Sediment porosity collected from R/V Oceanus cruise OC1906A and R/V Sikuliaq cruise SKQ202016S off the coast of California in 2019 and 2020

Website: https://www.bco-dmo.org/dataset/959217
Data Type: Cruise Results
Version: 1
Version Date: 2025-04-16

Project
» Collaborative Research: Peptide Deamination as a Source of Refractory Dissolved Organic Matter in Marine Sediments (Peptide Deamination)

Contributors	Affiliation	Role
Burdige, David J.	Old Dominion University (ODU)	Principal Investigator
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Abstract
Sediment porosity was determined in cores collected at several stations off the coast of California: at a site in Catalina Basin ('Cat'; latitude: 33.301, longitude: -118.6; water depth, 1310 m); sites K and D off the coast of central California south of Monterey Bay ('K'; latitude: 35.375, longitude: -121.501; water depth, 1000 m; 'D'; latitude: 36.113, longitude: -122.186; water depth, 1440 m). The Cat cores were collected in June 2019, while the site K and D cores were collected in December 2020. Sediment cores were sectioned on-board the ship, and wet sediment was placed in pre-weighed scintillation vials. The vials were frozen and returned to the shore-based lab at Old Dominon University (ODU) where the samples were dried to constant weight and wet-to-dry sediment ratios were converted to porosity values. These samples were collected as part of a larger project examining deaminated peptides and organic matter cycling in the sediments at these sites.

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Coverage

Location: California continental margin
Spatial Extent: **N**:36.112556 **E**:-118.6 **S**:33.3005 **W**:-122.186097
Temporal Extent: 2019-06-24 - 2020-12-09

Methods & Sampling

Sediment cores were collected using a gravity corer and a multicorer on both cruises. Following recovery, the gravity cores were secured horizontally on the ship's deck and sampled from the bottom of the core upwards. This was done by sequentially removing 10-centimeter (cm) sediment intervals by cutting the core liner using a pipe cutter. Freshly exposed sediment was placed in pre-weighed scintillation vials, and the vials were frozen on-board the ship.

Most multi cores were sectioned at intervals ranging from 1 to 5 cm over the 30-40 cm length of the core. Some cores were sampled using pre-drilled holes in multi-core tubes that were sealed with tape during deployment. Upon recovery of the cores, the holes were cut open to sample the sediment with open-faced syringes inserted horizontally into the holes in the core tube. In both cases, the collected sediment was again placed in pre-weighed scintillation vials, and the vials were frozen on-board the ship.

Frozen vials were returned to the shore-based lab at ODU where the samples were dried to constant weight, to obtain the wet-to-dry mass ratio of the sediment sample (±1% precision). A dry sediment density of 2.67 gr/cm3 and a pore water density of 1.024 gr/cm3 were used in the porosity calculations (cm3 pore water/cm3 total sediment). All values were corrected for the salt content of the pore water.

While it is possible to recover intact sediment-water interfaces using multi-corers, loss of surface sediments is typical during gravity coring, making it impossible to directly quantify absolute depths below the sediment-water interface in a gravity core. We therefore determined absolute depths of sediment sample intervals in gravity cores by aligning DIC, sulfate, ammonium, and porosity gravity core profiles to multicore profiles from the same site (Berelson et al., 2005; Iversen and Jørgensen, 1985; Komada et al., 2016).

BCO-DMO Processing Description

- Imported original file "porosity.txt" into the BCO-DMO system.
- Converted Date column to YYYY-mm-dd format.
- Added station latitude and longitude columns.
- Added cruise ID column.
- Replaced "MC" with "M" in the Core column for consistency.
- Saved final file as "959217_v1_sediment_porosity.csv".

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Data Files

File	
959217_v1_sediment_porosity.csv	(Comma Separated Values (.csv), 12.13 KB) MD5:2cafa37b4d8a251c293a629cd021856f
Primary data file for dataset ID 959217, version 1	

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Related Publications

Berelson, W. M., Prokopenko, M., Sansone, F. J., Graham, A. W., McManus, J., & Bernhard, J. M. (2005). Anaerobic diagenesis of silica and carbon in continental margin sediments: Discrete zones of TCO2 production. Geochimica et Cosmochimica Acta, 69(19), 4611–4629. doi:10.1016/j.gca.2005.05.011
Methods

Iversen, N., & Jorgensen, B. B. (1985). Anaerobic methane oxidation rates at the sulfate-methane transition in marine sediments from Kattegat and Skagerrak (Denmark)1. Limnology and Oceanography, 30(5), 944–955. Portico. https://doi.org/10.4319/lo.1985.30.5.0944
Methods

Komada, T., Burdige, D. J., Li, H.-L., Magen, C., Chanton, J. P., & Cada, A. K. (2016). Organic matter cycling across the sulfate-methane transition zone of the Santa Barbara Basin, California Borderland. Geochimica et Cosmochimica Acta, 176, 259–278. doi:10.1016/j.gca.2015.12.022
Methods

