

# Sediment geochemistry summary from push cores collected during HOV Alvin dives during the R/V Atlantis cruise AT37-06 in the Guaymas Basin from December 2016

**Website:** <https://www.bco-dmo.org/dataset/819127>

**Data Type:** Cruise Results

**Version:** 1

**Version Date:** 2020-07-21

## 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 summary from push cores collected during HOV Alvin dives during the R/V Atlantis cruise AT37-06 in the Guaymas Basin from December 2016. Part of this dataset was published in Zhuang et al., 2018.

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## Coverage

**Spatial Extent:** N:27.50767 E:-111.38417 S:27.0065 W:-111.68383

**Temporal Extent:** 2016-12-12 - 2016-12-24

## Acquisition Description

Location: Guaymas Basin, Gulf of California, 27 00.00 N, -111 20.00 W

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 by centrifugation. Porewater and sediment samples were preserved and analyzed as follows:

1) Nutrients (DOC, TDN, NO<sub>x</sub>, NO<sub>2</sub>, NH<sub>4</sub>, PO<sub>4</sub>, 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.

TDN was determined using high temperature combustion and a chemiluminescence detector following the method described in Watanabe et. al, 2007.

NO<sub>x</sub> was determined using chemical reduction and a nitric oxide detector following the method described by Garside, 1982.

NO<sub>2</sub> was determined using the colorimetric method described by Bendschneider and Robinson, 1952 as reproduced by Parsons, Marta, and Lalli, 1984.

NH<sub>4</sub> was determined using the colorimetric method described by Solorzano, 1969.

PO<sub>4</sub> was determined using the colorimetric method described by Strickland and Parsons, 1972.

TDP was determined using the colorimetric method described by Solorzano and Sharp, 1980.

2) C1-C3 (CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>3</sub>H<sub>8</sub>): Sediment sample was collected into a glass serum vial, preserved with 1M NaOH, crimp-sealed with a butyl rubber stopper and stored at room temperature until analysis. C1-C3 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).

3) H<sub>2</sub>S: Porewater sample was collected into a 15 mL centrifuge tube containing 2M zinc acetate and stored at 5°C until analysis. H<sub>2</sub>S was determined using the colorimetric method described by Cline, 1969.

4) SO<sub>4</sub>: Porewater sample was collected into a 7 mL scintillation vial, acidified with 10 uL concentrated hydrochloric acid per mL sample and sealed with a PTFE lined cap. SO<sub>4</sub> determination was made after Cl removal using a Dionex OnGuard Ag cartridge (Prod. No. 039637). 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).

5) TPN: The pressed sediment sample (mud-cake) was dried at 60°C and then homogenized via grinding. TPN was determined by the method described by Gordan, Jr., 1969 as reproduced by Sharp, 1974. Samples were analyzed on a ThermoFinnigan FlashEA 1112 series NC Soil Analyzer.

6) TPC: The pressed sediment sample (mud-cake) was dried at 60°C and then homogenized via grinding. TPC was determined by the method described by Gordan, Jr., 1969 as reproduced by Sharp, 1974. Samples were analyzed on a ThermoFinnigan FlashEA 1112 series NC Soil Analyzer.

7) POC: The pressed sediment sample (mud-cake) was acidified with 1 N HCl, dried at 60°C, and then homogenized via grinding. POC was determined by the method described by Gordan, Jr., 1969 as reproduced by Sharp, 1974. Samples were analyzed on a ThermoFinnigan FlashEA 1112 series NC Soil Analyzer.

8) Calculated Values (NO<sub>3</sub>, DIN, DON, DOP): These values were calculated as follows:

NO<sub>3</sub> = NO<sub>x</sub> - NO<sub>2</sub>

DIN = NO<sub>x</sub> + NH<sub>4</sub>

DON = TDN - DIN

DOP= TDP - PO<sub>4</sub>

## Processing Description

BCO-DMO Data Manager Processing Notes:

- \* added a conventional header with dataset name, PI name, version date
- \* modified parameter names to conform with BCO-DMO naming conventions (spaces, +, and - changed to underscores). Units in parentheses removed and added to Parameter Description metadata section.
- \* Data submitted in Excel file "AT37-06 Sediment Summary submit.xlsx" Sheet1 extracted to csv
- \* The default missing identifier in the original file N.D. for "not determined" is displayed as "nd" in the data. nd is the default missing data identifier in the BCO-DMO system.
- \* removed metadata notes at the bottom of the file and moved to parameter descriptions. E.g. "B.D.: Below detection limit."
- \* Date formats converted to ISO 8601 yyyy-mm-dd
- \* Lat/lon converted to decimal degrees from degrees decimal minutes
- \* OLW flag for sediment sampling depth (OLW = overlying water) moved from a value in the Depth column to a new Depth\_OLW column

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## Related Publications

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](https://doi.org/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](https://doi.org/10.1016/0304-4203(82)90039-1)  
*Methods*

