3H-leucine and thymidine incorporation of North Atlantic subseafloor sediments from cruise KN223 on R/V Knorr in the North and West Atlantic Ocean in November 2014

Website: https://www.bco-dmo.org/dataset/685944
Data Type: Cruise Results
Version: 1
Version Date: 2017-03-27

Project
» Defining the interplay between oxygen, organic carbon, and metabolism in subseafloor sediment communities (Subseafloor metabolisms)

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

Contributors	Affiliation	Role
Boyd, Eric S.	Montana State University	Principal Investigator
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Abstract
3H-leucine and thymidine incorporation of North Atlantic subseafloor sediments from cruise KN223 on R/V Knorr in the North and West Atlantic Ocean in November 2014.

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Coverage

Spatial Extent: **N**:29.6767 **E**:-56.5173 **S**:22.7835 **W**:-58.3283
Temporal Extent: 2014-11-19 - 2014-11-21

Dataset Description

3H-leucine and thymidine incorporation of North Atlantic subseafloor sediments collected on cruise KN223 on R/V Knorr in November 2014.

Methods & Sampling

All samples used in this work were collected as part of the North Atlantic long-coring expedition in Oct.-Dec. 2014 (R/V Knorr, Cruise KN223); this project focuses on sediments from 4 sites (2, 3, 11, 12) exhibiting variations in the depth to which oxygen penetrates. The sediment subsamples were collected from long piston cores or shorter gravity cores. While oxygen penetrates through the full long core depth at sites 11 and 12, oxygen was consumed in the sediment column at site 3 and especially at site 2. All samples were collected anaerobically in order to perform on-board culture enrichments via the most probable number (MPN) method. Sediments were placed in sterile serum vials, capped with butyl rubber stoppers and flushed with N2 for 2 min and maintained at 4 degrees C for immediate shipboard MPN inoculation work (see MPN dataset). Parallel samples were similarly collected from these and additional core sections and maintained at 4 degrees C for later determination of microbial production rates (this dataset).

We assessed microbial production on selected core sections at sites 11 and 12 using proxies for DNA synthesis (incorporation of methyl-3H thymidine) and protein synthesis (incorporation of 4,5-3H leucine). Core material was retained at 4 degrees C under an N2 atmosphere prior to slurry preparation. Aerobic slurry was prepared 1:1 by volume with 0.2 um-filtered deep seawater and incubations began immediately thereafter. Incubations (n=4 live treatments, n=4 TCA-killed controls) of 0.5 ml slurry each were conducted in sterile microfuge tubes for each label addition. Seawater-only blanks incubated and processed along with samples exhibited near background levels of activity. 50 ul of working 3H-Thy or 3H-Leu stock was added at time zero. This equates to 3.75 uCi Leu or 4.4375 uCi Thy per sample at concentrations of appx. 114 nmol label compound per liter slurry final. Incubations were carried out at 4 degrees C in the dark.

Incubations were terminated at 18-24 hr; a time-course experiment confirmed linearity of incorporation out to at least 24 hr. Live incubations were terminated with TCA and an extraction protocol modified from Dixon & Turley (2001, Microb. Ecol. 42:549) was used to isolate the protein + DNA fraction, which was analyzed by liquid scintillation counting for 3H-Leu incorporation; the DNA fraction alone was isolated and similarly analyzed for 3H-Thy incorporation. Rates are reported as pmol leucine or thymidine incorporated per ml of sediment per day (based on mean treatment minus mean control). Errors were calculated by propagating the standard deviations of treatments and controls.

Data Processing Description

These data represent short-term rates of label incorporation at the stated levels of addition. No corrections for potential isotope dilution were attempted, given the overall low metabolic rates of the system. Rates are reported as determined; therefore, where mean controls exceeded mean treatments, negative rates are reported.

BCO-DMO Processing:
- modified parameter names to conform with BCO-DMO naming conventions;
- re-formatted date to yyyy-mm-dd;
- replaced "R/V Knorr" with "RV_Knorr" in data.

