Contextual data for samples collected for metagenome sequencing from the deep subseafloor biosphere as accessed via CORKs along the Juan de Fuca Ridge flank in the Northeast Pacific Ocean between 2008 and 2014

Website: https://www.bco-dmo.org/dataset/945915
Data Type: Cruise Results, Other Field Results
Version: 1
Version Date: 2024-12-12

Project
» Collaborative Research: Illuminating microbes and their viruses within the dark ocean crust through strain-level approaches (JdFR Strain level)

Contributors	Affiliation	Role
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Abstract
This dataset provides contextual information about samples used for metagenome sequencing. These samples were collected from pristine crustal fluids sampled via CORK observatories along the Juan de Fuca Ridge flank in the Northeast Pacific Ocean off the coast of North America. Also included are metadata for seawater and sediment metagenomes that have been sequenced as controls. All of the data are publicly available via the National Center for Biotechnology Information (NCBI) accession numbers provided in the dataset (BioProject numbers PRJNA655018 to PRJNA655040).

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Coverage

Location: Northeast Pacific Ocean along the Juan de Fuca ridge flank
Spatial Extent: **N**:47.88745 **E**:-127.7592 **S**:47.75348333 **W**:-128.64865
Temporal Extent: 2008-08-07 - 2014-08-21

Methods & Sampling

Samples were collected from the Northeast Pacific Ocean along the Juan de Fuca ridge flank, off of the continent of North America. CORK observatories are on the seafloor at a water column depth of approximately 2660 meters. CORKs are located in the general vicinity of 47.75 lat, -127.76 lon. Samples were collected during the following R/V Atlantis cruises:

2008 cruise: AT15-35, James Cowen (Chief Sci)

2009 cruise: AT15-51, Andrew Fisher (Chief Sci)
2010 cruise: AT15-66, James Cowen (Chief Sci)
2011 cruise: AT18-07, Andrew Fisher (Chief Sci)
2013 cruise: AT26-03, Andrew Fisher (Chief Sci)
2014 cruise: AT26-18, Geoff Wheat (Chief Sci)

Deep subseafloor basement crustal fluids were collected from boreholes fitted with CORKs (subseafloor borehole observatory systems) along the Juan de Fuca Ridge flank, which are located at a water column depth of approximately 2,650 meters (m) and penetrate through sediment and into the igneous basement. The CORKs fitted to these boreholes feature fluid delivery lines that access fluids at different depth horizons. Custom sampling equipment enabled the pumping of borehole fluids directly through 0.22 micrometer (µm) pore-size polyethersulfone filters or filter cartridges at the seafloor. DNA was extracted directly from the filters using either phenol-chloroform or commercially available kits, as specified in the sample log. Genomic DNA was submitted to the Joint Genome Institute for sequencing.

Sampling used custom-designed equipment: the Medium Volume Bag Sampler (MVBS), Large Volume Bag Sampler (LVBS), and In Situ Passive Viral Filter. These have been described in publications previously (Nigro et al., 2017; Cowen et al., 2012).

BCO-DMO Processing Description

- Imported original file "rappe_deepSS_BCODMO.csv" into the BCO-DMO system.
- Created the Creation_Date column in YYYY-MM-DD format.
- Renamed fields to comply with BCO-DMO naming conventions.
- Saved final file as "945915_v1_sequencing_samples.csv".

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Data Files

File	
945915_v1_sequencing_samples.csv	(Comma Separated Values (.csv), 10.73 KB) MD5:fec734c132e2520c682759bab62adcef
Primary data file for dataset ID 945915, version 1	

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Related Publications

Cowen, J. P., Copson, D. A., Jolly, J., Hsieh, C.-C., Lin, H.-T., Glazer, B. T., & Wheat, C. G. (2012). Advanced instrument system for real-time and time-series microbial geochemical sampling of the deep (basaltic) crustal biosphere. Deep Sea Research Part I: Oceanographic Research Papers, 61, 43–56. doi:10.1016/j.dsr.2011.11.004
Methods

Nigro, O. D., Jungbluth, S. P., Lin, H.-T., Hsieh, C.-C., Miranda, J. A., Schvarcz, C. R., Rappé, M. S., & Steward, G. F. (2017). Viruses in the Oceanic Basement. MBio, 8(2). https://doi.org/10.1128/mbio.02129-16
Methods

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Parameters

Parameter	Description	Units

Sample_Type	Type of sample	unitless
Sample_Name	Sample name	unitless
DNA_Isolation_Method	DNA isolation method: MoBio Powersoil, Phenol, Zymobiomics, or mixed.	unitless
Collection_Date	Collection date	unitless
Collection_Year	Collection year	unitless
Collection_Month	Collection month	unitless
Collection_Day	Day of month of collection	unitless
Sample_Source	Sample source location	unitless
Fluid_Delivery_Line	Type of fluid delivery line: stainless steel or Tefzel.	unitless
Environment	Description of sample environment: seawater, sediment, or subseafloor crustal fluid.	unitless
Latitude	Latitude of sample collection	decimal degrees North
Longitude	Longitude of sample collection	decimal degrees East
Depth	Depth of sample collection. "msb" refers to "meters sub-basement", or the depth in meters below the sediment-basement interface.	msb
Area	Geographic area of sample collection	unitless
Full_Sample_Name_and_Description	Sample name and description	unitless
IMG_Genome_ID	Joint Genome Institute (JGI) IMG ID number (https://img.jgi.doe.gov/)	unitless
NCBI_Bioproject_Accession	National Center for Biotechnology Information (NCBI) BioProject accession number (https://www.ncbi.nlm.nih.gov/)	unitless

