Dissolved radium isotope activity around Guaymas Basin from samples collected by CTD and HOV Alvin during R/V Atlantis cruise AT37-06 in December 2016

Website: https://www.bco-dmo.org/dataset/782977
Data Type: Cruise Results
Version: 1
Version Date: 2019-11-26

Project
» Validation of a New Geochemical Approach to Constrain Deep Sea Porewater Residence Times and Advection Rates: Applications to Biogeochemical Cycling at Guaymas Basin (Guaymas Basin Ra 224 Approach)

Contributors	Affiliation	Role
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Abstract
This dataset presents dissolved radium isotope activities around Guaymas Basin.

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Coverage

Spatial Extent: **N**:27.509165 **E**:-111.381567 **S**:27.006592 **W**:-111.681819
Temporal Extent: 2016-12-12 - 2016-12-25

Dataset Description

This dataset presents dissolved radium isotope activities around Guaymas Basin.

Methods & Sampling

Samples for this dataset were separated into different worksheets depending on the sample collection method (worksheets have been combined into one dataset; "Collection_Method" column indicates the source worksheet).

"CTD" samples were collected from 20L Niskin bottles associated with CTD casts by slowly (<1 L/min) draining the sample via a sampling tube from the spigot on the Niskin bottle through a dry, 25 g aliquot of acrylic fiber impregnated with MnO2 (Moore, 1976). These "Mn fibers" quantitatively sorb Ra isotopes from the aqueous phase.

"Core-top waters" were collected by gravity siphoning water overlying sediment cores that were collected as push cores by HOV Alvin, filtering the samples through 0.45 um cellulose filters, then slowly (< 1 L/min) passing the effluent over 25 g Mn fiber.

"Alvin Slurp" samples were collected using the slurp gun on HOV Alvin. These sample waters were stored onboard Alvin until they were recovered on the ship and slowly (< 1 L/min) passed over 25 g Mn fiber.

Finally, "Alvin Niskins" were recovered from one or several of the 1.25 L Niskin bottles on Alvin. On the ship, these water samples were drained from the Niskin bottles and slowly (<1 L/min) passed over 25 g Mn fiber.

After passing the water samples over the Mn fibers, the fibers were rinsed with Ra-free fresh water, then dried using a compressed air stream to a suitable humidity (Sun and Torgersen, 1998). The fibers were then counted immediately on a Radium Delayed Coincidence Counter (Moore and Arnold, 1996) for total Ra-224 and Ra-223 activity. The fibers were counted again after 3 weeks to measure the supported Ra-224 activity from any sorbed Th-228 on the fibers. This activity is subtracted from the total Ra-224 activity derived from the initial measurement to compute the excess Ra-224 activity (the activity reported in the dataset). Ra-226 activities were measured by sealing the Mn fibers in air-tight cartridges for ~1 week and measuring the accumulated Rn-222 (daughter product of Ra-226) on a radon emanation line (Peterson et al., 2009). Fibers were then counted an additional time on the Radium Delayed Coincidence Counter after ~1 year from collection for Ra-228 (as the change in Th-228 activity from the 3-week measurement; Moore, 2008). Analytical uncertainties are based on counting statistics (as 1-s standard deviation of the total counts logged, propagated through the activity computations).

Data Processing Description

BCO-DMO Processing:
- modified parameter names (changed hyphens to underscores; replaced spaces with underscores);
- formatted date/time to ISO 8601 format;
- concatenated data from the 4 separate worksheets into one;
- saved Radium Delayed Coincidence Counter calibrations as PDF - see Supplemental Files.

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Data Files

File
water_column_radium.csv (Comma Separated Values (.csv), 9.40 KB) MD5:06c31cb00e4b3e28df8628c3af418fd8 Primary data file for dataset ID 782977

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Supplemental Files

File
Radium Delayed Coincidence Counter Calibrations filename: Radium_Delayed_Coincidence_Counter_Calibrations_Dissolved_Ra.pdf (Portable Document Format (.pdf), 354.22 KB) MD5:b50ceb4e6fc8c4f03c90387f28747a70 Radium Delayed Coincidence Counter Calibrations for dataset 782977

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Related Publications

Moore, W. S. (1976). Sampling 228Ra in the deep ocean. Deep Sea Research and Oceanographic Abstracts,

23(7), 647–651. doi:10.1016/0011-7471(76)90007-3
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

Moore, W. S., & Arnold, R. (1996). Measurement of 223Ra and224Ra in coastal waters using a delayed coincidence counter. Journal of Geophysical Research: Oceans, 101(C1), 1321–1329. doi:10.1029/95jc03139 https://doi.org/10.1029/95JC03139
Methods

Peterson, R. N., Burnett, W. C., Dimova, N., & Santos, I. R. (2009). Comparison of measurement methods for radium-226 on manganese-fiber. Limnology and Oceanography: Methods, 7(2), 196–205. doi:10.4319/lom.2009.7.196
Methods

Sun, Y., & Torgersen, T. (1998). The effects of water content and Mn-fiber surface conditions on measurement by emanation. Marine Chemistry, 62(3-4), 299–306. doi:10.1016/s0304-4203(98)00019-x https://doi.org/10.1016/S0304-4203(98)00019-X
Methods

