Water column radiotracer methane oxidation rates in the Guaymas Basin, Gulf of California from R/V Atlantis cruise AT42-05 in 2018 and R/V Falkor cruise FK190211 in 2019

Website: https://www.bco-dmo.org/dataset/821587
Data Type: Cruise Results
Version: 2
Version Date: 2023-07-23

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
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Abstract
Water column radiotracer methane oxidation rates in the Guaymas Basin, Gulf of California from R/V Atlantis cruise AT42-05 in 2018 and R/V Falkor cruise FK190211 in 2019.

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Coverage

Spatial Extent: **Lat**:27 **Lon**:-111
Temporal Extent: 2018-11 - 2019-03

Methods & Sampling

Sampling and analytical procedures:

CH4:
Samples were collected by filling 160 ml glass serum vials with seawater, stoppering them headspace-free with butyl chloride stoppers, and crimp sealing them. Samples were killed by injecting 0.5 ml 8 M NaOH. Ten ml killed sample was then displaced with a ten ml UHP nitrogen gas headspace. Samples were stored at room temperature until analysis. At the time of analysis, an additional ten ml of nitrogen was added to the vials. Vials were shaken for 2 min before headspace was sampled and injected into a GC FID (Shimadzu GC 2014, Alltech Carbosphere 80/100 6'x1/8" column). This method is adapted from Magen, 2014 (A simple headspace equilibration method for measuring dissolved methane. Limnol. Oceanogr. Methods 12(9): 637-650).

MOx [data in both cruises]:
Four technical replicates were collected from each sampled depth by filling 16.6 mL Hungate tubes headspace-free and sealing with exetainer septa. Tubes were stored at 4 C until injection. One of the four replicates was

killed by displacing 1.6 ml sample with 1.6 ml 37% formalin. All samples, including the killed abiotic control, were injected with ~2000000 dpm tritiated methane tracer. Samples were incubated at near-in situ temperature for 1-4 days. Immediately before incubation termination, a 100 ul subsample was removed from each tube and measured on a liquid scintillation counter to determine total dissolved 3H-methane addition. Incubations were terminated by killing with 1.6 ml 37% formalin and purging with air for 1 hour to remove remaining tracer. A 5 ml aliquot of each killed replicate was measured on a liquid scintillation counter to determine the ratio of tracer turnover. The turnover ratio was multiplied by the measured in situ methane concentration to obtain the MOx rate. Killed controls were subtracted and the replicates averaged to obtain the final rate number. See Rogener, 2018 (Long-term impact of the Deepwater Horizon oil well blowout on methane oxidation dynamics in the northern Gulf of Mexico. Elem Sci Anth, 6(1), 73).

Data Processing Description

BCO-DMO Processing Notes:
- data submitted in Excel files "AT42-05_MOx_summary.xlsx" and "FK190211_MOx_summary.xlsx" extracted to csv and combined into one data table. [Column "Deployment Number" in FK190211 data added to "Event" column]
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- blank cells originally submitted as 'ND' are displayed as nd, the default missing data identifier in the BCO-DMO data view.
- version 2 replaces version 1 on 2023-07-23. CH4 data added for the FK190211 cruise

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Data Files

File
mox.csv (Comma Separated Values (.csv), 10.36 KB) MD5:59c05c361d2d947c57d144eba731d581 Primary data file for dataset ID 821587

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Parameters

Parameter	Description	Units
Cruise_id	Cruise identifier	unitless
Event	Event or Deployment identifier	unitless
Deployment_Type	Deployment type	unitless
Site	Site name	unitless
Depth	Sample collection depth	meters (m)
Incubation_temp	Radiotracer incubation temperature	degrees Celsius
CH4	Dissolved methane concentration, BDL=Below detection limit, method detection limit 1.0	nanomolar (nM)
MOx_rate_avg	Average methane oxidation rate, BDL=Below detection limit, method detection limit 1.0	picomoles per liter per day, pmol/L/d (pM/d)
MOx_rate_stddev	Standard deviation of MOx rate (n=3), BDL=Below detection limit, method detection limit 1.0	picomoles per liter per day, pmol/L/d (pM/d)

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Instruments

Dataset-specific Instrument Name	SRI Instruments 8610C Gas Chromatograph with FID Detector
Generic Instrument Name	Gas Chromatograph
Generic Instrument Description	Instrument separating gases, volatile substances, or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay. (from SeaDataNet, BODC)

Dataset-specific Instrument Name	Beckman-Coulter LS6500 liquid scintillation counter
Generic Instrument Name	Liquid Scintillation Counter
Generic Instrument Description	Liquid scintillation counting is an analytical technique which is defined by the incorporation of the radiolabeled analyte into uniform distribution with a liquid chemical medium capable of converting the kinetic energy of nuclear emissions into light energy. Although the liquid scintillation counter is a sophisticated laboratory counting system used the quantify the activity of particulate emitting (ß and a) radioactive samples, it can also detect the auger electrons emitted from 51Cr and 125I samples.

Dataset-specific Instrument Name	Perkin Elmer TriCarb liquid scintillation counter
Generic Instrument Name	Liquid Scintillation Counter
Generic Instrument Description	Liquid scintillation counting is an analytical technique which is defined by the incorporation of the radiolabeled analyte into uniform distribution with a liquid chemical medium capable of converting the kinetic energy of nuclear emissions into light energy. Although the liquid scintillation counter is a sophisticated laboratory counting system used the quantify the activity of particulate emitting (ß and a) radioactive samples, it can also detect the auger electrons emitted from 51Cr and 125I samples.

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Deployments

AT42-05

Website	https://www.bco-dmo.org/deployment/773347
Platform	R/V Atlantis
Start Date	2018-11-15
End Date	2018-11-29
Description	Alvin dives to hydrothermal vent area.

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

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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.

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Funding

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

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