Polysaccharide hydrolysis rates for Marmara Sea, Guaymas Basin, and Eastern Mediterranean Sea sediments collected from R/V El Puma and R/V Meteor cruises

Website: https://www.bco-dmo.org/dataset/668648
Data Type: Cruise Results
Version: 09 December 2016
Version Date: 2016-12-09

Project
» Investigating microbial activities driving organic matter transformations in the deep subsurface (SedS)

Program
» Center for Dark Energy Biosphere Investigations (C-DEBI)

Contributors	Affiliation	Role
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Dataset Description

Polysaccharide hydrolysis rates for Marmara Sea, Guaymas Basin, and Eastern Mediterranean Sea sediments. The polysaccharide hydrolysis rates for Marmara Sea sediment were generated during methods development experiments.

This dataset contains the final hydrolysis rates. Raw data are also available for download in a 20.5 MB .zip file. The .zip file contains GPC chromatographic output for incubations with sediment from Guaymas Basin and the Eastern Mediterranean, used for hydrolysis rate calculations (CoreComparison folder). The "MarmaraMethods" folder contains GPC output for methods development experiments conducted using mud from the Marmara Sea. The "stds" folders contain GPC output for a set of standards of known molecular weight, which are necessary for rate calculations (each folder is a different run – depending on when a sample is run on the GPC, the standards run most recently are used as reference for rate calculations). Each file is raw chromatographic output is in fluorescence units (mV) over time for a 75-minute run.

The associated processing an analysis scripts are available through GitHub: https://github.com/ahoarfrost/SedS

Methods & Sampling

In the Marmara Sea, surficial sediments were collected by multicorer, and deeper sediments from 570-585 cm and 520-530 cm were collected by gravity corer. Eastern Mediterranean sediments were collected by gravity corer. Guaymas Basin sediments were collected by push core.

Sediment incubations with fluorescently labeled organic substrates were set up with three live incubations, a kill control, and one live blank. Incubations were subsampled over time, and each subsample was centrifuged and syringe filtered through a 0.2 um GF filter. Porewater containing partially hydrolyzed fluorescent substrate products were processed using gel permeation chromatography with fluorescence detection. Standards of fluorescent substrates of known molecular weight were also run for the purpose of rate calculations.

GPC chromatographic analysis was conducted on a Shimadzu liquid chromatography system and a Hitachi fluorescence detector.

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Data Files

File
Hydrolysis_Rates.csv (Comma Separated Values (.csv), 14.83 KB) MD5:947593b6cfbba82e603bab7a674fb573 Primary data file for dataset ID 668648

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Parameters

Parameter	Description	Units
description	Maximum potential hydrolysis rates of six polysaccharides measured in sediment incubations	unitless
sample	Sample identifier	unitless
kcrate_1_nM_hr	kill-corrected hydrolysis rate of experimental replicate 1, in nM/hr	nM/hr
kcrate_2_nM_hr	kill-corrected hydrolysis rate of experimental replicate 2, in nM/hr	nM/hr
kcrate_3_nM_hr	kill-corrected hydrolysis rate of experimental replicate 3, in nM/hr	nM/hr
kcrate_live_nM_hr	mean hydrolysis rate before kill correction	nM/hr
mean_kcrate_nM_hr	mean kill-corrected hydrolysis rate of all replicates	nM/hr
sd_kcrate_nM_hr	Standard deviation	nM/hr
location	Location source of the sediment sample	unitless
core	Identifier for the sediment core	unitless
seddepth_cm	Sediment depth within the core	centimeter (cm)
core_depth	Core + sediment depth	centimeter (cm)
treatment	Experimental treatment of sediment incubation	unitless
substrate	Polysaccharide substrate for which hydrolysis rates were measured	unitless
timepoint	Timepoint label of sample	unitless
elapsedtime	Time since incubation start time	hours (hr)

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Instruments

Dataset-specific Instrument Name	Shimadzu liquid chromatography system
Generic Instrument Name	Gel Permeation Chromatograph
Dataset-specific Description	GPC chromatographic analysis was conducted on a Shimadzu liquid chromatography system and a Hitachi fluorescence detector.
Generic Instrument Description	Instruments that separate components in aqueous or organic solution based on molecular size generally for molecular weight determination. Gel permeation chromatography (GPC) is a type of size exclusion chromatography (SEC), that separates analytes on the basis of size.

