Porewater geochemistry from sediment pushcores collected by ROV Doc Ricketts from Southern California Seeps in May 2021

Website: https://www.bco-dmo.org/dataset/908217
Data Type: Cruise Results
Version: 1
Version Date: 2023-09-13

Project
» Collaborative Research: Redefining the footprint of deep ocean methane seepage for benthic ecosystems (Methanosphere)

Contributors	Affiliation	Role
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Abstract
This dataset provides geochemical data (major ions) for porewaters from sediment pushcores collected by a remotely-operated vehicle (ROV) deployed from the R/V Western Flyer in May 2021 (WF05-21) at the Del Mar and Santa Monica Seeps and in Newport Canyon, California, USA. Cores were sectioned into 1-3 centimeter (cm) horizons, and porewater was extracted shipboard using an argon-pressurized squeezer. Porewater samples were frozen at sea and thawed just before analysis. This dataset reports concentrations of fluoride, acetate, formate, chloride, bromide, nitrate, sulfate, thiosulfate, and phosphate anions and lithium, sodium, potassium, magnesium, and calcium cations. Measurements were made using the Thermo Dual Dionex Integrion HPIC ion chromatography system with either a 250-millimeter (mm) Dionex IonPac AS19-4um column (anions) or a 250 mm Dionex IonPac CS16-4um column (cations), in the Resnick Water and Environment Laboratory at the California Institute of Technology (Caltech).

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Coverage

Spatial Extent: **N**:36.7767 **E**:-117.782 **S**:32.9042 **W**:-122.085
Temporal Extent: 2021-05-19 - 2021-05-24

Methods & Sampling

Sediment pushcores were collected by a remotely-operated vehicle (ROV Doc Ricketts) from the R/V Western Flyer in May 2021 (cruise ID WF05-21) at the Del Mar Seep (32.9043, -117.7824), Santa Monica Seep Mound 800 (33.7993, -118.6465), Santa Monica Seep Mound 863 (33.7891, -118.6683), and Newport Canyon (33.5450, -117.9251). Pushcores were manually sectioned into 1- or 3-centimeter (cm) horizons using plastic rings, and porewaters were extracted using a KC Denmark squeezer. Samples for ion chromatography were frozen shipboard and thawed immediately prior to analysis. Measurements were made using a Thermo Dual

Dionex Integrion HPIC ion chromatography system with either a 250-millimeter (mm) Dionex IonPac AS19-4um column (anions) with 50 mm guard column or a 250 mm Dionex IonPac CS16-4um column (cations) with a 50 mm guard column, in the Resnick Water and Environment Laboratory at the California Institute of Technology (Caltech).

Data Processing Description

100 microliter (uL) samples were diluted 50x in milliQ nanopure water before running. Standard curves were generated using calibration standards diluted similarly to samples, with 100 uL of 500 millimolar (mM) NaCl added to mimic typical seawater sample peak behavior. Analyte peaks were integrated and values were calculated using the standards automatically in the Chromeleon software, with manual QC to ensure regular peak shapes.

Known issues or problems:
Na and Cl are not quantitative, as the standards have an excess of each spiked in, above the upper limit of quantification. Formate values reported as 'ND' indicate they are below the LoQ but not LoD. Ca elutes near the end of the run, and occasionally is not captured in its entirety.

BCO-DMO Processing Description

- Imported original file "20230630_WF05-21_Ions_for_NSF.xlsx" into the BCO-DMO system.
- Flagged 'ND' and 'NOT_MEASURED' as missing data identifiers but retained this notation in the dataset.
- Converted the date column YYYY-MM-DD format.
- Created the ISO 8601 date/time field (UTC) using the Date_UTC and Time_UTC columns as input.
- Saved the final file as "908217_v1_porewater_biogeochem.csv".

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Parameters

Parameter	Description	Units
serial	Internal Orphan Lab identifier (sample serial number)	unitless
Fluoride	concentration of fluoride ion	millimolar (mM)
Acetate	concentration of acetate ion. ND = below level of quantification; NOT_MEASURED = this ion was not measured for this sample.	millimolar (mM)
Formate	concentration of formate ion. ND = below level of quantification; NOT_MEASURED = this ion was not measured for this sample.	millimolar (mM)
Chloride	concentration of chloride ion. ND = below level of quantification; NOT_MEASURED = this ion was not measured for this sample.	millimolar (mM)
Bromide	concentration of bromide ion	millimolar (mM)
Nitrate	concentration of nitrate ion. ND = below level of quantification; NOT_MEASURED = this ion was not measured for this sample.	millimolar (mM)
Sulfate	concentration of sulfate ion. ND = below level of quantification; NOT_MEASURED = this ion was not measured for this sample.	millimolar (mM)
Thiosulfate	concentration of thiosulfate ion. ND = below level of quantification; NOT_MEASURED = this ion was not measured for this sample.	millimolar (mM)
Phosphate	concentration of phosphate ion. ND = below level of quantification; NOT_MEASURED = this ion was not measured for this sample.	millimolar (mM)

