Porewater geochemistry of sediments collected Fall 2019 in the Santa Barbara Basin using ROV Jason during R/V Atlantis cruise AT42-19

Website: https://www.bco-dmo.org/dataset/867007
Data Type: Cruise Results
Version: 1
Version Date: 2021-12-23

Project
» Collaborative Research: Do benthic feedbacks couple sulfur, nitrogen and carbon biogeochemistry during transient deoxygenation? (BASIN)

Contributors	Affiliation	Role
Treude, Tina	University of California-Los Angeles (UCLA)	Principal Investigator, Contact
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Abstract
Sediments were collected in Fall 2019 across three transects in the Santa Barbara Basin using the ROV Jason during R/V Atlantis cruise AT42-19. Porewater was separated from the sediments and geochemical properties measured.

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Coverage

Spatial Extent: **N**:34.36270433 **E**:-120.0147509 **S**:34.14209313 **W**:-120.1164661
Temporal Extent: 2019-10-31 - 2019-11-09

Acquisition Description

Sediments were collected with push cores (6 cm inner diameter) along three depth transects across the Santa Barbara Basin using the ROV Jason. Porewater was separated from sediment by centrifugation (4300 x g for 20 mins) in anoxic centrifugation vials and subsampled for further analysis.

Porewater geochemical properties were determined as listed:

- Porewater sulfate concentrations were determined by ion chromatography (Metrohm 761).
- Porewater sulfide concentrations were determined spectrophotometrically (Shimadzu UV-Spectrophotometer UV-1800) according to Cline (1969).
- Porewater ammonium, iron (II), and phosphate concentrations were determined spectrophotometrically

(Shimadzu UV-Spectrophotometer UV-1800) according to Grasshoff et al. (1999).
- Porewater nitrate and nitrite concentrations were determined spectrophotometrically (Shimadzu UV-Spectrophotometer UV-1800) according to García-Robledo et al. (2014).
- Porewater Total Alkalinity was determined by titration according to Dale et al. 2015. Porewater Dissolved Inorganic Carbon was determined using a flow injection system (Hall & Aller 1992).

Note: Negative depths refer to measurements in the sediment core supernatant water. Supernatant water was collected with an anoxic syringe prior to core slicing.

Processing Description

BCO-DMO Data Processing
- Imported data from source file "Treude_Valentine_BASIN_2019_datasets_BCO-DMO.xlsx" into the BCO-DMO processing tool
- Combined data from multiple stations into a single file
- Separated data for porewater, microbial, and sediment into individual tables
- Modified parameter (column) names to conform with BCO-DMO naming conventions
    The only allowed characters are A-Z,a-z,0-9, and underscores
    No spaces, hyphens, commas, parentheses, or Greek letters
- Added column for Cruise
- Changed date format from m/d/yyyy to yyyy-mm-dd (ISO Date 8601 format)
- Added conventional header with dataset name, PI name, version date

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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
Methods

Dale, A. W., Sommer, S., Lomnitz, U., Montes, I., Treude, T., Liebetrau, V., Gier, J., Hensen, C., Dengler, M., Stolpovsky, K., Bryant, L. D., & Wallmann, K. (2015). Organic carbon production, mineralisation and preservation on the Peruvian margin. In Biogeosciences (Vol. 12, Issue 5, pp. 1537–1559). Copernicus GmbH. https://doi.org/10.5194/bg-12-1537-2015
Methods

García-Robledo, E., Corzo, A., & Papaspyrou, S. (2014). A fast and direct spectrophotometric method for the sequential determination of nitrate and nitrite at low concentrations in small volumes. Marine Chemistry, 162, 30–36. doi:10.1016/j.marchem.2014.03.002
Methods

Grasshoff, K., Kremling, K., & Ehrhardt, M. (Eds.). (1999). Methods of Seawater Analysis. doi:10.1002/9783527613984
Methods

Hall, P. . J., & Aller, R. C. (1992). Rapid, small-volume, flow injection analysis for SCO2, and NH4+ in marine and freshwaters. Limnology and Oceanography, 37(5), 1113–1119. doi:10.4319/lo.1992.37.5.1113 https://doi.org/https://doi.org/10.4319/lo.1992.37.5.1113
Methods

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Related Datasets

IsRelatedTo

Treude, T., Valentine, D. L. (2021) **Microbial activity from sediments collected Fall 2019 in the Santa Barbara Basin using ROV Jason during R/V Atlantis cruise AT42-19.** Biological and Chemical

Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-12-28 http://lod.bco-dmo.org/id/dataset/867221 [view at BCO-DMO]

Treude, T., Valentine, D. L. (2021) **Porosity and density of sediments collected Fall 2019 in the Santa Barbara Basin using ROV Jason during R/V Atlantis cruise AT42-19.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-12-28 http://lod.bco-dmo.org/id/dataset/867113 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Cruise	Cruise ID	unitless
Location	Sampling and cruise location	unitless
Latitude	Latitude of sample collection	decimal degrees
Longitude	Longitude of sample collection; west is negative	decimal degrees
ISO_DateTime_UTC	Date and time in ISO8601 standard format (YYYY-MM-DDThh:mm:ssZ)	unitless
Station	Station	unitless
Water_Depth	Water depth at sampling location	meters (m)
Sampling_Instrument	Sampling instrument used to obtain sediments	unitless
Sediment_Depth	Depth of sediment core	centimeters (cm)
Total_Alkalinity	Total alkalinity concentration in porewater	millimole per liter (mmol/L)
DIC	Dissolved inorganic carbon concentration in porewater	millimole per liter (mmol/L)
Iron_II	Iron (II) concentration in porewater	micromole per liter (µmol/L)
Total_Sulfide	Total sulfide concentration in porewater	micromole per liter (µmol/L)
Sulfate	Sulfate concentration in porewater	millimole per liter (mmol/L)
Ammonium	Ammonium ion concentration in porewater	micromole per liter (µmol/L)
Nitrate	Nitrate concentration in porewater	micromole per liter (µmol/L)
Nitrite	Nitrite concentration in porewater	micromole per liter (µmol/L)
Phosphate	Phosphate concentration in porewater	micromole per liter (µmol/L)

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Instruments

Dataset-specific Instrument Name	Gravity Core
Generic Instrument Name	Gravity Corer
Generic Instrument Description	The gravity corer allows researchers to sample sediment layers at the bottom of lakes or oceans. The coring device is deployed from the ship and gravity carries it to the seafloor. (http://www.whoi.edu/instruments/viewInstrument.do?id=1079).

Dataset-specific Instrument Name	Shimadzu UV-Spectrophotometer UV-1800
Generic Instrument Name	UV Spectrophotometer-Shimadzu
Dataset-specific Description	Shimadzu UV-Spectrophotometer UV-1800 was used to determine porewater sulfide, ammonum, iron(II), phosphate, nitrate, and nitrite concentrations
Generic Instrument Description	The Shimadzu UV Spectrophotometer is manufactured by Shimadzu Scientific Instruments (ssi.shimadzu.com). Shimadzu manufacturers several models of spectrophotometer; refer to dataset for make/model information.

Dataset-specific Instrument Name	ROV Jason
Generic Instrument Name	ROV Jason
Dataset-specific Description	Sediments were collected with push cores in the Santa Barbara Basin using the ROV Jason.
Generic Instrument Description	The Remotely Operated Vehicle (ROV) Jason is operated by the Deep Submergence Laboratory (DSL) at Woods Hole Oceanographic Institution (WHOI). WHOI engineers and scientists designed and built the ROV Jason to give scientists access to the seafloor that didn't require them leaving the deck of the ship. Jason is a two-body ROV system. A 10-kilometer (6-mile) fiber-optic cable delivers electrical power and commands from the ship through Medea and down to Jason, which then returns data and live video imagery. Medea serves as a shock absorber, buffering Jason from the movements of the ship, while providing lighting and a bird’s eye view of the ROV during seafloor operations. During each dive (deployment of the ROV), Jason pilots and scientists work from a control room on the ship to monitor Jason’s instruments and video while maneuvering the vehicle and optionally performing a variety of sampling activities. Jason is equipped with sonar imagers, water samplers, video and still cameras, and lighting gear. Jason’s manipulator arms collect samples of rock, sediment, or marine life and place them in the vehicle’s basket or on "elevator" platforms that float heavier loads to the surface. More information is available from the operator site at URL.

