Sediment geochemistry from push cores collected during HOV Alvin dives during the R/V Atlantis cruise AT42-05 in Guaymas Basin, Gulf of California (27 00.00 N, -111 20.00 W) in November 2018

Website: https://www.bco-dmo.org/dataset/817797
Data Type: Cruise Results
Version: 1
Version Date: 2020-07-02

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
Sediment geochemistry from push cores obtained using the human-occupied deep-diving vehicle (HOV) Alvin dives 4991-5000 during the R/V Atlantis cruise AT42-05 in Guaymas Basin, Gulf of California (27 00.00 N, -111 20.00 W) in November 2018.

Table of Contents

Coverage

Spatial Extent: **N**:27.0122 **E**:-111.4036 **S**:26.9998 **W**:-111.4076
Temporal Extent: 2018-11-17 - 2018-11-26

Dataset Description

Sediment geochemistry from push cores obtained using the human-occupied deep-diving vehicle (HOV) Alvin dives 4991-5000 during the R/V Atlantis cruise AT42-05 in Guaymas Basin, Gulf of California (27 00.00 N, -111 20.00 W) in November 2018.

Methods & Sampling

Sediment samples were collected by the DSV Alvin using PVC push cores. Upon arrival at the surface the

cores were described and cataloged prior to being sectioned into discrete depth intervals. Porewater was separated from the sediment using a manually-actuated pore water press. Porewater and sediment samples were preserved and analyzed as follows:

1) Nutrients (DOC, TDN, NOx, NO2, NH4, PO4, TDP): Porewater sample was filtered through a pre-rinsed 0.2 um regenerated cellulose Target2 syringe filter (Thermo Scientific, Prod. No. F25047), collected into an HDPE bottle and stored frozen at -20°C until analysis. Individual analytes were analyzed as follows:

DOC was determined using high temperature catalytic combustion and an NDIR detector following the method described in Sugimura and Suzuki, 1988 (*A high-temperature catalytic oxidation method for the determination of non-volatile dissolved organic carbon in seawater by direct injection of liquid sample. Mar. Chem., 24: 105-131*).

TDN was determined using high temperature combustion and a chemiluminescence detector following the method described in Watanabe et. al, 2007 (*Conversion efficiency of the high-temperature combustion technique for dissolved organic carbon and total dissolved nitrogen analysis. Intern. J. Environ. Anal. Chem., 87: 387-399*).

NOx was determined using chemical reduction and a nitric oxide detector following the method described by Garside, 1982 (*A chemiluminescent technique for the determination of nanomolar concentrations of nitrate and nitrite in seawater. Mar. Chem. 11: 159-167*).

NO2 was determined using the colorimetric method described by Bendschneider and Robinson, 1952 (*A new spectrophotometric method for the determination of nitrite in sea water. J. Mar. Res., 11: 87*) as reproduced by Parsons, Marta, and Lalli, 1984 (*Determination of Nitrite. A manual of chemical and biological methods for seawater analysis pp. 7-9*).

NH4 was determined using the colorimetric method described by Solorzano, 1969 (*Determination of ammonia in natural waters by the phenolhypochlorite method. Limnol. Oceanogr., 14: 799-801*).

PO4 was determined using the colorimetric method described by Strickland and Parsons, 1972 (*Determination of reactive phosphorus. A practical handbook of seawater analysis. Fisheries Research Board of Canada, pp. 49-52*).

TDP was determined using the colorimetric method described by Solorzano and Sharp, 1980 (*Determination of total dissolved phosphorous and particulate phosphorous in natural waters. Limnol. Oceanogr., 25: 754-758*).

Sediment pH was determined using a sediment probe (Oakton, Prod. No. 35634-50) and measured immediately during core sectioning; the probe was calibrated using NBS standards.

Pore water pH was determined using a Ross electrode (Thermo Fisher, Prod. No. 8103BNUWP) that was calibrated using NBS standards.