Lithium	concentration of lithium ion (Li+). ND = below level of quantification; NOT_MEASURED = this ion was not measured for this sample.	millimolar (mM)
Sodium	concentration of sodium ion (Na+)	millimolar (mM)
Ammonium	concentration of ammonium ion (NH4+). ND = below level of quantification; NOT_MEASURED = this ion was not measured for this sample.	millimolar (mM)
Potassium	concentration of potassium ion (K+)	millimolar (mM)
Magnesium	concentration of magnesium ion (Mg2+)	millimolar (mM)
Calcium	concentration of calcium ion (Ca2+). ND = below level of quantification; NOT_MEASURED = this ion was not measured for this sample.	millimolar (mM)
pH	pH value, measured shipboard. ND = below level of quantification; NOT_MEASURED = was not measured for this sample.	unitless
Dive	Dive number of the ROV Doc Ricketts	unitless
Lat	Latitude	decimal degrees
Long	Longitude, with west longitude negative	decimal degrees
Horizon	depth (cm) in sediment, measured from top of core	cenimeters (cm)
Date_UTC	core collection date (UTC)	unitless
Time_UTC	core collection time (UTC)	unitless
Depth_m	ocean depth in meters at the sampling location	meters (m)
Station	name of the sampling site	unitless
Sample_Name	the sample name, which is composed of the dive number and the ROV pushcore number	unitless
ISO_DateTime_UTC	core collection date and time (UTC) in ISO 8601 format	unitless

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Instruments

Dataset-specific Instrument Name	Thermo Dual Dionex Integrion HPIC ion chromatography system
Generic Instrument Name	Ion Chromatograph
Dataset-specific Description	Thermo Dual Dionex Integrion HPIC ion chromatography system with either a 250 mm Dionex IonPac AS19-4um column (anions) with 50 mm guard column or a 250 mm Dionex IonPac CS16-4um column (cations) with a 50 mm guard column, in the Resnick Water and Environment Laboratory at the California Institute of Technology (Caltech).
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	pushcores
Generic Instrument Name	Push Corer
Dataset-specific Description	Sediment pushcores were collected by ROV.
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	
Generic Instrument Name	ROV Doc Ricketts
Dataset-specific Description	ROV Doc Ricketts is operated by the Monterey Bay Aquarium Research Institute (MBARI). ROV Doc Ricketts is capable of diving to 4000 meters (about 2.5 miles). The R/V Western Flyer was the support vessel for Doc Ricketts and was designed with a center well whose floor can be opened to allow Doc Ricketts to be launched from within the ship into the water below. For a complete description see: https://www.mbari.org/technology/rov-doc-ricketts/
Generic Instrument Description	The remotely operated vehicle (ROV) Doc Ricketts is operated by the Monterey Bay Aquarium Research Institute (MBARI). ROV Doc Ricketts is capable of diving to 4000 meters (about 2.5 miles). The R/V Western Flyer is the support vessel for Doc Ricketts and was designed with a center well whose floor can be opened to allow Doc Ricketts to be launched from within the ship into the water below. For a complete description, see: https://www.mbari.org/at-sea/vehicles/remotely-operated-vehicles/rov-doc...

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Deployments

WF05-21

Website	https://www.bco-dmo.org/deployment/877837
Platform	R/V Western Flyer
Start Date	2021-05-19
End Date	2021-05-22

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Project Information

Collaborative Research: Redefining the footprint of deep ocean methane seepage for benthic ecosystems (Methanosphere)

Coverage: Gulf of Alaska and Southern California Bight

NSF Award Abstract:
This research examines the role of deep-sea organisms in determining the fate and footprint of methane, a potent greenhouse gas, on Pacific continental margins. The investigators are evaluating the deep ocean methanosphere defined by the microbial communities that consume methane and the animals that directly feed on or form symbioses with methane-consuming microbes. They are also investigating animal communities that gain energy indirectly from methane, as well as those that take advantage of carbonate rocks, the physical manifestation of methane consumption in seafloor sediments. The study of methane seeps in the deep waters of both Alaska (4400-5500 meters) and Southern California (450-1040 meters) is enabling comparisons of the methanosphere under different food-limitation and oxygen regimes. By applying diverse chemical, isotopic, microscopy, and genetic-based analyses to seep microbes and fauna, this study is advancing understanding of the contribution of methane to deep-sea biodiversity and ecosystem function, information that can inform management and conservation actions in US waters. In addition to training for graduate and undergraduate students at their home institutions, the investigators are collaborating with the Alaska Native Science and Engineering Program (ANSEP). They are recruiting Alaskan undergraduates to participate in the research, contributing to ANSEP's online resources that promote interaction between scientists and middle and high school students, and participating in ANSEP's annual residential Career Exploration in Marine Science programs to engage middle school students in learning about deep-sea ecosystems and the variety of career pathways available in marine related fields.

Microbial production and consumption of methane is dynamic and widespread along continental margins, and some animals within deep-sea methane seeps rely on the oxidation and sequestration of methane for nutrition. At the same time, understanding of methane-dependent processes and symbioses in the deep-sea environment is still rudimentary. The goals of this study are to 1) examine the diversity of animals involved in methane-based symbioses and heterotrophic consumption of methane-oxidizing microbes and how these symbioses extend the periphery of seeps, contributing to non-seep, continental slope food webs; and 2) determine whether carbonates on the seep periphery sustain active methanotrophic microbial assemblages, providing a localized food source or chemical fuel for thiotrophic symbioses, via anaerobic oxidation of methane, or free-living, sulfide-oxidizing bacteria consumed by animals. The investigators are addressing these goals by surveying, sampling, and characterizing microbes, water, sediments, carbonates and animals at a deep seep site on the Aleutian Margin and a shallow site off Southern California. Shipboard experiments and laboratory analyses are using molecular, isotopic, geochemical, and radiotracer tools to understand transfer of methane-sourced carbon from aerobic methanotrophs under multiple oxygen levels, pressures, and photosynthetic food inputs. This approach offers a wide lens by which to examine the methane seep footprint, allow reinterpretation of past observations, and identify new scientific areas for future study. Improved characterization of the deep continental margin methanosphere informs climate science, biodiversity conservation, and resource management.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2048666

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