitude; positive values = East	decimal degrees
Event_ID	Event number	unitless
Sample_ID	GEOTRACES sample number	unitless
Sample_Depth	Sample depth	meters (m)
Be_7_A_T_CONC_HIVOL_pv5z9e	Concentration (or activity) for total Be-7 in aerosols (No leaching)	milliBecquerel per cubic meter (mBq/m ³)
SD1_Be_7_A_T_CONC_HIVOL_pv5z9e	One standard deviation of Be_7_A_T_CONC_HIVOL_pv5z9e	mBq/m ³
Flag_Be_7_A_T_CONC_HIVOL_pv5z9e	Quality flag for Be_7_A_T_CONC_HIVOL_pv5z9e	unitless
Be_7_D_CONC_PUMP_kzmaqr	Seawater Be-7 activity or concentration	microBecquerels per kilogram (uBq/kg)
SD1_Be_7_D_CONC_PUMP_kzmaqr	One standard deviation of Be_7_D_CONC_PUMP_kzmaqr	uBq/kg
Flag_Be_7_D_CONC_PUMP_kzmaqr	Quality flag for Be_7_D_CONC_PUMP_kzmaqr	unitless

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Instruments

Dataset-specific Instrument Name	Tisch TE-5170V-BL high volume aerosol sampler
Generic Instrument Name	Aerosol Sampler
Dataset-specific Description	Aerosol samples were obtained with a Tisch TE-5170V-BL high volume aerosol sampler, modified to collect 12 replicate samples on acid-washed 47mm diameter Whatman-41 (W-41) filters, using procedures of the US GEOTRACES aerosol program.
Generic Instrument Description	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

Dataset-specific Instrument Name	
Generic Instrument Name	Pump
Dataset-specific Description	A weighted sampling hose, attached to a submersible pump with a portable ctd was deployed over the aft of the ship to collect seawater for Be-7 analysis.
Generic Instrument Description	A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps

Dataset-specific Instrument Name	gamma spectroscopy
Generic Instrument Name	Gamma Ray Spectrometer
Dataset-specific Description	For 7Be, three of the 47mm aerosol samples were stacked in a plastic Petri dish and counted by gamma spectroscopy
Generic Instrument Description	Instruments measuring the relative levels of electromagnetic radiation of different wavelengths in the gamma-ray waveband.

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Deployments

RR1814

Website	https://www.bco-dmo.org/deployment/776913
Platform	R/V Roger Revelle
Report	https://datadocs.bco-dmo.org/docs/geotraces/GEOTRACES_PMT/casciotti/data_docs/GP15_Cruise_Report_with_ODF_Report.pdf
Start Date	2018-09-18
End Date	2018-10-21

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Project Information

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

Website: http://www.usgeotraces.org/USGEOTRACES_website/html/pacific-alaska.html

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.

GEOTRACES Pacific Meridional Transect: Measurement of Beryllium-7 as a Tracer of Upper Ocean Processes (PMT Be-7)

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. One of the stated goals in the GEOTRACES Science Plan is to "create a unique opportunity for exploration and discovery by determining the distributions of novel trace elements and isotopes (TEIs) that have received little attention to date." This is a proposal to make measurements of one such species, the radioactive isotope beryllium-7 which will provide important biogeochemical rate information pertinent to the TEIs that will be measured during the 2018 U.S. GEOTRACES Pacific Meridional transect from Tahiti to Alaska. Many processes in the ocean cannot be directly observed and as such, tracers are used to provide important constraints on their rates and pathways. Beryllium-7 is a tracer that, because of its half-life (53.3 days), allows the study of processes which occur over time scales and depth scales that are otherwise difficult to obtain but which are critically important to studies of biological production, nutrient regeneration, and atmospheric deposition, to name a few. Advances in sampling and analytical techniques, coupled with a better understanding of the behavior of Be-7 in ocean biogeochemical cycles, present an opportunity to fully utilize this tracer. The proposed work has three main components: 1) Measurements of Be-7 in the surface waters and in the lower atmosphere along the cruise track will provide estimates of the atmospheric input of relevant TEIs. The atmospheric input into the global ocean is an important budgetary component of numerous chemical species, yet is very difficult to constrain. The data generated in this work will be available to allow ground-truthing of models of aerosol deposition and atmospheric input of trace elements. 2) Water column measurements of Be-7 provide a tracer of physical processes, such as mixing and upwelling, which redistribute biologically active species. Given 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. 3) The rate of oxygen utilization within the upper thermocline will be determined by water column measurements of Be-7 coupled with collected hydrographic data and observed oxygen distributions. The seasonal timescale afforded by Be-7 is ideal for estimating OUR within the shallow water just beneath the euphotic zone, where the most significant C remineralization is occurring. The project will support undergraduate student researchers at Florida International University, a leading minority serving institution. Lead investigator Kadko will participate in the Nippon Foundation - Partnership for Observation of the Global Oceans Center of Excellence (NF-POGO CofE), a unique platform which aims to provide world class training programs for students from emerging countries. Kadko will be offering an advanced topic course in chemical oceanography to these students during a stay at the Alfred Wegener Institute of Polar Studies. This outreach effort is consistent with the capacity building and educational goals of GEOTRACES as well as promoting international collaboration.

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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-1736319

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