2) Alkalinity: Porewater alkalinity was determined using the spectrophotometric method described by Sarazin et al., 1999 (*A rapid and accurate spectroscopic method for alkalinity measurements in sea water samples. Water Research 33:290-294).*/

3) CH4: Sediment samples (3 cubic centimeters) were collected into a glass serum vial, preserved with 1M NaOH (3 milliliters), crimp-sealed with a butyl rubber stopper and stored at room temperature until analysis. CH4 was determined by headspace analysis using an SRI 8610C gas chromatograph equipped with a flame ionization detector and SRI Hayesep D 6'x1/8" column (Prod. No. 8600-PKDB).

4) H2S: Porewater sample was collected into a 15 mL centrifuge tube containing 2M zinc acetate and stored at 5°C until analysis. H2S was determined using the colorimetric method described by Cline, 1969 (*Spectrophotometric determination of hydrogen sulfide in natural waters. Limnol. Oceanogr., 14: 454-458*).

5) Sulfate (SO4): Porewater sample was filtered through a pre-rinsed 0.2 μm regenerated cellulose Target2 syringe filter (Thermo Scientific, Prod. No. F25047) into a 7 mL scintillation vial. Samples were acidified with 10 μL of concentrated HNO3 per 1 mL sample, sealed with a PTFE lined cap, and stored at room temperature until analysis. Sample analysis was performed using KOH eluent supplied by a Dionex EGC III KOH Eluent Generator Cartridge (Prod. No. 074532), Dionex CR-ATC Continuously Regenerated Trap Column (Prod. No. 060477), Dionex AERS 500 Electronically Regenerated Suppressor (Prod. No. 082541), Dionex IonPac AG19 Guard Column (Prod. No. 062888), Dionex IonPac AS19 Analytical Column (Prod. No. 062886) and Dionex CRD 200 RFIC Carbonate Removal Device (Prod. No. 062986). Reference - Weston et al. 2006, Biogeochemistry 77: 375-408.

6) Chloride (Cl): Porewater sample was filtered through a pre-rinsed 0.2 µm regenerated cellulose Target2 syringe filter (Thermo Scientific, Prod. No. F25047) into a 7 mL scintillation vial. Samples were acidified with 10 µL of concentrated HNO3 per 1 mL sample, sealed with a PTFE lined cap, and stored at room temperature until analysis. Sample analysis was performed using KOH eluent supplied by a Dionex EGC III KOH Eluent Generator Cartridge (Prod. No. 074532), Dionex CR-ATC Continuously Regenerated Trap Column (Prod. No. 060477), Dionex AERS 500 Electronically Regenerated Suppressor (Prod. No. 082541), Dionex IonPac AG19 Guard Column (Prod. No. 062888), Dionex IonPac AS19 Analytical Column (Prod. No. 062886) and Dionex CRD 200 RFIC Carbonate Removal Device (Prod. No. 062986). Reference - Weston et al. 2006, Biogeochemistry 77: 375-408.

7) Calculated Values: Values for NO3, DIN, DON, DOP were calculated as follows:
NO3 = NOx - NO2
DIN = NOx + NH4
DON = TDN - DIN
DOP= TDP - PO4

Data Processing Description

BCO-DMO Processing Notes:
- data submitted in Excel file "Joye_OCE_1357360_Data_Submission_AT4205_sediment.xlsx" sheet 1 extracted to csv
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions: spaces, +, and - changed to underscores; changed µ to u; removed #, (,)
- converted latitude and longitude from degrees-decimal-minutes to decimal-degrees, rounded to 4 decimal places
- re-formatted date from d/m/yy to yyyy-mm-dd
- extracted strings from numeric columns and added to new adjacent columns: OLW from depth and bdl from O2_uM, DOP_uM, H2S_mM, PIC_pcent
- changed blank cells to 'nd' for 'no data'

[table of contents | back to top]

Data Files

File
AT42-05_sed_chem.csv (Comma Separated Values (.csv), 17.63 KB)   MD5:3a40e665b62eec76d56d2bd60562ef23   Primary data file for dataset ID 817797

[table of contents | back to top]

Related Publications

Bendschneider, K., and Robinson, R.J. (1952). A new spectrophotometric method for the determination of nitrite in sea water. Technical Report No. 8. University of Washington
Methods

Cline, J. D. (1969). Spectrophotometric Determination of Hydrogen Sulfide in Natural Waters. Limnology and Oceanography, 14(3), 454–458. doi:10.4319/lo.1969.14.3.0454
Methods

