Radium isotopes collected on R/V Thomas G. Thompson cruise TN303 in the Eastern Tropical Pacific in 2013 (U.S. GEOTRACES EPZT project)

Website: https://www.bco-dmo.org/dataset/650340
Data Type: Cruise Results
Version: 29 June 2016
Version Date: 2016-06-29

Project
» U.S. GEOTRACES East Pacific Zonal Transect (GP16) (U.S. GEOTRACES EPZT)
» US GEOTRACES Pacific Zonal Transect: Rates of supply, removal and internal cycling of trace elements and isotopes (EPZT TEI Rates)

Program
» U.S. GEOTRACES (U.S. GEOTRACES)

Contributors	Affiliation	Role
Charette, Matthew A.	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
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Dataset Description

Radium and Thorium isotopes were collected on manganese oxide impregnated cartridges using an in situ pump filtering 1500-2000L at depth, while ~1000L surface samples were collected by hanging manganese oxide impregnated acrylic fibers over the side of the ship. Samples were collected for Radium Isotopes ex223Ra (227Ac corrected), ex224Ra (228Th corrected), 226Ra, 228Ra, 228Th (particulate), 228Th (dissolved), and 228Th (total). **Only 226Ra and 228Ra are reported in this version of the dataset.** Future versions will include the other Ra isotopes and 228Th.

Related files and references:
Cartridge preparation:
Henderson, P. B., Morris, P. J., Moore, W. S., and Charette, M. A.: Methodological advances for measuring low-level radium isotopes in seawater, J. Radioanal. Nucl. Chem., 293, 1–6, doi:10.1007/s10967-012-2047-9, 2012.

Particulate and dissolved 228Th determination:
Maiti, K., Charette, M.A., Buesseler, K.O., Zhou, K., Henderson, P., Moore, W.S., Morris, P., Kipp, L., 2015. Determination of particulate and dissolved ^{228}Th in seawater using a delayed coincidence counter. Mar. Chem. doi:10.1016/j.marchem. 2014.12.001.

Methods & Sampling

Radium was collected onto an manganese coated cartridge filtered at depth using an adapted McLane (WTS-LV). The pumps were programmed to filter 1500-2000L of seawater per deployment. Water (15-25 L) was also collected at the same depth using a 30L Niskin bottle; these samples were filtered (at <1L/min) through a manganese coated acrylic fiber and used calculate radium extraction efficiency of the pumped samples. The cartridges were rinsed with radium-free fresh water and excess moisture was removed using compressed air. Samples were analyzed three times using an Alpha delayed coincidence counter (RaDeCC) for 223Ra, 224Ra, 228Th, and 227Ac. The cartridge and fiber media were ashed at 820 degrees C and measured on gamma detectors for long lived radium (226Ra, 228Ra) and thorium isotopes. 226Ra was determined via alpha scintillation counting of the Niskin bottle Mn fiber samples.

Data Processing Description

The data were corrected for decay from the time of sampling. 223Ra was corrected for 227Ac (ex223Ra), 224Ra was corrected for 228Th (ex224Ra). The radium activity of the water samples (cartridges) were corrected from the measured radium on acrylic fiber (<1L/min) using the emanation technique.

Information on data quality and intercalibration can be found in the intercalibration report (PDF).

Quality flag definitions:
1 = 228Radium measured in Modane (France),
2 = Radium efficiency based on Silicate/radium correlation,
3 = Below detection,
4 = vial broken, sample lost,
5 = efficiency can not be determined,
6 = 228Radium measured through 228Thorium (gamma spectroscopy),
7 = 228Radium measured through 228Actinium (gamma spectroscopy),
8 = Pump Failure, no sample collected,
9 = Interpolated value based on neighboring data points,
10 = based on the Barium / Radium relationship
11 = Questionable quality.

BCO-DMO Processing:
- converted date format to YYYYmmdd;
- modified parameter names to conform with BCO-DMO and GEOTRACES naming conventions.

Additional GEOTRACES Processing by BCO-DMO:
As was done for the GEOTRACES-NAT data, BCO-DMO added standard US GEOTRACES information, such as the US GEOTRACES event number, to each submitted dataset lacking this information. To accomplish this, BCO-DMO compiled a 'master' dataset composed of the following parameters:
cruise_id, EXPOCODE,SECT_ID, STNNBR, CASTNO, GEOTRC_EVENTNO, GEOTRC_SAMPNO, GEOTRC_INSTR, SAMPNO, GF_NO, BTLNBR, BTLNBR_FLAG_W, DATE_START_EVENT, TIME_START_EVENT, ISO_DATETIME_UTC_START_EVENT, EVENT_LAT, EVENT_LON, DEPTH_MIN, DEPTH_MAX, BTL_DATE, BTL_TIME, BTL_ISO_DATETIME_UTC, BTL_LAT, BTL_LON, ODF_CTDPRS, SMDEPTH, FMDEPTH, BTMDEPTH, CTDPRS, CTDDEPTH.

