# 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 $MnO_2$ (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<br>Primary data file for dataset ID 782977 |

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## Supplemental Files

| File |
| --- |
| **Radium Delayed Coincidence Counter Calibrations**<br>filename: Radium_Delayed_Coincidence_Counter_Calibrations_Dissolved_Ra.pdf (Portable Document Format (.pdf), 354.22 KB) MD5:b50ceb4e6fc8c4f03c90387f28747a70<br>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

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|---|---|
| **Dataset-specific Instrument Name** | HOV Alvin slurp gun |
| **Generic Instrument Name** | Alvin Slurp Sampler |
| **Generic Instrument Description** | Small and large capacity vacuum pump samplers. May have single or multiple chambers. See http://www.whoi.edu/main/alvin/subsystems/optional-scientific-samplers |

| | |
|---|---|
| **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** | |
| **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. |

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|---|---|
| **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**

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|---|---|
| **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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