Garside, C. (1982). A chemiluminescent technique for the determination of nanomolar concentrations of nitrate and nitrite in seawater. Marine Chemistry, 11(2), 159–167. doi:10.1016/0304-4203(82)90039-1
Methods

Parsons, T. R., Y. Maita, and C. M. Lalli. "A Manual of Chemical and Biological Methods of Seawater Analysis",

Pergamon Press (1984). ISBN: [9780080302874](#)
Methods

Sarazin, G., Michard, G., & Prevot, F. (1999). A rapid and accurate spectroscopic method for alkalinity measurements in sea water samples. Water Research, 33(1), 290–294. doi:10.1016/s0043-1354(98)00168-7
https://doi.org/10.1016/S0043-1354(98)00168-7
Methods

Solorzano, L. (1969). DETERMINATION OF AMMONIA IN NATURAL WATERS BY THE PHENOLHYPOCHLORITE METHOD Limnology and oceanography, 14(5), 799-801.
https://pdfs.semanticscholar.org/7b24/b41d9b4e1ad507a06f282d0e0aed1e51e89e.pdf
Methods

Solórzano, L., & Sharp, J. H. (1980). Determination of total dissolved phosphorus and particulate phosphorus in natural waters1. Limnology and Oceanography, 25(4), 754–758. doi:[10.4319/lo.1980.25.4.0754](#)
Methods

Strickland, J. D. H. and Parsons, T. R. (1972). A Practical Hand Book of Seawater Analysis. Fisheries Research Board of Canada Bulletin 157, 2nd Edition, 310 p.
Methods

Sugimura, Y., & Suzuki, Y. (1988). A high-temperature catalytic oxidation method for the determination of non-volatile dissolved organic carbon in seawater by direct injection of a liquid sample. Marine Chemistry, 24(2), 105–131. doi:[10.1016/0304-4203(88)90043-6](#)
Methods

Watanabe, K., Badr, E.-S., Pan, X., & Achterberg, E. P. (2007). Conversion efficiency of the high-temperature combustion technique for dissolved organic carbon and total dissolved nitrogen analysis. International Journal of Environmental Analytical Chemistry, 87(6), 387–399. doi:[10.1080/03067310701237023](#)
Methods

[[table of contents](#) | [back to top](#)]

Parameters

Parameter	Description	Units
ALVIN_Dive	Alvin dive number	unitless
Site	Site identifier	unitless
lat_decdeg	latitude; north is positive	decimal degrees
lon_decdeg	longitude; east is positive	decimal degrees
Date_processed	Date when core was sectioned for geochemical analysis	yyyy-mm-dd
Core	Identifier to differentiate push cores taken during an ALVIN dive	unitless
Depth_cm	Sediment sampling depth; OLW = overlying water	cm
Depth_cm_OLW	OLW flag for sediment sampling depth (OLW = overlying water)	unitless
sediment_pH	pH taken during core sectioning; method detection limit = 0.05	unitless; pH scale
porewater_pH	pH taken during porewater geochemistry processing; method detection limit = 0.05	unitless; pH scale
salinity	Pore water salinity	Practical Salinity Units (PSU)
NO2_uM	Pore water concentrations of nitrite; method detection limit = 0.1	micromol/L
NO2_uM_bdl	BDL flag for pore water concentrations of nitrite (bdl = below detection limit); method detection limit = 0.1	unitless

