Measurements of Radium isotopes (Ra-224 and Ra-223) collected aboard the R/V Falkor cruise FK190211 in the Guaymas Basin of the Gulf of California from February to March 2019.

Website: https://www.bco-dmo.org/dataset/924638
Data Type: Cruise Results
Version: 1
Version Date: 2024-04-30

Project
» Collaborative Research: Microbial Carbon cycling and its interactions with Sulfur and Nitrogen transformations in Guaymas Basin hydrothermal sediments (Guaymas Basin Interactions)

Contributors	Affiliation	Role
Peterson, Richard N.	Coastal Carolina University	Co-Principal Investigator, Contact

Abstract
During cruise FK190211 aboard the R/V Falkor in the Guaymas Basin within the Gulf of California, water samples were analyzed for short-lived radium isotopes (Ra-224 and Ra-223). This cruise occurred during February-March 2019. The short-lived radium isotopes can be used as an indicator of subsurface fluids discharged into the water column, and when coupled with nutrient and microbial analyses, can yield insight into cycling rates within the water column.

Table of Contents

Coverage

Location: Guaymas Basin, Gulf of California
Spatial Extent: **N**:27.583333 **E**:-108.862033 **S**:23.956883 **W**:-111.464667
Temporal Extent: 2019-02-27 - 2019-03-11

Methods & Sampling

Water samples for radium isotope analysis were collected from both niskin bottles attached to the CTD rosette (‘C’ designator in data sheet) and from niskin bottles attached to the remotely operated vehicle (ROV). Water samples were filtered through 47 mm GFF filters (unless otherwise noted), then passed slowly through 25 g (dry) acrylic fibers impregnated with MnO_2 (Moore, 1976). Fibers were then washed 10x with Ra-free freshwater to remove salts and dried to a mass between 35 and 57 g for optimal humidity levels (Sun and Torgersen, 1998). Fibers were then immediately counted on a Radium Delayed Coincidence Counter (RaDeCC; Moore and Arnold, 1996) for total Ra-224 and Ra-223. Roughly 3 weeks later, fibers were counted again for supported Ra-224. Thus, excess (‘XS’) Ra-224 is the difference between total and supported Ra-224 measurements.

Radium isotopes were analyzed with a Radium Delayed Coincidence Counter (Moore and Arnold, 1996). This system was calibrated to standard MnO2 prepared from NIST-traceable solutions of Th-232 and Ac-227 (with daughters in equilibrium).

Data Processing Description

Data processing was performed in Microsoft Excel.

BCO-DMO Processing Description

- Modified parameter (column header) names to conform with CSV standards (remove spaces, special characters, etc.)
- Added column for ISO DateTime in UTC
- Converted the submitted Date column to ISO format (i.e., YYYY-MM-DD)
- Added correct hemisphere sign to longitude values (negative sign)
- Created columns for comments to accommodate identification of measurements that were below detection; previously marked as "BD" within numeric isotope observations columns.
- Corrected reference to Gulf of Mexico in dataset abstract to Gulf of California.

[table of contents | back to top]

Related Publications

Currie, L. A. (1968). Limits for qualitative detection and quantitative determination. Application to radiochemistry. Analytical Chemistry, 40(3), 586–593. doi:10.1021/ac60259a007
Methods

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., & 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

[table of contents | back to top]

Parameters

Parameter	Description	Units
C_or_R	CTD or ROV Niskin sample designator	unitless
Station	Station #	unitless

Site	Site Name	unitless
Date	Local date (EST) sample collected	unitless
Time	Local time (EST) sample collected	unitless
Latitude	Sampling latitude	decimal degrees
Longitude	Sampling longitude	decimal degrees
Depth	Water depth of sample collection	meters (m)
Sample_Volume	Water sample volume	Liters (l)
Ra223_Activity	Radium-223 activity. Note, minimum detectable activities (dpm/100L) are calculated based on Currie (1968). Any measured values lower than the minimum detectable activity is labeled 'BD'.	disintegrations per minute per 100 Liters (dpm/100L)
Ra223_Activity_Comment	Radium-223 activity comment field where BD = below detection	unitless
Ra223_Unc	1-s analytical uncertainty for Ra223. Any value corresponding to measured values lower than the minimum detectable activity is labeled 'BD'.	disintegrations per minute per 100 Liters (dpm/100L)
Ra223_Unc_Comment	1-s analytical uncertainty for Ra223 comment field where BD = below detection	unitless
XS_Ra224_Activity	Excess radium-224 activity. Note, minimum detectable activities (dpm/100L) are calculated based on Currie (1968). Any measured value lower than the minimum detectable activity is labeled 'BD'.	disintegrations per minute per 100 Liters (dpm/100L)
XS_Ra224_Activity_Comment	Excess radium-224 activity comment field where BD = below detection	unitless
XS_Ra224_Unc	1-s analytical uncertainty for Ra224	disintegrations per minute per 100 Liters (dpm/100L)
XS_Ra224_Unc_Comment	1-s analytical uncertainty for Ra225 comment field where BD = below detection	unitless