NCBI_Biosample_Accession	National Center for Biotechnology Information (NCBI) BioSample accession number (https://www.ncbi.nlm.nih.gov/)	unitless
SRA_ID	National Center for Biotechnology Information (NCBI) SRA experiment accession (https://www.ncbi.nlm.nih.gov/)	unitless

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Deployments

AT15-51

Website	https://www.bco-dmo.org/deployment/660521
Platform	R/V Atlantis
Start Date	2009-08-20
End Date	2009-09-06

AT15-66

Website	https://www.bco-dmo.org/deployment/660524
Platform	R/V Atlantis
Start Date	2010-06-15
End Date	2010-07-01

AT18-07

Website	https://www.bco-dmo.org/deployment/660555
Platform	R/V Atlantis
Start Date	2011-06-29
End Date	2011-07-14

AT26-18

Website	https://www.bco-dmo.org/deployment/626369
Platform	R/V Atlantis
Report	http://dmoserv3.whoi.edu/data_docs/C-DEBI/cruise_reports/AT26-18_JFR_Cork_Recovery_Cruise_Report_reduced.pdf
Start Date	2014-08-10
End Date	2014-08-24
Description	Research was conducted on this cruise as part of the C-DEBI project titled "Completing single- and cross-hole hydrogeologic and microbial experiments: Juan de Fuca Flank" (see http://www.bco-dmo.org/project/625989).

AT15-35

Website	https://www.bco-dmo.org/deployment/637087
Platform	R/V Atlantis
Start Date	2008-07-28
End Date	2008-08-13
Description	Science activities (according to WHOI's cruise synopsis): 1) Service instrumentation at up to seven subseafloor “CORK” hydrological observatories installed by ODP in 1996 and IODP in 2004; 2) make in situ, shipboard and shore-based measurements to characterize the microbial geochemistry of the subseafloor basement (basaltic crust) utilizing subset of above 7 CORK observatories; and 3) test underwater optical communication device associated with a temperature probe deployed within a thermal vent.

AT26-03

Website	https://www.bco-dmo.org/deployment/946035
Platform	R/V Atlantis
Start Date	2013-07-13
End Date	2013-07-26

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Project Information

Collaborative Research: Illuminating microbes and their viruses within the dark ocean crust through strain-level approaches (JdFR Strain level)

Coverage: Boreholes along the eastern flank of Juan de Fuca Ridge (47N, 128 W)

NSF Award Abstract:
Our planet's seafloor consists primarily of sediment layered over a basement of basalt rock. Every 50,000 to 100,000 years, a volume of seawater equivalent to the entire global ocean circulates through cracks and fissures of this basement beneath the seafloor, forming one of the largest reservoirs for microscopic life on Earth. While high temperature fluids discharging at iconic hydrothermal vents at mid-ocean ridges are visually striking, the fluid flowing in and out of the flanks of these ridges is around three orders of magnitude greater and rivals the discharge of all rivers to the ocean. As it travels through the deep subseafloor, this fluid is significantly altered by water and rock interaction and the metabolic activity of microorganisms that are thought to ultimately help shape nutrient and energy budgets of the global ocean. However, our knowledge and understanding of this system suffer greatly from logistical difficulties in accessing it for scientific inquiry. Initial evidence suggests uncharacterized microbes that possess ancient homologs of enzymes involved in key metabolic pathways thought to be important to Earth's early microbial inhabitants populate this biome and are infected by novel viruses. In this study, the investigators are performing an integrated set of observations, experiments, and analyses aimed to advance our understanding of deep subseafloor microbes and their viruses by providing new, fundamental insights into which organisms and metabolisms are active in this environment, their evolutionary history and genetic characteristics, and their interactions. This project contributes to the development of a diverse STEM-educated workforce, and incorporate the training of one postdoctoral scientist, two graduate students, and ~29 undergraduate students in field-based research, wet-lab experimentation, and bioinformatics. This project also fosters a unique collaboration between scientists and the University of Hawaii Academy for Creative Media that supports undergraduate interns from the Academy to work with project personnel and produce creative videos and graphics to communicate aspects of our research to diverse audiences. Finally, this project supports two early career female scientists who started faculty positions in 2017.

This project leverages existing sampling infrastructure, DNA sequencing by the Department of Energy Joint Genome Institute, and a research expedition to the Juan de Fuca Ridge (JdFR) flank off the coast of

Washington, USA, that is already supported by NSF. Here, subseafloor observatories have been previously installed to aid in exploring actively flowing subseafloor crustal fluids. These fluids will be collected from different sampling depths for an integrated set of geochemical, genomic, and cultivation studies. The project's specific objectives are to (i) use genomics to characterize microbial and viral populations inhabiting crustal fluids of the JdFR flank, (ii) use transcriptomics to identify the active metabolic pathways that are performing transformations relevant to elemental cycling within microorganisms of the JdFR flank, as well as identify active viral infections in these microbes, and (iii) generate microbial and viral pure cultures or limited diversity enrichments from crustal fluids of the JdFR flank. It combines bioinformatic analyses, controlled laboratory experiments, and field sampling to pursue both hypothesis-driven and discovery-based cultivation experiments, viral assays, and strain-level ecogenomic and metatranscriptomic analyses. Importantly, the investigators intend to generate new cultivated microbes and viruses to serve as model systems for investigating the characteristics of life in the deep ocean crust.

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-1851045
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851099
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851582

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