This added information will facilitate subsequent analysis and inter-comparison of the datasets.

Bottle parameters in the master file were taken from the GT-C_Bottle and ODF_Bottle datasets. Non-bottle parameters, including those from GeoFish tows, Aerosol sampling, and McLane Pumps, were taken from the TN303 Event Log (version 30 Oct 2014). Where applicable, pump information was taken from the PUMP_Nuts_Sals dataset.

A standardized BCO-DMO method (called "join") was then used to merge the missing parameters to each US GEOTRACES dataset, most often by matching on sample_GEOTRC or on some unique combination of other parameters.

If the master parameters were included in the original data file and the values did not differ from the master file, the original data columns were retained and the names of the parameters were changed from the PI-submitted names to the standardized master names. If there were differences between the PI-supplied parameter values and those in the master file, both columns were retained. If the original data submission included all of the master parameters, no additional columns were added, but parameter names were modified to match the naming conventions of the master file.

See the dataset parameters documentation for a description of which parameters were supplied by the PI and which were added via the join method.

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Data Files

File
Radium_joined.csv (Comma Separated Values (.csv), 51.70 KB) MD5:4c406b022d5f658edc9f4a7f30d9df21 Primary data file for dataset ID 650340

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Parameters

Parameter	Description	Units
cruise_id	Cruise identification	unitless
cruise_name	Alternate cruise identifier	unitless
STNNBR	Station number	unitless
GEOTRC_EVENTNO	GEOTRACES event number; added from the EPZT master file.	unitless
DATE_PI	Date in YYYYmmdd format; provided by the PI.	unitless
LAT_PI	Latitude ; provided by the PI.	decimal degrees
LON_PI	Longitude; provided by the PI.	decimal degrees
ISO_DATETIME_UTC_START_EVENT	Date and time, formatted to the ISO 8601 standard, at the start of the sampling event, according to the event log.	YYYY-MM-DDTHH:MM:SS[.xx]Z
EVENT_LAT	Latitude at the start of the event; north is positive. Added from the EPZT master file.	decimal degrees
EVENT_LON	Longitude at the start of the event; east is positive. Added from the EPZT master file.	decimal degrees
GEOTRC_SAMPNO	Unique GEOTRACES sample number	unitless
CASTNO	Cast number; added from the EPZT master file.	unitless
SAMPNO	Sequential sample number within the cast (usually corresponds to bottle number); added from the EPZT master file.	unitless
GEOTRC_INSTR	Sampling instrument	unitless
DEPTH	Depth; provided by the PI.	meters
Ra_228_D_CONC_PUMP	Concentration of 228-Radium (dissolved).	disintegrations per minute (dpm) per 100 liters (dpm/100L)
Ra_228_D_CONC_PUMP_FLAG	Quality flag for Ra_228_D_CONC_PUMP. See Processing Description for quality flag definitions.	unitless
Ra_228_D_CONC_PUMP_ERR	Error for Ra_228_D_CONC_PUMP.	disintegrations per minute (dpm) per 100 liters (dpm/100L)
Ra_226_D_CONC_PUMP	Concentration of 226-Radium (dissolved).	disintegrations per minute (dpm) per 100 liters (dpm/100L)
Ra_226_CONC_D_PUMP_FLAG	Quality flag for Ra_226_D_CONC_PUMP. See Processing Description for quality flag definitions.	unitless
Ra_226_CONC_D_PUMP_ERR	Error for Ra_226_D_CONC_PUMP.	disintegrations per minute (dpm) per 100 liters (dpm/100L)

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Instruments

Dataset-specific Instrument Name	McLane (WTS-LV)
Generic Instrument Name	McLane Large Volume Pumping System WTS-LV
Generic Instrument Description	The WTS-LV is a Water Transfer System (WTS) Large Volume (LV) pumping instrument designed and manufactured by McLane Research Labs (Falmouth, MA, USA). It is a large-volume, single-event sampler that collects suspended and dissolved particulate samples in situ. Ambient water is drawn through a modular filter holder onto a 142-millimeter (mm) membrane without passing through the pump. The standard two-tier filter holder provides prefiltering and size fractioning. Collection targets include chlorophyll maximum, particulate trace metals, and phytoplankton. It features different flow rates and filter porosity to support a range of specimen collection. Sampling can be programmed to start at a scheduled time or begin with a countdown delay. It also features a dynamic pump speed algorithm that adjusts flow to protect the sample as material accumulates on the filter. Several pump options range from 0.5 to 30 liters per minute, with a max volume of 2,500 to 36,000 liters depending on the pump and battery pack used. The standard model is depth rated to 5,500 meters, with a deeper 7,000-meter option available. The operating temperature is -4 to 35 degrees Celsius. The WTS-LV is available in four different configurations: Standard, Upright, Bore Hole, and Dual Filter Sampler. The high-capacity upright WTS-LV model provides three times the battery life of the standard model. The Bore-Hole WTS-LV is designed to fit through a narrow opening such as a 30-centimeter borehole. The dual filter WTS-LV features two vertical intake 142 mm filter holders to allow simultaneous filtering using two different porosities.

