

# Water column dissolved radium-226 from 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

**Website:** <https://www.bco-dmo.org/dataset/825947>

**Data Type:** Cruise Results

**Version:** 1

**Version Date:** 2020-10-01

## Project

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

» [Collaborative Research: US GEOTRACES PMT: Sources and Rates of Trace Element and Isotope Cycling Derived from the Radium Quartet](#) (PMT Radium Isotopes)

## Program

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

Contributors	Affiliation	Role
<a href="#">Charette, Matthew A.</a>	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
<a href="#">Moore, Willard S.</a>	University of South Carolina	Co-Principal Investigator
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## Abstract

Water column dissolved radium-226 from 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.

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## Coverage

**Spatial Extent:** N:18.907 E:-151.986 S:-20 W:-155.258

**Temporal Extent:** 2018-10-25 - 2018-11-23

## Acquisition Description

At sea,  $^{226}\text{Ra}$  samples were collected following the GEOTRACES cookbook. Samples were collected from a 30L Niskin mounted directly above McLane large volume in situ pump WTS-LV (>1000 m) or on a CTD Rosette (<1000 m). These samples (10-25 L) were gravity filtered through 15 g of manganese oxide impregnated acrylic fiber at approximately 0.5L/min. The filtrate was collected inside of a graduated rigid sided container and the volume was recorded. A mass was also obtained by using a hand-held digital balance.

The Mn fiber from the Niskin bottles were rinsed with deionized water back at WHOI, partially dried, and sealed within a fiber holder after being flushed with helium equivalent to 30 column volumes. Samples were stored for a minimum of 12 days and analyzed for  $^{226}\text{Ra}$  via  $^{222}\text{Rn}$  ingrowth using alpha scintillation counting (Key et al., 1979). Samples were counted for 1-20 hours depending on the activity on the fiber, which resulted in counting uncertainties of ~2% dependent upon  $^{226}\text{Ra}$  content on the fiber and sample volume.

## Processing Description

### Data Processing:

The data were corrected for decay from the time of sampling. Data is originally calculated in dpm/L and is converted to mBq/kg using the standard ocean rho = 1.0235 kg/L and 1 dpm = 16.667 mBq. 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.

### BCO-DMO Processing:

- renamed fields;
- added date/time columns in ISO8601 format;
- replaced "N/A" with "nd" to indicate "no data".

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## Related Publications

Charette, M. A., Dulaiova, H., Gonnee, M. E., Henderson, P. B., Moore, W. S., Scholten, J. C., & Pham, M. K. (2012). GEOTRACES radium isotopes interlaboratory comparison experiment. *Limnology and Oceanography: Methods*, 10(6), 451–463. doi:[10.4319/lom.2012.10.451](https://doi.org/10.4319/lom.2012.10.451)

*General*

Cutter, G.A., Andersson, P., Codispoti, L., Croot, P., Francois, R., Lohan, M., Obata, H., van der Loeff, M. R. (2014) Sampling and Sample-Handling Protocols for GEOTRACES Cruises (cookbook) Version 2.0; December 2014.

[http://www.geotraces.org/images/stories/documents/intercalibration/Cookbook\\_v2.pdf](http://www.geotraces.org/images/stories/documents/intercalibration/Cookbook_v2.pdf)

*Methods*

Key, R. M., Brewer, R. L., Stockwell, J. H., Guinasso, N. L., & Schink, D. R. (1979). Some improved techniques for measuring radon and radium in marine sediments and in seawater. *Marine Chemistry*, 7(3), 251–264.

doi:[10.1016/0304-4203\(79\)90042-2](https://doi.org/10.1016/0304-4203(79)90042-2)

*Methods*

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## Related Datasets

### Continues

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Charette, M. A., Moore, W. S. (2020) **Water column dissolved radium-226 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.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2020-10-01 <http://lod.bco-dmo.org/id/dataset/825891> [[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
Station_ID	GEOTRACES station number	unitless
Start_Date.UTC	Sample collection start date; format: MM/DD/YYYY	unitless
Start_Time.UTC	Sample collection start time; 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	Sample collection end date; format: MM/DD/YYYY	unitless
End_Time.UTC	Sample collection end time; format: hh:mm	unitless
End_ISO_DateTime.UTC	Sampling end date/time (UTC) formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
Start_Latitude	Sample collection start Latitude	degrees North
Start_Longitude	Sample collection start Longitude	degrees East
End_Latitude	Sample collection end Latitude	degrees North
End_Longitude	Sample collection end Longitude	degrees East
Event_ID	GEOTRACES event number	unitless
Sample_ID	GEOTRACES sample number	unitless
Sample_Depth	Depth of sample collection	meters (m)
Ra_226_D_CONC_BOTTLE_zkto8n	Dissolved Radium-226 activity	milliBecquerels per kilogram (mBq/kg)
SD1_Ra_226_D_CONC_BOTTLE_zkto8n	Error on Radium-226 activity	milliBecquerels per kilogram (mBq/kg)
Flag_Ra_226_D_CONC_BOTTLE_zkto8n	Quality flag for Ra-226 activity	unitless

