

Metagenomic data from samples collected on cruise Chikyu-331 in the Okinawa Trough, Japan from September to October 2010

Website: <https://www.bco-dmo.org/dataset/781137>

Data Type: Cruise Results

Version: 1

Version Date: 2019-11-05

Project

» [An In-Depth analysis of the subvent biosphere within Okinawa Backarc Basin \(IODP 331, Iheya North Hydrothermal Field\) sediments](#) (Subvent_Biosphere_Sediments)

Programs

» [Center for Dark Energy Biosphere Investigations](#) (C-DEBI)

» [International Ocean Discovery Program](#) (IODP)

Contributors	Affiliation	Role
House, Christopher	Pennsylvania State University (PSU)	Principal Investigator
Brandt, Leah	Pennsylvania State University (PSU)	Scientist
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

The purpose these metagenomic data was to capture a distinct changeover of microbial assemblages between the mesophilic horizons above 10 mbsf and the hottest (55C) hydrothermal clay horizon. In this section of the dynamic Iheya North Hydrothermal system, the temperature gradient was estimated to be ~3C/m. These metagenomes provide functional evidence to this model, demonstrating that molecular signals represent a responsive microbial community to the increasingly demanding environmental conditions.

Table of Contents

- [Coverage](#)
- [Dataset Description](#)
 - [Methods & Sampling](#)
 - [Data Processing Description](#)
- [Data Files](#)
- [Related Publications](#)
- [Parameters](#)
- [Instruments](#)
- [Deployments](#)
- [Project Information](#)
- [Program Information](#)
- [Funding](#)

Coverage

Spatial Extent: Lat:27.790278 Lon:126.900833

Temporal Extent: 2010-09-16 - 2010-09-27

Dataset Description

Next-generation sequencing data across a hydrothermal gradient; Okinawa Backarc Basin IODP 331 – subvent biosphere. The purpose these metagenomic data was to capture a distinct changeover of microbial assemblages between the mesophilic horizons above 10 mbsf and the hottest (55C) hydrothermal clay horizon. In this section of the dynamic Iheya North Hydrothermal system, the temperature gradient was estimated to be ~3C/m. These metagenomes provide functional evidence to this model, demonstrating that molecular signals represent a responsive microbial community to the increasingly demanding environmental conditions.

Methods & Sampling

Sampling of cores was done in accordance with IODP protocols.

All C0014 samples were cored on 16 September 2010 via HPCS (hydraulic piston coring system).

All C0015 samples were cored on 18 September 2010 via HPCS.

All C0017 samples were cored on 27 September 2010 via HPCS.

Core sections were kept frozen (-80°C) until DNA extractions. A MoBio® Power Soil kit was used to extract environmental DNA. Metagenomic data was produced from whole genome amplified environmental DNA (REPLI-g Mini Kit, Qiagen).

Sequencing was performed at the Penn State Genomics Core Facility – University Park, PA using the Illumina® HiSeq 2500 (NSF-MRI award DBI-1229046 (Axtell et al., 2012)). The sequencing facility prepared DNA libraries using Nextera XT Library Preparation Kits prior to sequencing. Together, the samples were run on one-half of a sequencing plate. This sequencing run was run using rapid-run model that averages up to 300 million single reads, or 600 million paired reads of ~150 nucleotides per rapid-run.

Data Processing Description

Data Processing: Data assembly was performed with Ray Meta de novo assembly program using a k-mer of 65 for all samples.

[[table of contents](#) | [back to top](#)]

Data Files

File
metagenome.csv (Comma Separated Values (.csv), 1.33 KB) MD5:b3feb5ee3193948c6484c370c4d9db34
Primary data file for dataset ID 781137

[[table of contents](#) | [back to top](#)]

Related Publications

Brandt, L. D., & House, C. H. (2016). Marine Subsurface Microbial Community Shifts Across a Hydrothermal Gradient in Okinawa Trough Sediments. *Archaea*, 2016, 1–12. doi:[10.1155/2016/2690329](https://doi.org/10.1155/2016/2690329)
Results

[[table of contents](#) | [back to top](#)]

Parameters

Parameter	Description	Units
Cruise_ID	Cruise ID number	unitless
Sample_Name	Sample name	unitless
Latitude	Latitude; positive values = North	decimal degrees
Longitude	Longitude; positive values = East	decimal degrees
Water_depth	Water depth	meters
Top_Depth	Top depth	meters below seafloor
Bottom_Depth	Bottom depth	meters below seafloor
Sediment_type	Sediment type	unitless
Estimated_Temp	Estimated temperature; based on 3 degrees C/m	degrees Celsius
MGRAST_Name	MGRAST name	unitless
MGRAST_ID	MGRAST ID	unitless
Notes	Notes	unitless

[[table of contents](#) | [back to top](#)]

Instruments

Dataset-specific Instrument Name	Illumina HiSeq 2500
Generic Instrument Name	Automated DNA Sequencer
Generic Instrument Description	General term for a laboratory instrument used for deciphering the order of bases in a strand of DNA. Sanger sequencers detect fluorescence from different dyes that are used to identify the A, C, G, and T extension reactions. Contemporary or Pyrosequencer methods are based on detecting the activity of DNA polymerase (a DNA synthesizing enzyme) with another chemoluminescent enzyme. Essentially, the method allows sequencing of a single strand of DNA by synthesizing the complementary strand along it, one base pair at a time, and detecting which base was actually added at each step.

Dataset-specific Instrument Name	hydraulic piston coring system (HPCS)
Generic Instrument Name	Piston Corer
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.