Dataset-specific Instrument Name	Alpha delayed coincidence counter (RaDeCC)
Generic Instrument Name	Radium Delayed Coincidence Counter
Generic Instrument Description	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

TN303

Website	https://www.bco-dmo.org/deployment/499719
Platform	R/V Thomas G. Thompson
Report	http://dmoserv3.whoi.edu/data_docs/GEOTRACES/EPZT/GT13_EPZT_ODFReport_All.pdf
Start Date	2013-10-25
End Date	2013-12-20
Description	A zonal transect in the eastern tropical South Pacific (ETSP) from Peru to Tahiti as the second cruise of the U.S.GEOTRACES Program. This Pacific section includes a large area characterized by high rates of primary production and particle export in the eastern boundary associated with the Peru Upwelling, a large oxygen minimum zone that is a major global sink for fixed nitrogen, and a large hydrothermal plume arising from the East Pacific Rise. This particular section was selected as a result of open planning workshops in 2007 and 2008, with a final recommendation made by the U.S.GEOTRACES Steering Committee in 2009. It is the first part of a two-stage plan that will include a meridional section of the Pacific from Tahiti to Alaska as a subsequent expedition. Figure 1. The 2013 GEOTRACES EPZT Cruise Track. [click on the image to view a larger version] Additional cruise information is available from the Rolling Deck to Repository (R2R): http://www.rvdata.us/catalog/TN303

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Project Information

U.S. GEOTRACES East Pacific Zonal Transect (GP16) (U.S. GEOTRACES EPZT)

Website: http://www.geotraces.org/

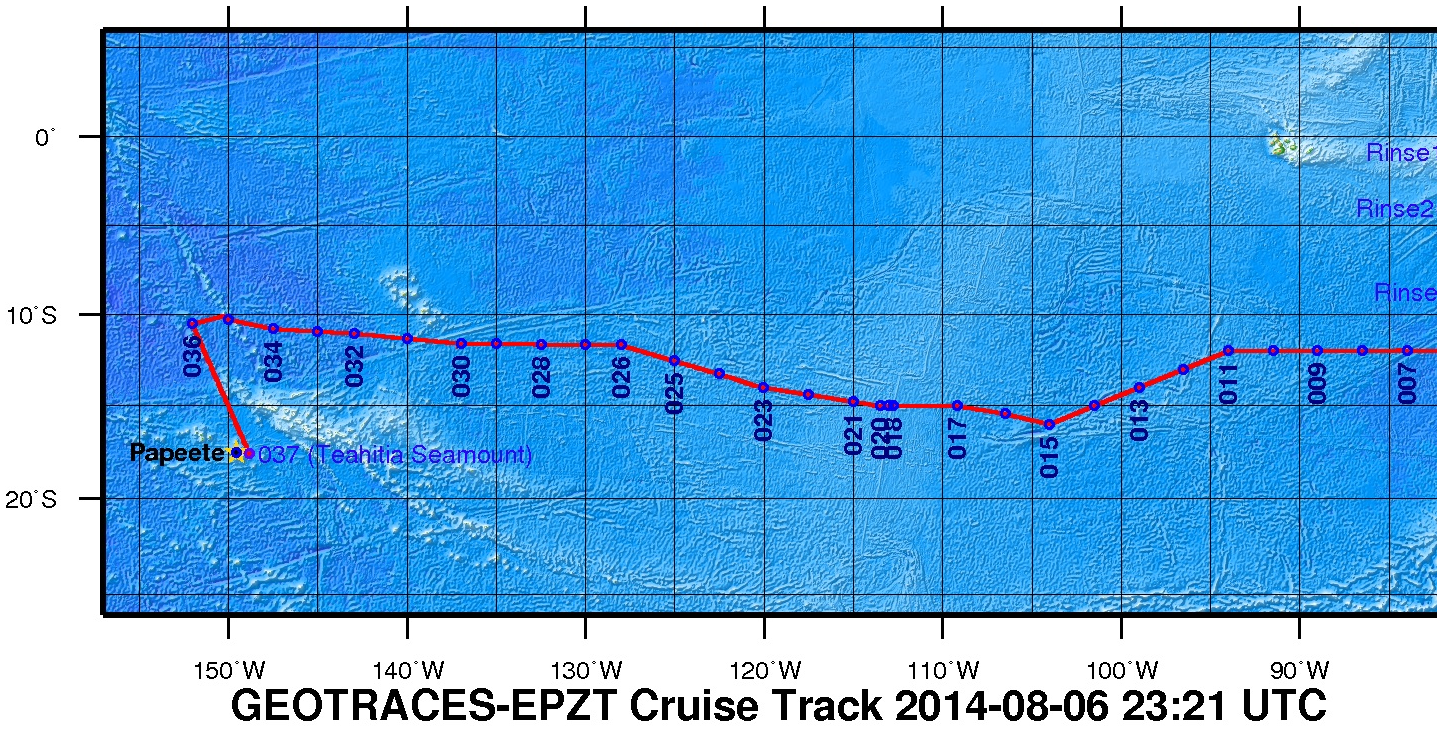
Coverage: Eastern Tropical Pacific - Transect from Peru to Tahiti (GP16)