ISO_DateTime_UTC	Sample date and time in ISO standardized format added by repository	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Niskin bottle
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Both niskin bottles attached to the CTD rosette (‘C’ designator in data sheet) and from niskin bottles attached to the remotely operated vehicle (ROV) were used to collect samples.
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	Radium Delayed Coincidence Counter (Moore and Arnold, 1996)
Generic Instrument Name	Radium Delayed Coincidence Counter
Dataset-specific Description	Radium Delayed Coincidence Counter (Moore and Arnold, 1996). This system was calibrated to standard MnO2 prepared from NIST-traceable solutions of Th-232 and Ac-227 (with daughters in equilibrium).
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.

Dataset-specific Instrument Name	ROV
Generic Instrument Name	ROV SuBastian
Dataset-specific Description	Water samples for radium isotope analysis were collected from niskin bottles attached to the remotely operated vehicle (ROV).
Generic Instrument Description	ROV SuBastian is operated from the research vessel Falkor and the R/V Falkor(too). The ROV is outfitted with a suite of sensors and scientific equipment to support scientific data and sample collection, as well as interactive research, experimentation, and technology development. More information available at https://schmidtocean.org/technology/robotic-platforms/4500-m-remotely-op...

[table of contents | back to top]

Deployments

FK190211

Website	https://www.bco-dmo.org/deployment/820900
Platform	R/V Falkor
Start Date	2019-02-11
End Date	2019-03-14
Description	Start and end port: Manzanillo, Mexico

[table of contents | back to top]

Project Information

Collaborative Research: Microbial Carbon cycling and its interactions with Sulfur and Nitrogen transformations in Guaymas Basin hydrothermal sediments (Guaymas Basin Interactions)

Coverage: Guaymas Basin, Gulf of California, 27.00 N, 111.00W

Description from NSF award abstract:
Hydrothermally active sediments in the Guaymas Basin are dominated by novel microbial communities that catalyze important biogeochemical processes in these seafloor ecosystems. This project will investigate genomic potential, physiological capabilities and biogeochemical roles of key uncultured organisms from Guaymas sediments, especially the high-temperature anaerobic methane oxidizers that occur specifically in hydrothermally active sediments (ANME-1Guaymas). The study will focus on their role in carbon transformations, but also explore their potential involvement in sulfur and nitrogen transformations. First-order research topics include quantifying anaerobic methane oxidation under high temperature,in situ concentrations of phosphorus and methane , and with alternate electron acceptors; sulfate and sulfur-dependent microbial pathways and isotopic signatures under these conditions; and nitrogen transformations in methane-oxidizing microbial communities, hydrothermal mats and sediments.

This integrated biogeochemical and microbiological research will explore the pathways of and environmental controls on the consumption and production of methane, other alkanes, inorganic carbon, organic acids and organic matter that fuel the Guaymas sedimentary microbial ecosystem. The hydrothermal sediments of Guaymas Basin provide a spatially compact, high-activity location for investigating novel modes of methane cycling and carbon assimilation into microbial biomass. In the case of anaerobic methane oxidation, the high temperature and pressure tolerance of Guaymas Basin methane-oxidizing microbial communities, and their potential to uncouple from the dominant electron acceptor sulfate, vastly increase the predicted subsurface habitat space and biogeochemical role for anaerobic microbial methanotrophy in global deep subsurface diagenesis. Further, microbial methane production and oxidation interlocks with syulfur and nitrogen transformations, which will be explored at the organism and process level in hydrothermal sediment microbial communities and mats of Guaymas Basin. In general, first-order research tasks (rate measurements, radiotracer incorporation studies, genomes, in situ microgradients) define the key microbial capabilities, pathways and processes that mediate chemical exchange between the subsurface hydrothermal/seeps and deep ocean waters.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1357360

[table of contents | back to top]