[[table of contents](#) | [back to top](#)]

Deployments

Chikyu-331

Website	https://www.bco-dmo.org/deployment/682963
Platform	Chikyu
Start Date	2010-09-01
End Date	2010-10-03
Description	IODP cruise for Deep Hot Biosphere expedition. For more information, including cruise reports, visit http://publications.iodp.org/proceedings/331/331title.htm

[[table of contents](#) | [back to top](#)]

Project Information

An In-Depth analysis of the subvent biosphere within Okinawa Backarc Basin (IODP 331, Iheya North Hydrothermal Field) sediments (Subvent_Biosphere_Sediments)

Coverage: Iheya North Hydrothermal Field, Pacific Ocean

The Iheya North Hydrothermal Field in the Okinawa Backarc Basin represents an ideal environment in which to investigate the biotic temperature fringe of microbial life at depth because of its subsurface hydrothermal activity within its continental margin-type sediment profile. Geographically, the Okinawa Backarc Basin is situated along a continental margin, which is a sediment profile type commonly sampled and studied across the seafloor (e.g. Peru Margin, Costa Rica Margin, Cascadia Margin). The hydrothermal network within the subsurface here supplies an additional temperature obstacle to microbial life existing in the sediments. In particular, the sediment profile at Site C0014 exhibits a transition from hemipelagic ooze with pumiceous volcanoclastic sediments and low temperature (4°C) to a hydrothermally altered sequence of clays within the top ~10 mbsf of sediment. Temperature measurements indicate a gradient of approximately 3°C/m, which is roughly an order of magnitude greater than continental margin sites (e.g. Cascadia Margin, IODP 311 and Costa Rica Margin, IODP 344), but is more gradual than intense, centimeter-scale gradients from other hot, surface sediments. We have focused on the application of culture-independent, molecular methods to understand taxonomic and functional characteristics through this hydrothermal gradient. Confidence in DNA recovery suggests a microbial biosphere extent of approximately 15 mbsf (55°C).

Results from both 16S rRNA gene surveys and metagenomics analyses suggest a temperature-dependent stratigraphy of taxonomic and functional adaptations between the shallowest and deepest sample horizons. Cosmopolitan marine subsurface bacterial and archaeal taxa are present throughout the top 10 mbsf, whereas, hyperthermophilic heterotrophic as well as thermophilic anaerobic methanotrophic archaea appear in varying local abundances in deeper, hydrothermal clay horizons. "An In-Depth analysis of the subvent biosphere within Okinawa Backarc Basin (IODP 331, Iheya North Hydrothermal Field) sediments" encompasses datasets funded through C-DEBI to investigate the microbial communities in IODP 331 Iheya North Hydrothermal Field sediments. Site C0014 at this field site is 500 m away from the active vent and experiences a 3C/m temperature gradient with depth. In the research grant "Investigating the active microbial populations in near hydrothermal vent sediments" and the Research Exchange grant "Learning new RNA extraction techniques", we used an RNA-based approach to explore the active microbial community. Upon analysis, the RNA dataset does not appear to reflect the same information as the phylogenetic signals coming from both the 16S rRNA gene as well as the metagenomes. The data indicate significant background noise from the RNA extraction process rather than from an indigenous representation of the subsurface biosphere.

The graduate fellowship "An in-depth analysis of the subvent biosphere within the Okinawa backarc basin Iheya North hydrothermal field" provided an opportunity to bring together metagenomic, 16S rRNA gene amplicon (DNA), and 16S rRNA amplicon datasets from IODP 331 Iheya North Hydrothermal Field sediments to understand the biogeography of this subvent biosphere.

For more information, refer to the following C-DEBI grants/projects.

An in-depth analysis of the subvent biosphere within the Okinawa backarc basin Iheya North hydrothermal field:

<https://www.darkenergybiosphere.org/award/an-in-depth-analysis-of-the-subvent-biosphere-within-the->

[okinawa-backarc-basin-iheya-north-hydrothermal-field/](#)

Investigating the active microbial populations in near hydrothermal vent sediments: <https://www.darkenergybiosphere.org/award/investigating-the-active-microbial-populations-in-near-hydrothermal-vent-sediments/>

Learn new RNA extraction techniques: <https://www.darkenergybiosphere.org/award/learn-new-rna-extraction-techniques/>

[[table of contents](#) | [back to top](#)]

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.

International Ocean Discovery Program (IODP)

Website: <http://www.iodp.org/index.php>

Coverage: Global

The International Ocean Discovery Program (IODP) is an international marine research collaboration that explores Earth's history and dynamics using ocean-going research platforms to recover data recorded in seafloor sediments and rocks and to monitor subseafloor environments. IODP depends on facilities funded by three platform providers with financial contributions from five additional partner agencies. Together, these entities represent 26 nations whose scientists are selected to staff IODP research expeditions conducted throughout the world's oceans.

IODP expeditions are developed from hypothesis-driven science proposals aligned with the program's [science plan](#) *Illuminating Earth's Past, Present, and Future*. The science plan identifies 14 challenge questions in the four areas of climate change, deep life, planetary dynamics, and geohazards.

IODP's three platform providers include:

- The U.S. National Science Foundation ([NSF](#))
- Japan's Ministry of Education, Culture, Sports, Science and Technology ([MEXT](#))
- The European Consortium for Ocean Research Drilling ([ECORD](#))

More information on IODP, including the Science Plan and Policies/Procedures, can be found on their website at <http://www.iodp.org/program-documents>.

[[table of contents](#) | [back to top](#)]

Funding

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

[[table of contents](#) | [back to top](#)]