Scanning Electron Microscopy (SEM) photographs of biofilms on indium tin oxide electrodes from cathodic poised potential experiments with subsurface crustal samples from CORK borehole observatories at North Pond on the Mid-Atlantic Ridge during R/V A

Website: https://www.bco-dmo.org/dataset/780261
Data Type: Cruise Results, experimental
Version: 1
Version Date: 2020-02-03

Project
» Collaborative Research: Completing North Pond Borehole Experiments to Elucidate the Hydrology of Young, Slow-Spread Crust (North Pond 2017)

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

Contributors	Affiliation	Role
Orcutt, Beth N.	Bigelow Laboratory for Ocean Sciences	Principal Investigator
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Scanning Electron Microscopy (SEM) photographs of biofilms on indium tin oxide electrodes from cathodic poised potential experiments with subsurface crustal samples from CORK borehole observatories at North Pond on the Mid-Atlantic Ridge during R/V Atlantis cruise AT39-01.

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Coverage

Spatial Extent: **N**:22.8023 **E**:-46.053 **S**:22.7564 **W**:-46.0817
Temporal Extent: 2018-01-03 - 2019-01-10

Dataset Description

Scanning Electron Microscopy (SEM) photographs of biofilms on indium tin oxide electrodes from cathodic poised potential experiments with subsurface crustal samples from CORK borehole observatories at North Pond on the Mid-Atlantic Ridge during R/V Atlantis cruise AT39-01.

These results were published in Jones et al. (2020).

Related datasets from the same experiment:
AT39-01 CathodicEET Chronoamperometry: https://www.bco-dmo.org/dataset/780127
AT39-01 CathodicEET CyclicVoltametry: https://www.bco-dmo.org/dataset/780248
AT39-01 CathodicEET Amplicons: https://www.bco-dmo.org/dataset/780255
AT39-01 CathodicEET Experimental Metadata:
https://www.bco-dmo.org/dataset/780225

Methods & Sampling

Microbial fuel cells (MFCs) were used to conduct cathodic poised potential experiments as described in Jones et al. (in preparation). After cyclic voltametry scanning of the indium tin oxide electrodes in the fuel cells at the end of the experiment, the ITO electrodes were carefully removed from the MFCs and split into two sections using a diamond scribe and tweezers for microscopy and DNA analysis. One piece was serially dehydrated in ethanol solutions (10 min steps each at 50:50, 60:40, 70:30, 80:20, 90:10 and 100:0 ratios of ethanol:distilled water) and hexamethyldisilizane (10 min) and air dried for 3 days in a HEPA-filtered biosafety cabinet in preparation for scanning electron microscopy (SEM), following methods available elsewhere (DAngelo and Orcutt, 2019). Dehydrated slide pieces were then mounted onto 12-mm-diameter SEM stubs with double-sided carbon tape, sputter coated with gold with a Denton Vacuum Desk IV cold sputter instrument (Denton Vacuum LLC, Moorestown, NJ), and imaged with a Zeiss Supra25 SEM at between 5-10 kV and a working distance between 3-9 mm.

Data Processing Description

BCO-DMO Data Manager Processing Notes:
* All images zipped into SEM_images.zip
* Imagelist made of all SEM images submitted. Imagelist matched with metadata in the tabular dataset to verify each image had metadata.
* Column of direct links to download individual images added to tabular dataset.
* Sample IDs modified to match experimental metadata as discussed with data submitter.

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Data Files

File	
sem.csv Primary data file for dataset ID 780261	(Comma Separated Values (.csv), 13.66 KB) MD5:6b4a4bcd85167f8afae53cbdfacb3687
SEM images filename: SEM_images.zip Scanning Electron Microscopy (SEM) photographs of biofilms on indium tin oxide electrodes from cathodic poised potential experiments with subsurface crustal samples. The file SEM_images.zip contains 68 SEM images. 67 Images are .tif format with the name of the image as the sample name plus ".tif" extension. One image is a JPEG file.	(ZIP Archive (ZIP), 198.72 MB) MD5:a5bc3ca79a4279fd474d2cac813b8337

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Related Publications

DAngelo, T., & Orcutt, B. (2019). SEM Sample Prep v1 (protocols.io.w9ufh6w). Protocols.io. doi:10.17504/protocols.io.w9ufh6w
Methods

Jones, R. M., D'Angelo, T., & Orcutt, B. N. (2020). Using Cathodic Poised Potential Experiments to Investigate Extracellular Electron Transport in the Crustal Deep Biosphere of North Pond, Mid-Atlantic Ridge. Frontiers in Environmental Science, 8. doi:10.3389/fenvs.2020.00011
Results