Dataset-specific Instrument Name	
Generic Instrument Name	Gravity Corer
Dataset-specific Description	Eastern Mediterranean sediments were collected by gravity corer. In the Marmara Sea, deeper sediments (from 570-585 cm and 520-530 cm) were collected by 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	
Generic Instrument Name	Multi Corer
Dataset-specific Description	In the Marmara Sea, surficial sediments were collected by multicorer.
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	
Generic Instrument Name	Push Corer
Dataset-specific Description	Guaymas Basin sediments were collected by push core.
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/

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Deployments

Guaymas_2014

Website	https://www.bco-dmo.org/deployment/661688
Platform	R/V El Puma
Start Date	2014-10-14
End Date	2014-10-27

M84-1

Website	https://www.bco-dmo.org/deployment/669447
Platform	R/V Meteor
Report	http://dmoserv3.whoi.edu/data_docs/C-DEBI/cruise_reports/awi_doi-10.2312_2Fcr_m84_1.pdf
Start Date	2011-02-09
End Date	2011-02-22

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Project Information

Investigating microbial activities driving organic matter transformations in the deep subsurface (SedS)

Coverage: Eastern Mediterranean, Guaymas Basin, Marmara Sea

Project description from C-DEBI:
Heterotrophic organisms are central to subsurface microbial communities and play an important role in carbon cycling. Most approaches to measuring enzymatic activities rely on the addition of a fluorescently labeled substrate to a sediment incubation. However, quantifying rates of extracellular enzymatic hydrolysis of organic matter is often problematic due to the tendency for a fluorescently labeled organic substrate to sorb to the sediment matrix. This results in lower fluorescence intensities and distorted, inaccurate hydrolysis rate calculations. In this project, a desorption treatment was developed to counteract the adverse effects of

sorption on enzymatic activity measurements. Upon subsampling a sediment incubation amended with a fluorescently labeled substrate, the subsample is treated with a concentrated solution of unlabeled substrate, along with 0.2% sodium dodecyl sulfate (SDS), in order to competitively desorb the adsorbed, fluorescent substrate target. This treatment improves measured fluorescence intensities by a median of 62.5%, and is particularly effective at desorbing high molecular weight substrate products, resulting in debiased hydrolysis rates that are 14.75 nM/hr lower on average. Competitive desorption treatment was demonstrated to be effective for multiple substrates and in a broad range of sediments from diverse geological and geochemical contexts. Future applications of this method will result in more quantitative and comparable hydrolysis rates in subsurface sediments, will enable enzymatic activity measurements in problematic sediments that were previously infeasible, and will facilitate physiological characterization of microbial communities and model organisms in order to better understand heterotrophic carbon cycling in the subsurface environment.

This project was funded by a C-DEBI Graduate Fellowship.

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Program Information

Center for Dark Energy Biosphere Investigations (C-DEBI)

Website: http://www.darkenergybiosphere.org

Coverage: Global

The mission of the Center for Dark Energy Biosphere Investigations (C-DEBI) is to explore life beneath the seafloor and make transformative discoveries that advance science, benefit society, and inspire people of all ages and origins.

C-DEBI provides a framework for a large, multi-disciplinary group of scientists to pursue fundamental questions about life deep in the sub-surface environment of Earth. The fundamental science questions of C-DEBI involve exploration and discovery, uncovering the processes that constrain the sub-surface biosphere below the oceans, and implications to the Earth system. What type of life exists in this deep biosphere, how much, and how is it distributed and dispersed? What are the physical-chemical conditions that promote or limit life? What are the important oxidation-reduction processes and are they unique or important to humankind? How does this biosphere influence global energy and material cycles, particularly the carbon cycle? Finally, can we discern how such life evolved in geological settings beneath the ocean floor, and how this might relate to ideas about the origin of life on our planet?

C-DEBI's scientific goals are pursued with a combination of approaches:
(1) coordinate, integrate, support, and extend the research associated with four major programs—Juan de Fuca Ridge flank (JdF), South Pacific Gyre (SPG), North Pond (NP), and Dorado Outcrop (DO)—and other field sites;
(2) make substantial investments of resources to support field, laboratory, analytical, and modeling studies of the deep subseafloor ecosystems;
(3) facilitate and encourage synthesis and thematic understanding of submarine microbiological processes, through funding of scientific and technical activities, coordination and hosting of meetings and workshops, and support of (mostly junior) researchers and graduate students; and
(4) entrain, educate, inspire, and mentor an interdisciplinary community of researchers and educators, with an emphasis on undergraduate and graduate students and early-career scientists.

Note: Katrina Edwards was a former PI of C-DEBI; James Cowen is a former co-PI.

Data Management:
C-DEBI is committed to ensuring all the data generated are publically available and deposited in a data repository for long-term storage as stated in their Data Management Plan (PDF) and in compliance with the NSF Ocean Sciences Sample and Data Policy. The data types and products resulting from C-DEBI-supported research include a wide variety of geophysical, geological, geochemical, and biological information, in addition to education and outreach materials, technical documents, and samples. All data and information generated by C-DEBI-supported research projects are required to be made publically available either following publication of

research results or within two (2) years of data generation.

To ensure preservation and dissemination of the diverse data-types generated, C-DEBI researchers are working with BCO-DMO Data Managers make data publicly available online. The partnership with BCO-DMO helps ensure that the C-DEBI data are discoverable and available for reuse. Some C-DEBI data is better served by specialized repositories (NCBI's GenBank for sequence data, for example) and, in those cases, BCO-DMO provides dataset documentation (metadata) that includes links to those external repositories.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0939564

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