Measurements of global dissolved submarine groundwater discharge (SGD) 226-Radium and 228-Radium

Website: https://www.bco-dmo.org/dataset/878519
Data Type: Other Field Results
Version: 1
Version Date: 2022-08-16

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

Contributors	Affiliation	Role
Charette, Matthew A.	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
Moore, Willard S.	University of South Carolina	Co-Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset includes measurements of global dissolved submarine groundwater discharge (SGD) 226-Radium and 228-Radium.

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Coverage

Spatial Extent: **N**:48.10041 **E**:32.678 **S**:-52.64855 **W**:-69.63428
Temporal Extent: 1993-10-24 - 2016-08-17

Methods & Sampling

Samples were collected using either a peristaltic pump or a well pump and the groundwater was passed through a 1 or 5 µm prefilter to remove suspended sediment before being filtered at <1 L/min onto Mn-coated acrylic fiber. The fiber was rinsed with Ra-free MilliQ water to remove any salts or sediment, then partially dried.

Samples with low activities (<0.4 dpm) were analyzed for 228Ra via 228Th ingrowth using a delayed coincidence counter (RaDeCC) (Moore, 2008), as described in Charette et al. (2015). Briefly, when 228Ra is extracted onto the Mn fiber, 228Th is extracted in parallel. Using the initial concentration of 228Th and the concentration of 228Th after 1 to 2 years, measured via RaDeCC, along with the decay constants of 228Th and 228Ra, the initial concentration of 228Ra can be calculated. Low activity samples were analyzed for 226Ra via 222Rn emanation (Key et al. 1979), as described in Charette et al. (2015). Fibers were placed in a fiber holder that was then flushed with He for 5 minutes at 250 mL/min, sealed, and left for two weeks before analysis via 222Rn ingrowth and scintillation counting. These two methods were used for low activity samples due to better method sensitivity than gamma counting (Charette et al., 2001), which was used for samples with high activities (>0.4 dpm per sample). For this method, the fibers were ashed (880 °C, 16 h),

homogenized, capped with epoxy resin, and left for >3 weeks to obtain secular equilibrium between 226Ra and its daughter radionuclides. The samples were then counted in a well-type gamma spectrometer for 228Ra (via 228Ac at 338 keV) and 226Ra (via 214Pb at 351.9 keV) (Charette et al., 2001).

When not specifically listed, errors are 10%.

Data Processing Description

BCO-DMO Processing:
- renamed fields to comply with BCO-DMO naming conventions;
- removed commas and apostrophes from data values;
- re-organized original spreadsheet, moving sub-headings into the 'Source' column.

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Data Files

File	
Ra226_Ra228_Global_SGD.csv	(Comma Separated Values (.csv), 76.10 KB) MD5:c1991671ea8c26a39d814fefd08f3ffa
Primary data file for dataset ID 878519	

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Supplemental Files

File	
SGD_Database_Sources.pdf	(Portable Document Format (.pdf), 387.81 KB) MD5:2a2da61c8073f15477653cbf012a9b67
Complete citations of papers noted in the "Source" column of the "Global SGD 226Ra and 228Ra" dataset.	

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Related Publications

Charette, M. A., Buesseler, K. O., & Andrews, J. E. (2001). Utility of radium isotopes for evaluating the input and transport of groundwater-derived nitrogen to a Cape Cod estuary. Limnology and Oceanography, 46(2), 465–470. Portico. https://doi.org/10.4319/lo.2001.46.2.0465
Methods

Charette, M. A., Morris, P. J., Henderson, P. B., & Moore, W. S. (2015). Radium isotope distributions during the US GEOTRACES North Atlantic cruises. Marine Chemistry, 177, 184–195. doi:10.1016/j.marchem.2015.01.001
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
Methods

Moore, W. S. (2008). Fifteen years experience in measuring 224Ra and 223Ra by delayed-coincidence counting. Marine Chemistry, 109(3-4), 188–197. doi:10.1016/j.marchem.2007.06.015
Methods

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Parameters

Parameter	Description	Units
Source	sample location/source; see Supplemental File "SGD_Database_Sources.pdf" for complete citations of papers referred to in this column.	unitless
Site	Sample ID; site name; reference	unitless
Date	Date sampled (local time); most values are in format YYYY-MM-DD	unitless
Longitude	Longitude of sample site	decimal degrees North
Latitude	Latitude of sample site	decimal degrees East
Salinity	Salinity when sampled	ppt
Ra226	226Ra isotope concentration	dpm/L
Ra228	228Ra isotope concentration. "BDL" = "below detection limit. 0.4 dpm/100L is the detection limit for 228Ra for this dataset.	dpm/L
Ra224	224Ra isotope concentration	dpm/L
Ra223	223Ra isotope concentration	dpm/L
ratio_228Ra_to_226Ra	sample activity ratio (228/226)	unitless
ratio_avg228Ra_to_avg226Ra	average site AR (228/226)	unitless
ratio_med228Ra_to_med226Ra	median site AR (228/226	unitless

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Instruments

Dataset-specific Instrument Name	well-type gamma spectrometer
Generic Instrument Name	Gamma Ray Spectrometer
Dataset-specific Description	Gamma detectors made by Canberra or Ortec.
Generic Instrument Description	Instruments measuring the relative levels of electromagnetic radiation of different wavelengths in the gamma-ray waveband.

Dataset-specific Instrument Name	peristaltic pump or well pump
Generic Instrument Name	Pump
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	RaDeCC
Generic Instrument Name	Radium Delayed Coincidence Counter
Dataset-specific Description	RaDeCCs made by Scientific Computer Instruments
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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Project Information

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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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1736277

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