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Parameters

Parameter	Description	Units
SampleID	Sample identifier (unique file names for .tif images)	unitless
ExperimentID	Text description of experiment with microbial fuel cells; values of NP11, NP12, NP13, NP14 or NP15	unitless
Treatment	Treatment of the microbial fuel cell; values of Offline (with sample but no voltage applied), Fluid (with filtered fluid only/no sample and with voltage applied), or Echem (with sample and voltage applied)	unitless
imagename	Scanning Electron Microscopy (SEM) photograph imagename.	unitless
FLOCSsubstrate	Description of the FLOCS sample type put into the microbial fuel cell; values of Mixed (a mixture of samples), NA (not applicable, no sample), Basalt, Glass Wool, or Pyrrhotite	unitless
FLOCSdeployDate	Date of the FLOCS deployment, in ISO 8601 format yyyy-mm-dd	unitless
FLOCSdepth	Approximate depth, in meters below seafloor, where the FLOCS experiment was deployed	meters below seafloor (m)
FLOCSrecoverDate	Date of the FLOCS recovery, in ISO 8601 format yyyy-mm-dd	unitless
FluidcollectionCruise	Name of the cruise and ROV Jason dive number when the crustal fluid was collected; values of AT39-01 (R/V Atlantis cruise AT39-01) + J2-#### (ROV Jason dive number)	unitless
FluidcollectionDate	Date of the collection of the crustal fluids, in ISO 8601 format yyyy-mm-dd	unitless
Latitude	Degree decimal minutes N latitude of the FLOCS experiment	decimal degrees
Longitude	Degree decimal minates W longitude of the FLOCS experiment	decimal degrees
WaterDepth	water depth to seafloor of the IODP Hole	meters (m)
imagelink	URL for SEM image	unitless

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Instruments

Dataset-specific Instrument Name	Zeiss Supra25 field emission scanning microscope
Generic Instrument Name	Scanning Electron Microscope
Generic Instrument Description	A scanning electron microscope (SEM) scans a focused electron beam over a surface to create an image. The electrons in the beam interact with the sample, producing various signals that can be used to obtain information about the surface topography and composition.

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Deployments

AT39-01

Website	https://www.bco-dmo.org/deployment/723337
Platform	R/V Atlantis
Report	http://datadocs.bco-dmo.org/docs/Subseafloor_Microbial_Carbon_Cycling/data_docs/North_Pond_2017_Expedition%20Report_FINAL.pdf
Start Date	2017-10-02
End Date	2017-11-02

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Project Information

Collaborative Research: Completing North Pond Borehole Experiments to Elucidate the Hydrology of Young, Slow-Spread Crust (North Pond 2017)

Website: http://www.darkenergybiosphere.org/research-activities/field-sites/

Coverage: North Pond, Mid-Atlantic Ridge flank CORKs

NSF Award Abstract:
Seawater circulates through the upper part of the oceanic crust much like groundwater flows through continental aquifers. However, in the ocean this seawater circulation, many times heated by buried magmatic bodies, transports and releases 25% of the Earth's heat. The rate of fluid flow through ocean crust is estimated to be equal to the amount of water delivered by rivers to the ocean. Much of what we know of this subseafloor fluid flow comes from studies in the eastern Pacific Ocean on ocean crust created by medium and fast spreading mid-ocean ridges. These studies indicate that seawater and its circulation through the seafloor significantly impact crustal evolution and biogeochemical cycles in the ocean and affect the biosphere in ways that are just now beginning to be quantified and understood. To expand this understanding, this research focuses on fluid flow of seafloor generated by slow spreading ridges, like those in the Atlantic, Indian and Arctic Oceans because it is significantly different in structure, mineralogy, and morphology than that formed at fast and intermediate spreading ridges. This research returns to North Pond, a long-term; seafloor; fluid flow monitoring site, drilled and instumented by the Ocean Drilling Program in the Atlantic Ocean. This research site was punctured by boreholes in which fluid flow and geochemical and biological samplers have been deployed for a number of years to collect data and samples. It also provides resources for shipboard and on-shore geochemical and biological analysis. Broader impacts of the work include sensor and technology development, which increases infrastructure for science and has commercial applications. It also provides training for students and the integration of education and research at three US academic institutions, one of which is an EPSCoR state (Mississippi), and supports a PI whose gender is under-represented in sciences and engineering. Public outreach will be carried out in conjunction with the Center for Dark Energy Biosphere Investigations.

This project completes a long-term biogeochemical and hydrologic study of ridge flank hydrothermal processes on slow-spreading, 8 million year old crust on the western flank of the Mid-Atlantic Ridge. The site, North Pond, is an isolated northeast-trending sediment pond, bounded by undersea mountains that have been studied since the 1970s. During Integrated Ocean Drilling Program Expedition 336 in 2011 and an expedition five months later (2012), sensors, samplers, and experiments were deployed in four borehole observatories drilled into the seafloor that penetrated into volcanic crust, with the purpose of monitoring changes in hydrologic properties, crustal fluid composition and mineral alteration, among other objectives. Wellhead sampling in 2012 and 2014 already revealed changes in crustal fluid compositions; and associated pressure data confirm that the boreholes are sealed and overpressured, reflecting a change in the formation as the boreholes recover from drilling disturbances. This research includes a 13-day oceanographic expedition and use of on-site robotically operated vehicles to recover downhole instrument packages at North Pond. It will allow the sampling of crustal fluids, recovering pressure data, and measuring fluid flow rates. Ship- and shore-based analyses will be used to address fundamental questions related to the hydrogeology of hydrothermal processes on slow-spread crust.

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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-1536539

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