Dataset-specific Instrument Name	flow injection system
Generic Instrument Name	Flow Injection Analyzer
Dataset-specific Description	Porewater Dissolved Inorganic Carbon was determined using a flow injection system (Hall & Aller 1992).
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	Metrohm 761
Generic Instrument Name	Ion Chromatograph
Dataset-specific Description	Porewater sulfate concentrations were determined by ion chromatography (Metrohm 761).
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	ROV push cores
Generic Instrument Name	Push Corer
Dataset-specific Description	Sediments were collected with push cores (6 cm i.d.) along three depth transects across the Santa Barbara Basin using the ROV Jason.
Generic Instrument Description	Capable of being performed in numerous environments, push coring is just as it sounds. Push coring is simply pushing the core barrel (often an aluminum or polycarbonate tube) into the sediment by hand. A push core is useful in that it causes very little disturbance to the more delicate upper layers of a sub-aqueous sediment. Description obtained from: http://web.whoi.edu/coastal-group/about/how-we-work/field-methods/coring/

Dataset-specific Instrument Name	centrifuge
Generic Instrument Name	Centrifuge
Dataset-specific Description	Porewater was separated from sediment by centrifugation (4300 x g for 20 mins) in anoxic centrifugation vials and subsampled for further analysis.
Generic Instrument Description	A machine with a rapidly rotating container that applies centrifugal force to its contents, typically to separate fluids of different densities (e.g., cream from milk) or liquids from solids.

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Deployments

AT42-19

Website	https://www.bco-dmo.org/deployment/867020
Platform	R/V Atlantis
Start Date	2019-10-29
End Date	2019-11-10
Description	BASIN Project cruise to study chemical processes that occur in oxygen-limited waters along the continental margins

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Project Information

Collaborative Research: Do benthic feedbacks couple sulfur, nitrogen and carbon biogeochemistry during transient deoxygenation? (BASIN)

Coverage: Santa Barbara Basin, California, USA

NSF abstract:

This study focuses on chemical processes that occur in oxygen-limited waters along the world's continental margins. These processes are influenced by the activities of microbes and control the fate of key elements that are deposited to sediments in these areas including carbon, nitrogen and sulfur. As a result, they are key to the health and function of the ocean. The intellectual merit of this research is to study the coupled chemical and microbial processes that occur in these environments by combining robotic technology with experiments that will be conducted at the ocean floor and in the shipboard laboratory. The broader impacts of this project will provide at-sea training and educational opportunities to undergraduate and graduate students and the results will be broadly distributed to stakeholders and interested parties. Results from this research promise to identify and quantify rates for key processes that couple carbon, nitrogen and sulfur in marine environments adjacent to the continents. The project addresses an important aspect of environmental change in the ocean (i.e., decreased oxygen due to warming and nutrient enrichment) and its influence on chemical and biological cycles and ocean ecosystems.

The dynamics of oxygen minimum zones along continental margins, and their potential for future expansion, are important because of their intersection with global biogeochemical cycles and because of their far-reaching impacts on ocean ecosystems. However, the impacts of transient deoxygenation on biogeochemical cycles of carbon, nitrogen and sulfur at the sea floor are not well established and are the focus of this study. This study will test the overarching hypothesis that deoxygenation triggers a positive feedback loop between bacterial mats at the sea floor that consume hydrogen sulfide, a sulfur species that can be toxic to higher organisms, and an underlying community of bacteria that produce hydrogen sulfide. By this hypothesis, the establishment of sea floor mats, which depend on inorganic nitrogen sources to run their sulfur metabolism, accelerates nitrogen cycling in the uppermost sediment horizon following deoxygenation. The accelerated nitrogen cycling allows for upward expansion of the sulfide-producing bacteria, which in-turn provide a shallow source of sulfide as substrate to further support nitrogen cycling in the sea floor mat. The results of this study will enable understanding of the relationship between oxygen dynamics in the water column and the biogeochemical processes at the sea floor that link the transformations of carbon, nitrogen and sulfur. The results of this study promise to define the environmental conditions under which the sulfur and nitrogen cycles are coupled and subject to strong positive feedbacks at the seafloor, as well as the conditions under which they are decoupled. This study provides training in research and innovative analytical and experimental techniques to four graduate students and several undergraduates. Undergraduates will be engaged in research at two institutions, one of which has recently been designated as a Hispanic serving institution. Approximately 10 undergraduate students (20 in total) will participate in each of the two proposed oceanographic expeditions, through an established course entitled: Field Studies in Marine Biogeochemistry. This course provides an opportunity for students to develop an independent research project in advance of the expedition, to participate on the expedition, and to conduct research projects while at sea.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1829981
NSF Division of Ocean Sciences (NSF OCE)	OCE-1830033

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