Iversen, N., & Blackburn, T. H. (1981). Seasonal rates of methane oxidation in anoxic marine sediments. *Applied and Environmental Microbiology*, 41(6), 1295-1300.  
<https://aem.asm.org/content/41/6/1295.short>  
*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](https://www.isbn-international.org/product/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](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 waters<sup>1</sup>. *Limnology and Oceanography*, 25(4), 754–758.  
doi:[10.4319/lo.1980.25.4.0754](https://doi.org/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](https://doi.org/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](https://doi.org/10.1080/03067310701237023)

*Methods*

Zhuang, G., Montgomery, A., Samarkin, V. A., Song, M., Liu, J., Schubotz, F., ... Joye, S. B. (2019). Generation and Utilization of Volatile Fatty Acids and Alcohols in Hydrothermally Altered Sediments in the Guaymas Basin, Gulf of California. *Geophysical Research Letters*, 46(5), 2637–2646.

doi:10.1029/2018gl081284 <https://doi.org/10.1029/2018GL081284>

*Results*

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## Related Datasets

### IsRelatedTo

Joye, S. B., Teske, A. P. (2020) **Acetate and methanol turnover rates from sediment push cores collected during HOV Alvin dives during the R/V Atlantis cruise AT37-06 in Guaymas Basin, Gulf of California in December 2016.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2020-06-04 doi:10.26008/1912/bco-dmo.814406.1 [[view at BCO-DMO](#)]  
*Relationship Description: Related Datasets which used the same sediment core samples.*

Joye, S. B., Teske, A. P. (2020) **Results from inhibition experiments conducted using sediment samples from push cores obtained using HOV Alvin dive 4869 during the R/V Atlantis cruise AT37-06 in Guaymas Basin, Gulf of California in December 2016.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2020-06-04 doi:10.26008/1912/bco-dmo.814415.1 [[view at BCO-DMO](#)]  
*Relationship Description: Related Datasets which used the same sediment core samples.*

Joye, S. B., Teske, A. P. (2020) **Sediment geochemistry from push cores collected during HOV Alvin dives during the R/V Atlantis cruise AT37-06 in Guaymas Basin, Gulf of California in December 2016.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2020-07-21 doi:10.26008/1912/bco-dmo.814391.1 [[view at BCO-DMO](#)]  
*Relationship Description: Related Datasets which used the same sediment core samples.*

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## Parameters

Parameter	Description	Units
Dive_No	Dive number	unitless
Site	Site name	unitless
Sampling_Date	Sample date (UTC) in ISO 8601 format yyyy-mm-dd	unitless
Latitude	Latitude	decimal degrees
Longitude	Longitude	decimal degrees
Depth	Sediment sampling depth	centimeters (cm)
NO2	Nitrite; method detection limit = 0.1	micromolar (umol/L)
NOx	Nitrate + Nitrite; method detection limit = 0.1	micromolar (umol/L)
NO3	Nitrate; method detection limit = 0.1	micromolar (umol/L)
DIN	Dissolved Inorganic Nitrogen; method detection limit = 0.1	micromolar (umol/L)
TDN	Total Dissolved Nitrogen; method detection limit = 1	micromolar (umol/L)
NH4	Ammonium; method detection limit = 0.1	micromolar (umol/L)
PO4	Phosphate; method detection limit = 0.1	micromolar (umol/L)
TDP	Total Dissolved Phosphate; method detection limit = 0.1	micromolar (umol/L)
DIN_to_DIP	Dissolved Inorganic N:P ratio; molar ratio, method detection limit = 0.1	dimensionless
DOC	Dissolved Organic Carbon; method detection limit = 1	micromolar (umol/L)
CH4	Dissolved Methane; method detection limit = 0.1	micromolar (umol/L)
C2H6	Dissolved Ethane; method detection limit = 0.1	micromolar (umol/L)
C3H8	Dissolved Propane; method detection limit = 0.1	micromolar (umol/L)
H2S	Sulfide; method detection limit = 0.1	millimolar (mmol/L)
SO4	Dissolved Organic Nitrogen; method detection limit = 1	millimolar (mmol/L)
TPN	Sediment total particulate nitrogen	percent (%)
TPC	Sediment total particulate carbon	percent (%)
POC	Sediment particulate organic carbon	percent (%)

## Instruments

<b>Dataset-specific Instrument Name</b>	Beckman Coulter LS 6500 Scintillation Counter
<b>Generic Instrument Name</b>	Liquid Scintillation Counter
<b>Generic Instrument Description</b>	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 to quantify the activity of particulate emitting ( $\beta$ and $\alpha$ ) radioactive samples, it can also detect the Auger electrons emitted from $^{51}\text{Cr}$ and $^{125}\text{I}$ samples.