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## Instruments

<b>Dataset-specific Instrument Name</b>	30L Niskin
<b>Generic Instrument Name</b>	Niskin bottle
<b>Dataset-specific Description</b>	Samples were collected from a 30L Niskin mounted directly above McLane large volume in situ pump WTS-LV (>1000 m) or on a CTD Rosette (
<b>Generic Instrument Description</b>	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

<b>Dataset-specific Instrument Name</b>	Radium Delayed Coincidence (RaDeCC) counter
<b>Generic Instrument Name</b>	Radium Delayed Coincidence Counter
<b>Dataset-specific Description</b>	Samples were analyzed using Radium Delayed Coincidence (RaDeCC) counters and high-purity, well-type germanium detectors.
<b>Generic Instrument Description</b>	The RaDeCC is an alpha scintillation counter that distinguishes decay events of short-lived radium daughter products based on their contrasting half-lives. This system was pioneered by Giffin et al. (1963) and adapted for radium measurements by Moore and Arnold (1996). References: Giffin, C., A. Kaufman, W.S. Broecker (1963). Delayed coincidence counter for the assay of actinon and thoron. J. Geophys. Res., 68, pp. 1749-1757. Moore, W.S., R. Arnold (1996). Measurement of 223Ra and 224Ra in coastal waters using a delayed coincidence counter. J. Geophys. Res., 101 (1996), pp. 1321-1329. Charette, Matthew A.; Dulaiova, Henrieta; Gonneea, Meagan E.; Henderson, Paul B.; Moore, Willard S.; Scholten, Jan C.; Pham, M. K. (2012). GEOTRACES radium isotopes interlaboratory comparison experiment. Limnology and Oceanography - Methods, vol 10, pg 451.

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## Deployments

### RR1815

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/776917">https://www.bco-dmo.org/deployment/776917</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>	2018-10-24
<b>End Date</b>	2018-11-24

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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](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.

## **Collaborative Research: US GEOTRACES PMT: Sources and Rates of Trace Element and Isotope Cycling Derived from the Radium Quartet (PMT Radium Isotopes)**

### *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. Naturally occurring radioactive isotopes of the element radium can be used to measure the rates of important processes in the ocean. In turn, making these rate measurements at the same time as other trace element and isotope data are collected enables a more complete interpretation of these data. The investigators propose to measure the four isotopes of radium -- Ra-223, Ra-224, Ra-226, and Ra-228 -- on a U.S. GEOTRACES expedition from Alaska to Tahiti in 2018. The radium isotope data will be particularly useful in investigating trace element input and removal processes associated with ocean boundaries (rivers, continental shelves, and the ocean bottom) and with mid-ocean ridge hydrothermal vents and the long-range dispersal of their neutrally buoyant plumes. The investigators will also investigate the processes controlling the internal cycling of the longest-lived isotope, Ra-226, compared to the element barium, which has a very similar chemistry to radium.

The proposed work would address a number of key questions regarding trace element inputs from ocean boundaries and their potential impact on ocean productivity and biogeochemistry. As iron is an important nutrient for marine phytoplankton, the investigators will quantify the rates of lateral trace element transport from the Gulf of Alaska margin out to and including the offshore High Nutrient Low Chlorophyll region of the subarctic Northeast Pacific Ocean. In the ocean subsurface, they will seek to understand the trace element fluxes associated with high temperature hydrothermal venting, and the rate at which trace elements and isotopes are removed via scavenging along the hydrothermal plume. Lastly, the work will lead to an improved understanding of a marine carbonate sediment dating technique via an investigation of Ra-226 and barium fractionation processes in the upper ocean. The project will involve collaboration between two U.S. institutions and a partner in France who will analyze some of the samples. Two graduate students will participate in the project. Moore will supervise an undergraduate student through the South Carolina Alliance for Minority Participation, and will encourage this student to develop a senior thesis based on their participation in this project.

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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-1736277</a>

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