Nox_uM	Pore water concentrations of nitrite and nitrate; method detection limit = 0.2	micromol/L
NO3_uM	Pore water concentrations of nitrate (Nox - NO2); method detection limit = 0.1	micromol/L
DIN_uM	Pore water concentrations of dissolved inorganic nitrogen; method detection limit = 0.2	micromol/L
TDN_uM	Pore water concentrations of total dissolved nitrogen; method detection limit = 0.5	micromol/L
NH4_uM	Pore water concentrations of ammonium; method detection limit = 0.1	micromol/L
DON_uM	Pore water concentrations of dissolved organic nitrogen; method detection limit = 1	micromol/L
PO4_uM	Pore water concentrations of phosphate; method detection limit = 0.1	micromol/L
TDP_uM	Pore water concentrations of total dissolved phosphate; method detection limit = 0.1	micromol/L
DOP_uM	Pore water concentrations of dissolved organic phosphate; method detection limit = 0.1	micromol/L
DOP_uM_bdl	BDL flag for pore water concentrations of dissolved organic phosphate (bdl = below detection limit); method detection limit = 0.1	unitless
DIN_DIP	Pore water ratios of dissolved inorganic nitrogen to dissolved inorganic phosphate; method detection limit = 0.1	unitless
DON_DOP	Pore water ratios of dissolved organic nitrogen to dissolved organic phosphate; method detection limit = 0.5	unitless
DOC_uM	Porewater concentrations of dissolved organic carbon; method detection limit = 1	micromol/L
Alkalinity_mM	Pore water alkalinity; method detection limit = 0.05	mmol/L
CH4_uM	Pore water concentrations of methane; method detection limit = 0.1	micromol/L
H2S_mM	Pore water concentrations of hydrogen sulfide; method detection limit = 0.1	mmol/L
H2S_mM_bdl	BDL flag for pore water concentrations of hydrogen sulfide (bdl = below detection limit); method detection limit = 0.1	unitless
Sulfate_mM	Pore water concentrations of sulfate; method detection limit = 0.1	mmol/L
Chloride_mM	Pore water concentrations of chloride	mmol/L
Porosity_pcent	Sediment porosity	%
SOM_LOI_pcent	Sediment organic matter (Loss on ignition); method detection limit = 0.2	%
TPN_pcent	Sediment total particulate nitrogen	%
TPC_pcent	Sediment total particulate carbon	%
POC_pcent	Sediment particulate organic carbon	%
PIC_pcent	Sediment particulate inorganic carbon	%
PIC_pcent_bdl	BDL flag for sediment particulate inorganic carbon (bdl = below detection limit)	unitless
TPP_umol_P_g_sediment	Sediment total particulate phosphate	micromol P/gram sediment
TPP_pcent	Sediment total particulate phosphate (percent)	%

Instruments

Dataset-specific Instrument Name	Shimadzu Instruments GC-2014 Gas Chromatograph with FID Detector and Methanizer
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	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	DIONEX Corporation ICS-2000 Ion Chromatography System
Generic Instrument Name	Ion Chromatograph
Generic Instrument Description	Ion chromatography is a form of liquid chromatography that measures concentrations of ionic species by separating them based on their interaction with a resin. Ionic species separate differently depending on species type and size. Ion chromatographs are able to measure concentrations of major anions, such as fluoride, chloride, nitrate, nitrite, and sulfate, as well as major cations such as lithium, sodium, ammonium, potassium, calcium, and magnesium in the parts-per-billion (ppb) range. (from http://serc.carleton.edu/microbelife/research_methods/biogeochemical/ic....)

Dataset-specific Instrument Name	Oakton, Prod. No. 35634-50 and a Ross electrode (Thermo Fisher, Prod. No. 8103BNUWP)
Generic Instrument Name	pH Sensor
Generic Instrument Description	An instrument that measures the hydrogen ion activity in solutions. The overall concentration of hydrogen ions is inversely related to its pH. The pH scale ranges from 0 to 14 and indicates whether acidic (more H+) or basic (less H+).

Dataset-specific Instrument Name	Hach Company DR 2800 Spectrophotometer
Generic Instrument Name	Spectrophotometer
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

Dataset-specific Instrument Name	Shimadzu Instruments UV1601 Spectrophotometer
Generic Instrument Name	Spectrophotometer
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

Dataset-specific Instrument Name	Shimadzu Instruments TOC-Vcph Total Organic Carbon Analyzer with ASI-V Autosampler and TNM Total Nitrogen Analyzer
Generic Instrument Name	Total Organic Carbon Analyzer
Generic Instrument Description	A unit that accurately determines the carbon concentrations of organic compounds typically by detecting and measuring its combustion product (CO_2). See description document at: http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/bs116.pdf

[table of contents | back to top]

Deployments

AT42-05_Alvin_Dives

Website	https://www.bco-dmo.org/deployment/773374
Platform	Alvin
Start Date	2018-11-17
End Date	2018-11-25
Description	Alvin dives 4991-5001at Guaymas Basin

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.

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.

Funding

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