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Parameters

Parameter	Description	Units
Ship	Ship used: Oc = R/V Oceanus; Sk = R/V Sikuliaq	unitless
Cruise_ID	Cruise ID	unitless
St_ID	Station ID: Cat = Catalina Basin; K = station K; D = station D.	unitless
Station_Latitude	Station latitude	decimal degrees
Station_Longitude	Station longitude; negative values = West	decimal degrees
Date	Date core was collected	unitless
Sa_ID	Individual sample ID	unitless
Core	Type of core used to collect the sample: M = multi-core; G = gravity core	unitless
samp	How the sample was collected: cs = core sectioning; sp = pre-drilled holes in the multi-core tubes	unitless
Depth	Depth of the sediment sample	centimeters (cm)
Err	half-depth of the sampling interval	centimeters (cm)
Porosity	porosity of the sediment sample	cubic centimeters of porewater per cubic centimeters of total sediment (cm3pore water/cm3total sediment)

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Instruments

Dataset-specific Instrument Name	a standard lab drying oven
Generic Instrument Name	Drying Oven
Generic Instrument Description	a heated chamber for drying

Dataset-specific Instrument Name	gravity corer
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	multicorer
Generic Instrument Name	Multi Corer
Generic Instrument Description	The Multi Corer is a benthic coring device used to collect multiple, simultaneous, undisturbed sediment/water samples from the seafloor. Multiple coring tubes with varying sampling capacity depending on tube dimensions are mounted in a frame designed to sample the deep ocean seafloor. For more information, see Barnett et al. (1984) in Oceanologica Acta, 7, pp. 399-408.

Dataset-specific Instrument Name	top-loading balance
Generic Instrument Name	scale or balance
Generic Instrument Description	Devices that determine the mass or weight of a sample.

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Deployments

OC1906A

Website	https://www.bco-dmo.org/deployment/914972
Platform	R/V Oceanus
Start Date	2019-06-20
End Date	2023-07-03
Description	See more information at R2R: https://www.rvdata.us/search/cruise/OC1906A

SKQ202016S

Website	https://www.bco-dmo.org/deployment/915307
Platform	R/V Sikuliaq
Start Date	2020-12-01
End Date	2020-12-12
Description	See more information at R2R: https://www.rvdata.us/search/cruise/SKQ202016S

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Project Information

Collaborative Research: Peptide Deamination as a Source of Refractory Dissolved Organic Matter in Marine Sediments (Peptide Deamination)

Coverage: California Borderland

NSF Award Abstract:
Dissolved organic matter (DOM) in the ocean is one of the largest carbon reservoirs on Earth. Much of this DOM is highly resistant to degradation (refractory) and aged, but the nature and reasons behind the accumulation of refractory DOM in the ocean is one of the unresolved mysteries of the marine carbon cycle. While marine sediments have been shown to be a globally important source of DOM to the ocean, the connection between sediment DOM dynamics and the oceanic DOM cycle remains elusive, because information is lacking on the molecular composition and reactivity of pore water DOM. To fill this knowledge gap, this project will address the question of how refractory DOM is produced in sediments and the fate of benthic DOM in the water column. The research will focus on the relationship between protein/peptide dynamics and sediment DOM cycling, examining peptide deamination as an important pathway for the production of refractory and 14C-depleted DOM in continental margin sediments. These objectives will be met through a combination of geochemical profiling of sediment cores collected across a range of redox conditions, and long-term sediment incubation studies conducted under controlled laboratory conditions. At the heart of this proposed work is structural elucidation and quantification of intact and deaminated peptides in pore-water DOM using state-of-the-art analytical techniques. The study will help better understand how the present-day carbon cycle operates, as well as how it may respond in the future. The proposed work will integrate research and education using several approaches. All PIs routinely integrate their research into their classes, which range from introductory-undergraduate to advanced-graduate courses and will continue to do so here. All three PIs are also committed to engaging women and underrepresented minority students.

Marine sediments are a globally important source of dissolved organic matter (DOM) to the ocean. However, the connection between sediment DOM dynamics and the oceanic DOM cycle remains elusive because information about the molecular composition and reactivity of pore water DOM is lacking. To help fill this knowledge gap, this project will address the question of how refractory DOM is produced in sediments and the fate of the benthic DOM flux in the water column. The proposed study explores a novel and potentially transformative idea that deamination of peptides in sediments is a source of refractory and 14C-depleted DOM in seawater. This idea is consistent not only with the fact that the majority of seawater dissolved organic nitrogen occurs in amide form, but also with recent reports about the widespread occurrence of nitrogen-bearing formulas in deep-sea refractory DOM. The central hypothesis will be tested through a unique blend of bottom-up (molecular level DOM analyses) and top-down (bulk-level elemental and isotopic analyses, and numerical modeling) approaches. This work will involve a combination of geochemical profiling of sediment cores collected across a range of redox conditions, and long-term sediment incubation studies conducted under controlled laboratory conditions. At the heart of the proposed work is structural elucidation and quantification of intact and deaminated peptides in pore-water DOM using a state-of-the-art liquid chromatography-mass spectrometry system (ultra-high performance liquid chromatography coupled to an Orbitrap Fusion Tribrid Mass Spectrometer), which is expected to provide an unprecedented wealth of molecular-level information about pore water DOM. The proposed work will lead to an improved mechanistic understanding of organic matter decomposition and benthic DOM cycling and shed light on the connections between the modern-day oceanic and sedimentary carbon and nitrogen cycles as they relate to the formation of refractory DOM.

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-1756669

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