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Parameters

Parameter	Description	Units
Collection_Method	Sample collection method	unitless
Alvin_Dive_Number	Numeric identifier for Alvin dive (not applicable where Collection_Method = CTD)	unitless
Cast	Numerical reference for CTD cast # (Collection_Method = CTD only)	unitless
Depth	Sampling depth (Collection_Method = CTD only)	meters (m)
Core_Number	Core tube identifier for the specific Alvin dive (Collection_Method = Core_top_waters only)	unitless
Date_Time	Sampling date and time (GMT); format: yyyy-mm-ddTHH:MM	unitless
Latitude	Sampling latitude	decimal degrees
Longitude	Sampling longitude	decimal degrees
Sample_Volume	Sample volume	liters (L)
Ra223_Activity	Measured activity of Ra-223; "BD" = below detection	dpm/100L

Ra223_Unc	1-s analytical uncertainty in measured activity of Ra-223; "BD" = below detection	dpm/100L
Ra224_Activity	Measured activity of Ra-224; "BD" = below detection	dpm/100L
Ra224_Unc	1-s analytical uncertainty in measured activity of Ra-224; "BD" = below detection	dpm/100L
Ra226_Activity	Measured activity of Ra-226; "BD" = below detection	dpm/100L
Ra226_Unc	1-s analytical uncertainty in measured activity of Ra-226; "BD" = below detection	dpm/100L
Ra228_Activity	Measured activity of Ra-223; "BD" = below detection	dpm/100L
Ra228_Unc	1-s analytical uncertainty in measured activity of Ra-223; "BD" = below detection	dpm/100L

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Instruments

Dataset-specific Instrument Name	HOV Alvin push core
Generic Instrument Name	Alvin tube core
Generic Instrument Description	A plastic tube, about 40 cm (16 inches) long, is pushed into the sediment by Alvin's manipulator arm to collect a sediment core.

Dataset-specific Instrument Name	CTD
Generic Instrument Name	CTD - profiler
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	HOV Alvin slurp gun
Generic Instrument Name	HOV Alvin Slurp Samplers
Generic Instrument Description	Small and large capacity vacuum pump samplers. May have single or multiple chambers. Slurp Samplers (from https://ndsf.whoi.edu/alvin/systems/) The slurp samplers consist of a collection chamber and a hydraulically powered water pump. A nozzle with a tube connected to it is held and moved by a manipulator while water is pulled into the nozzle by the pump. The water travels down the tube into the collection chamber, and then goes through a mesh screen before going through the pump itself. Biological samples are sucked into the nozzle and deposited in the collection chamber. They are kept from going into the pump by the mesh screen. The screen can be changed for coarser or finer mesh as needed. Two styles of collection chamber are available; single chamber and 5-chamber. Single chamber: a large cylindrical single collection chamber into which all samples will be deposited. Water weight 2 lbs, 27 lbs full of water. 5-chamber: five separate cylindrical collection chambers of 4.5 inch ID x 11.5 inch height. One chamber is used at a time and the chambers are rotated by a hydraulic actuator mounted to the bottom of the 5-chamber assembly. Water weight 10 lbs, 140 lbs full of water.

Dataset-specific Instrument Name	
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Samples were collected from 20L Niskin bottles associated with CTD casts and from HOV Alvin's Niskin bottles.
Generic Instrument Description	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.

Dataset-specific Instrument Name	
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

AT37-06

Website	https://www.bco-dmo.org/deployment/720354
Platform	R/V Atlantis
Report	https://datadocs.bco-dmo.org/d3/data_docs/GuaymasBasin_Interactions/AT37-06_CruiseReport.pdf
Start Date	2016-12-09
End Date	2016-12-27

AT37-06_Alvin_Dives

Website	https://www.bco-dmo.org/deployment/782870
Platform	HOV Alvin
Report	https://datadocs.bco-dmo.org/d3/data_docs/GuaymasBasin_Interactions/AT37-06_CruiseReport.pdf
Start Date	2016-12-09
End Date	2016-12-27
Description	Alvin dives conducted at Guyamas Basin on R/V Atlantis cruise AT37-06.

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Project Information

Validation of a New Geochemical Approach to Constrain Deep Sea Porewater Residence Times and Advection Rates: Applications to Biogeochemical Cycling at Guaymas Basin (Guaymas Basin Ra 224 Approach)

Coverage: Guaymas Basin, Gulf of California

NSF Award Abstract:
This project proposes to validate a new approach to measure porewater flow dynamics from deep sea sediments using a biologically conservative, naturally-occurring tracer, Radium 224, which is constantly produced by porewaters. The technique will be validated using independent measures of porewater fluxes (i.e. heat gradients and magnesium profiles) during a cruise to the Guaymas Basin in the Gulf of California that is already funded by NSF. Once validated the technique will be broadly applicable to all sedimentary environments including oceans, rivers/streams, wetlands and lakes. Understanding porewater flow dynamics is important to understanding ocean and other aquatic system chemical budgets, microbial ecology and global heat flow.

This proposal hypothesizes that the short-lived radium isotope Ra 224 may serve as an effective tracer of porewater flows in deep ocean systems, regardless of the type or composition of seepages, because its sources and sinks can be uniquely constrained. The method will be tested in the Guaymas Basin which is comprised of areas undergoing a range of seepage rates and offers porewater thermal gradients resulting from the hydrothermal system. As a result heat fluxes and gradients in magnesium and other cations affected by high-temperature water/rock interactions can be used to independently validate the porewater flows measured by Ra 224.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1558829

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