From the NSF Award Abstract
The mission of the International GEOTRACES Program (https://www.geotraces.org/), of which the U.S. chemical oceanography research community is a founding member, is "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" (GEOTRACES Science Plan, 2006). In the United States, ocean chemists are currently in the process of organizing a zonal transect in the eastern tropical South Pacific (ETSP) from Peru to Tahiti as the second cruise of the U.S.GEOTRACES Program. This Pacific section includes a large area characterized by high rates of primary production and particle export in the eastern boundary associated with the Peru Upwelling, a large oxygen minimum zone that is a major global sink for fixed nitrogen, and a large hydrothermal plume arising from the East Pacific Rise. This particular section was selected as a result of open planning workshops in 2007 and 2008, with a final recommendation made by the U.S.GEOTRACES Steering Committee in 2009. It is the first part of a two-stage plan that will include a meridional section of the Pacific from Tahiti to Alaska as a subsequent expedition.

This award provides funding for management of the U.S.GEOTRACES Pacific campaign to a team of scientists from the University of Southern California, Old Dominion University, and the Woods Hole Oceanographic Institution. The three co-leaders will provide mission leadership, essential support services, and management structure for acquiring the trace elements and isotopes samples listed as core parameters in the International GEOTRACES Science Plan, plus hydrographic and nutrient data needed by participating investigators. With this support from NSF, the management team will (1) plan and coordinate the 52-day Pacific research cruise described above; (2) obtain representative samples for a wide variety of trace metals of interest using conventional CTD/rosette and GEOTRACES Sampling Systems; (3) acquire conventional JGOFS/WOCE-quality hydrographic data (CTD, transmissometer, fluorometer, oxygen sensor, etc) along with discrete samples for salinity, dissolved oxygen (to 1 uM detection limits), plant pigments, redox tracers such as ammonium and nitrite, 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-type data to the GEOTRACES Data Center (and US data centers); and (6) coordinate cruise communications between all participating investigators, including preparation of a hydrographic report/publication.

Broader Impacts: The project is part of an international collaborative program that has forged strong partnerships in the intercalibration and implementation phases that are unprecedented in chemical oceanography. The science product of these collective missions will enhance our ability to understand how to interpret the chemical composition of the ocean, and interpret how climate change will affect ocean chemistry. Partnerships include contributions to the infrastructure of developing nations with overlapping interests in the study area, in this case Peru. There is a strong educational component to the program, with many Ph.D. students carrying out thesis research within the program.

Figure 1. The 2013 GEOTRACES EPZT Cruise Track. [click on the image to view a larger version]



GEOTRACES-EPZT Cruise Track 2014-08-06 23:21 UTC

US GEOTRACES Pacific Zonal Transect: Rates of supply, removal and internal cycling of trace elements and isotopes (EPZT TEI Rates)

Coverage: East Pacific

Description from NSF award abstract:
The goal of GEOTRACES is to identify processes and quantify fluxes that control the distribution of trace elements and isotopes (TEIs) in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions. While the distribution of numerous TEIs will be mapped by a large team of GEOTRACES PIs along this transect, their distribution cannot be properly interpreted without concurrent measurement of tracers capable of providing rates of internal TEI cycling processes and fluxes at boundaries and across interfaces. Naturally-occurring radioisotopes of the Uranium-Thorium series are well suited for studying the sources and sinks of TEIs on time and space scales necessary to interpret lateral and vertical TEI distributions.

In this project, a research team from the Woods Hole Oceanographic Institution and the University of South Carolina at Columbia will carry out measurement of a suite of uranium/thorium series radionuclides on the US GEOTRACES cruise to the Eastern Tropical South Pacific (ETSP) Ocean. This radiotracer suite will include shorter-lived 234Th and 228Th as well as the radium quartet (224Ra, 223Ra, 228Ra, 226Ra), which together allow the quantification of rates of horizontal and vertical transport and mixing, as well as removal at ocean boundaries, surface export, and subsurface remineralization.

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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-1232669

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