Geochemical measurements of CTD and Alvin Niskin samples collected in the Gulf of California on RV/Atlantis AT42-05 Alvin dives, Nov. 2018

Website: https://www.bco-dmo.org/dataset/818934
Data Type: Cruise Results
Version: 1
Version Date: 2023-02-07

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 geochemical measurements of CTD and Alvin Niskin samples collected in the Gulf of California on RV/Atlantis cruise AT42-05 and Alvin dives 4991-5000 in Guaymas Basin, Gulf of California (27 00.00 N, -111 20.00 W) in November 2018.

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Coverage

Spatial Extent: **N**:27.04546 **E**:-111.4042 **S**:27.00654 **W**:-111.4106
Temporal Extent: 2018-11-18 - 2018-11-27

Methods & Sampling

1) Nutrients (DOC, TDN, NOx, NO2, NH4, PO4, TDP): Water 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 (Dissolved Organic Carbon) 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 (Total Dissolved Nitrogen) 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 (Nitric oxides) 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 (Nitrite) 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 (Ammonium) 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 (Phosphate) 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 (Total Dissolved Phosphorous) 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).

2) H2S (Hydrogen Sulfide): Water 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).

3) Alkalinity was determined colorimetrically by the method described in Sarazin, 1999 (A rapid and accurate spectroscopic method for alkalinity measurements in sea water samples. Water Research 33: 290-294).

4) CH4 (Methane): A 1L water sample was collected from the Niskin bottle using gas tight tubing and standard collection methods for dissolved gases. Subsequently in the lab, a 700 mL sub-sample was transferred to an evacuated 1L media bottle. The water was sonicated under vacuum for 1 minute and then shaken; this process was repeated twice to transfer dissolved gases into the bottle headspace. The bottle pressure was equilibrated with helium purged saturated salt brine and the volume of recovered dissolved gas was recorded. The gas sample was transferred to an evacuated serum vial for storage until analysis on the gas chromatograph. CH4 was determined by headspace analysis using an SRI 8610C gas chromatograph equipped with a flame ionization detector (Crespo-Medina et al. 2014, Nature Geoscience, 7:423-427).

5) Salinity and pH: Salinity was determined with a refractometer, and pH was measured with a Ross electrode calibrated with NBS standard buffers.

6) Calculated Values (NO3, DIN, DON, DOP): These values 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 "AT42-05_WC_geochem_dataset.xlsx" sheet 1 extracted to csv
- joined chemistry data with metadata table
- 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
- converted date from m/d/y to ISO format, yyyy-mm-dd
- added ISO datetime column
- changed blank cells to 'nd' for 'no data'
- columns Sulfate and Chloride removed as requested by the submitter, columns included in the file AT42-

05_WC_geochem_dataset_V2.xlsx by mistake.

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Data Files

File
ctdchem_at4205.csv(Comma Separated Values (.csv), 9.91 KB) MD5:f1d752b6078cd638d1fd180dc914fef0 Primary table for dataset ID 818934.

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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

Crespo-Medina, M., Meile, C. D., Hunter, K. S., Diercks, A.-R., Asper, V. L., Orphan, V. J., … Joye, S. B. (2014). The rise and fall of methanotrophy following a deepwater oil-well blowout. Nature Geoscience, 7(6), 423–427. doi:10.1038/ngeo2156
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

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Parameters

Parameter	Description	Units
Site	site identifier	unitless
Site_Description	site description	unitless
Collection_Event	ctd number or Alvin sample type	unitless
Deployment_date	Date of deployment; UTC	yyyy/mm/dd
Deployment_time	Time of deployment; UTC	HH:MM
ISO_DateTime_UTC	ISO DateTime; UTC	YYYY-MM-DDTHH:MM:SSZ
Latitude	Deployment latitude; north is positive	decimal degrees
Longitude	Deployment longitude; east is positive	decimal degrees
Depth	Sampling depth in water column	meters
pH	Water column pH; detection limit=0.05	unitless; pH scale
Salinity	Water column salinity; detection limit=1	Practical Salinity Units (PSU)
NO2	Water column nitrite concentration; detection limit=0.1	micromolar
NOx	Water column nitrate + nitrite concentration; detection limit=0.1	micromolar
NO3	Water column nitrate concentration; detection limit=0.1	micromolar
DIN	Water column dissolved inorganic nitrogen; detection limit=0.1	micromolar
TDN	Water column total dissolved nitrogen concentration; detection limit=1	micromolar
NH4	Water column ammonium concentration; detection limit=0.1	micromolar

DON	Water column dissolved organic nitrogen concentration; detection limit=1	micromolar
PO4	Water column phosphate concentration; detection limit=0.1	micromolar
TDP	Water column total dissolved ohosphate; detection limit=0.1	micromolar
DOP	Water column dissolved organic phosphate concentration; detection limit=0.1	micromolar
DIN_DIP	Water column dissolved inorganic N:P ratio; detection limit=0.1	molar ratio
DON_DOP	Water column dissolved organic N:P ratio; detection limit=1	molar ratio
DOC	Water column dissolved organic carbon concentration; detection limit=1	micromolar
Alkalinity	Water column total alkalinity; detection limit=0.1	millimolar
H2S	Water column concentration of Hydrogen Sulfide; detection limit=1 uM	micromolar
Methane	Water column methane concentration. detection limit =1.	nanomolar

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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	Orion 4 Star Meter (Thermo Fisher, Prod. No. 1116000) 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	Fisher refractometer
Generic Instrument Name	Refractometer
Dataset-specific Description	To measure salinity
Generic Instrument Description	A refractometer is a laboratory or field device for the measurement of an index of refraction (refractometry). The index of refraction is calculated from Snell's law and can be calculated from the composition of the material using the Gladstone-Dale relation. In optics the refractive index (or index of refraction) n of a substance (optical medium) is a dimensionless number that describes how light, or any other radiation, propagates through that medium.

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 (CO2). See description document at: http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/bs116.pdf

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Deployments

AT42-05_Alvin_Dives

Website	https://www.bco-dmo.org/deployment/773374
Platform	HOV 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.

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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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