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

Website: https://www.bco-dmo.org/dataset/782858
Data Type: Cruise Results
Version: 1
Version Date: 2019-11-25

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 sedimentary radium isotope activities around Guaymas Basin.

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Coverage

Spatial Extent: **N**:27.50622 **E**:-111.38469 **S**:27.00729 **W**:-111.68317
Temporal Extent: 2016-12-12 - 2016-12-21

Dataset Description

This dataset presents sedimentary radium isotope activities around Guaymas Basin.

Methods & Sampling

Samples for this dataset were collected as push cores using the HOV Alvin submersible. Analytical methods for measuring particulate Ra-224 and Th-228 are based on methods described in Cai et al. (2012; 2014). In short, once the cores were recovered on the ship, overlying waters were siphoned off and the sediment cores were sectioned in 2 cm vertical intervals for the top 10 cm, then 4 cm intervals for the remainder of the core. A slurry was prepared by adding ~¼ of the sediment volume (or ~1/8 of the sediment volume for the 4 cm intervals) to 150 mL of Ra-free tap water. The pH of the slurry was adjusted by adding 5-10 drops of concentrated NH3-OH, after which 1 mL of 19 mM KMnO4 and 1 mL of 40 mM MnCl2 solutions were added to precipitate any dissolved radium and thorium. A portion of this slurry was vacuum-filtered onto pre-weighed 47 mm diameter GFF filters until no further drops passed through the filter. Filters were dried in a drying oven (at

60 °C) for 12 hours, then placed is a filter holder within a cartridge and counted on a Radium Delayed Coincidence Counter (Moore and Arnold, 1996). Results from this analysis represent particulate Ra-224 activities. Filters were then measured on the Radium Delayed Coincidence Counter again after 3 weeks, from which the results are representative of Th-228 activities on the sediments.

Data Processing Description

BCO-DMO Processing:
- modified parameter names (changed hyphens to underscores; replaced spaces with underscores);
- formatted date/time to ISO 8601 format;
- corrected rows with value of "2019" as the year (changed to "2016");
- saved Radium Delayed Coincidence Counter calibrations as PDF - see Supplemental Files.

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Data Files

File
sedimentary_radium.csv (Comma Separated Values (.csv), 16.43 KB) MD5:fe41fb3b6cf4ae846cf3ac85b7e804a6 Primary data file for dataset ID 782858

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Supplemental Files

File
Radium Delayed Coincidence Counter Calibrations filename: Radium_Delayed_Coincidence_Counter_Calibration.pdf (Portable Document Format (.pdf), 286.07 KB) MD5:ed5bcc0a3360213b04eb71cead3ac298 Radium Delayed Coincidence Counter Calibrations for dataset 782858.

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Related Publications

Cai, P., Shi, X., Moore, W. S., & Dai, M. (2012). Measurement of 224Ra:228Th disequilibrium in coastal sediments using a delayed coincidence counter. Marine Chemistry, 138-139, 1–6. doi:10.1016/j.marchem.2012.05.004
Methods

Cai, P., Shi, X., Moore, W. S., Peng, S., Wang, G., & Dai, M. (2014). 224Ra:228Th disequilibrium in coastal sediments: Implications for solute transfer across the sediment–water interface. Geochimica et Cosmochimica Acta, 125, 68–84. doi:10.1016/j.gca.2013.09.029
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

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Parameters

Parameter	Description	Units
Alivn_Dive_Num	Numeric identifier for Alvin dive	unitless
Core_Num	Core tube identifier for the specific Alvin dive	unitless
Depth_Below_SWI	Sampling depth below the sediment-water interface (SWI)	centimeters (cm)
Date_Time	Sampling date and time (GMT); format: yyyy-mm-ddTHH:MM	unitless
Latitude	Sampling latitude	decimal degrees
Longitude	Sampling longitude	decimal degrees
Filter_Mass	Mass of dry sediments on filter	grams (g)
Ra224_Activity	Measured activity of Ra-224	dpm/g
Ra224_Unc	1-s analytical uncertainty in measured activity of Ra-224	dpm/g
Th228_Activity	Measured activity of Th-228	dpm/g
Th228_Unc	1-s analytical uncertainty in measured activity of Th-228	dpm/g

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Alvin tube core
Dataset-specific Description	Samples for this dataset were collected as push cores using the HOV Alvin submersible.
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	
Generic Instrument Name	Radium Delayed Coincidence Counter
Dataset-specific Description	Filters were dried in a drying oven (at 60 °C) for 12 hours, then placed is a filter holder within a cartridge and counted on a 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	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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