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Data Files

File
Microb_Prod.csv (Comma Separated Values (.csv), 1.08 KB) MD5:ca7fa76cc4ab4ebf42bb936f1dbe6329 Primary data file for dataset ID 685944

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Related Datasets

IsRelatedTo

Boyd, E. S., Amenabar, M. J. (2021) **North Atlantic subseafloor sediment viable microbe**

numbers/metabolisms from cruise KN223 on R/V Knorr in the North and West Atlantic Ocean in November 2014. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2017-03-28 doi:10.26008/1912/bco-dmo.686389.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
site	Site name	unitless
lat	Site latitude	decimal degrees
lon	Site longitude	decimal degrees
depth_w	Water depth	meters (m)
sed_thickness	Sediment thickness	meters (m)
basement_age	Basement age	millions of years ago (Ma)
date_coring	Date of coring in yyyy-mm-dd format	unitless
cruise_id	Cruise identifier	unitless
platform	Platform (e.g. vessel) name	unitless
core	Core identifier. LC = long core; GC = gravity core.	unitless
core_section	Core section	unitless
depth_mbsf	Sample depth	meters below sea floor (mbsf)
leucine_incorp	Leucine incorporation; mean rate of incorporation of leucine based on mean live treatment (n=4) minus mean killed control (n=4).	picomoles Leucine per milliliter sediment per day (pmol Leu/ml sed/d)
leu_sd	Standard deviation of rate of leucine incorporation based on propagation of sd of treatments and sd of controls.	picomoles Leucine per milliliter sediment per day (pmol Leu/ml sed/d)
thymidine_incorp	Thymidine incorporation; mean rate of incorporation of thymidine based on mean live treatment (n=4) minus mean killed control (n=4).	picomoles Thymidine per milliliter sediment per day (pmol Thy/ml sed/d)
thy_sd	Standard deviation of rate of thymidine incorporation based on propagation of sd of treatments and sd of controls.	picomoles Thymidine per milliliter sediment per day (pmol Thy/ml sed/d)

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Instruments

Dataset-specific Instrument Name	gravity core
Generic Instrument Name	Gravity Corer
Dataset-specific Description	The sediment subsamples were collected from long piston cores or shorter gravity cores.
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	liquid scintillation counting
Generic Instrument Name	Liquid Scintillation Counter
Dataset-specific Description	Live incubations were terminated with TCA and an extraction protocol modified from Dixon & Turley (2001, Microb. Ecol. 42:549) was used to isolate the protein + DNA fraction, which was analyzed by liquid scintillation counting for 3H-Leu incorporation.
Generic Instrument Description	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 the quantify the activity of particulate emitting (ß and a) radioactive samples, it can also detect the auger electrons emitted from 51Cr and 125I samples.

Dataset-specific Instrument Name	long piston core
Generic Instrument Name	Piston Corer
Dataset-specific Description	The sediment subsamples were collected from long piston cores or shorter gravity cores.
Generic Instrument Description	The piston corer is a type of bottom sediment sampling device. A long, heavy tube is plunged into the seafloor to extract samples of mud sediment. A piston corer uses a "free fall" of the coring rig to achieve a greater initial force on impact than gravity coring. A sliding piston inside the core barrel reduces inside wall friction with the sediment and helps to evacuate displaced water from the top of the corer. A piston corer is capable of extracting core samples up to 90 feet in length.

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Deployments

KN223

Website	https://www.bco-dmo.org/deployment/567408
Platform	R/V Knorr
Start Date	2014-10-25
End Date	2014-12-02

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Project Information

Defining the interplay between oxygen, organic carbon, and metabolism in subseafloor sediment communities (Subseafloor metabolisms)

Website: http://www.darkenergybiosphere.org/award/defining-the-interplay-between-oxygen-organic-carbon-and-metabolism-in-subseafloor-sediment-communities/

Coverage: SW North Atlantic sediments (13-42° N, 48-71° W)

Abstract from C-DEBI:

Deep marine sediments harbor an abundance of microbial cells that, if active, are likely to exert a strong influence on element biogeochemical cycling. Despite decades of study, our understanding of the fraction of cells that are active in situ and the metabolic processes that sustain them remain under-explored. We propose an integrated set of analyses aimed at unraveling the links between geochemical heterogeneity, cellular viability and synthesis, and metabolism along a vertical depth profile in four sediment cores collected during the North Atlantic long coring expedition. These sediment columns exhibit varying levels of organic carbon and differences in the degree of oxygen penetration along the depth profile which we hypothesize exert strong influence on the extent and nature of microbial life. Most probable number assays containing nine different selective enrichment conditions were initiated using subsamples from these cores in Nov. 2014. Separate subsamples were preserved for use in measuring rates of secondary production. Multivariate modeling tools will be applied to integrate these measurements with co-registered geochemical measurements, cell counts, and molecular data provided by collaborators. This work will provide new insight into the dynamic interplay between O2 and organic carbon and microbial activity, viability, and productivity in deep marine sediments.

NOTE: This project follows the C-DEBI program Data Management Plan (PDF).

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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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