<b>Dataset-specific Instrument Name</b>	Shimadzu Instruments TOC-Vcph Total Organic Carbon Analyzer
<b>Generic Instrument Name</b>	Total Organic Carbon Analyzer
<b>Dataset-specific Description</b>	Shimadzu Instruments TOC-Vcph Total Organic Carbon Analyzer with ASI-V Autosampler and TNM Total Nitrogen Analyzer
<b>Generic Instrument Description</b>	A unit that accurately determines the carbon concentrations of organic compounds typically by detecting and measuring its combustion product ( $\text{CO}_2$ ). See description document at: <a href="http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/bs116.pdf">http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/bs116.pdf</a>

<b>Dataset-specific Instrument Name</b>	TNM Total Nitrogen Analyzer
<b>Generic Instrument Name</b>	Total Nitrogen Analyzer
<b>Dataset-specific Description</b>	Shimadzu Instruments TOC-Vcph Total Organic Carbon Analyzer with ASI-V Autosampler and TNM Total Nitrogen Analyzer
<b>Generic Instrument Description</b>	A unit that accurately determines the nitrogen concentrations of organic compounds typically by detecting and measuring its combustion product ( $\text{NO}$ ). See description document at: <a href="http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/totalnit.pdf">http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/totalnit.pdf</a>

<b>Dataset-specific Instrument Name</b>	Shimadzu Instruments GC-2014 Gas Chromatograph with FID Detector and Methanizer
<b>Generic Instrument Name</b>	Gas Chromatograph
<b>Generic Instrument Description</b>	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)

<b>Dataset-specific Instrument Name</b>	SRI Instruments 8610C Gas Chromatograph with FID Detector
<b>Generic Instrument Name</b>	Gas Chromatograph
<b>Generic Instrument Description</b>	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)

<b>Dataset-specific Instrument Name</b>	DIONEX Corporation ICS-2000 Ion Chromatography System
<b>Generic Instrument Name</b>	Ion Chromatograph
<b>Generic Instrument Description</b>	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 <a href="http://serc.carleton.edu/microbelife/research_methods/biogeochemical/ic...">http://serc.carleton.edu/microbelife/research_methods/biogeochemical/ic...</a> )

<b>Dataset-specific Instrument Name</b>	Hach Company DR 2800 Spectrophotometer
<b>Generic Instrument Name</b>	Spectrophotometer
<b>Generic Instrument Description</b>	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.

<b>Dataset-specific Instrument Name</b>	Shimadzu Instruments UV1601 Spectrophotometer
<b>Generic Instrument Name</b>	Spectrophotometer
<b>Generic Instrument Description</b>	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.

<b>Dataset-specific Instrument Name</b>	Antek Instruments 7050 Nitric Oxide Detector with 745 Nitrate/Nitrite Reduction Assembly
<b>Generic Instrument Name</b>	Chemiluminescence NOx Analyzer
<b>Generic Instrument Description</b>	The chemiluminescence method for gas analysis of oxides of nitrogen relies on the measurement of light produced by the gas-phase titration of nitric oxide and ozone. A chemiluminescence analyzer can measure the concentration of NO/NO2/NOX. One example is the Teledyne Model T200: <a href="http://www.teledyne-api.com/products/T200.asp">http://www.teledyne-api.com/products/T200.asp</a>

<b>Dataset-specific Instrument Name</b>	ThermoFinnigan FlashEA 1112 series NC Soil Analyzer
<b>Generic Instrument Name</b>	Elemental Analyzer
<b>Generic Instrument Description</b>	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

<b>Dataset-specific Instrument Name</b>	Shimadzu Instruments TOC-Vcph Total Organic Carbon Analyzer with ASI-V Autosampler and TNM Total Nitrogen Analyzer
<b>Generic Instrument Name</b>	Laboratory Autosampler
<b>Dataset-specific Description</b>	Shimadzu Instruments TOC-Vcph Total Organic Carbon Analyzer with ASI-V Autosampler and TNM Total Nitrogen Analyzer
<b>Generic Instrument Description</b>	Laboratory apparatus that automatically introduces one or more samples with a predetermined volume or mass into an analytical instrument.

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## Deployments

AT37-06

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/720354">https://www.bco-dmo.org/deployment/720354</a>
<b>Platform</b>	R/V Atlantis
<b>Report</b>	<a href="https://datadocs.bco-dmo.org/d3/data_docs/GuaymasBasin_Interactions/AT37-06_CruiseReport.pdf">https://datadocs.bco-dmo.org/d3/data_docs/GuaymasBasin_Interactions/AT37-06_CruiseReport.pdf</a>
<b>Start Date</b>	2016-12-09
<b>End Date</b>	2016-12-27

### AT37-06\_Alvin\_Dives

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/782870">https://www.bco-dmo.org/deployment/782870</a>
<b>Platform</b>	Alvin
<b>Report</b>	<a href="https://datadocs.bco-dmo.org/d3/data_docs/GuaymasBasin_Interactions/AT37-06_CruiseReport.pdf">https://datadocs.bco-dmo.org/d3/data_docs/GuaymasBasin_Interactions/AT37-06_CruiseReport.pdf</a>
<b>Start Date</b>	2016-12-09
<b>End Date</b>	2016-12-27
<b>Description</b>	Alvin dives conducted at Guyamas Basin on R/V Atlantis cruise AT37-06.

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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 sulfur 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
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1357360</a>

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