CTD data from AT39-01 (North Pond 2017 expedition) from the R/V Atlantis in the central North Atlantic during October 2017

Website: https://www.bco-dmo.org/dataset/757722
Data Type: Cruise Results
Version: 1
Version Date: 2019-03-07

Project
» Collaborative Research: A multidimensional approach to understanding microbial carbon cycling beneath the seafloor during cool hydrothermal circulation (Subseafloor Microbial Carbon Cycling)
» Collaborative Research: Completing North Pond Borehole Experiments to Elucidate the Hydrology of Young, Slow-Spread Crust (North Pond 2017)
» Investigation of viruses and microbes circulating deep in the seafloor (North Pond Viruses)

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

Contributors	Affiliation	Role
Steward, Grieg	University of Hawai'i at Mānoa (SOEST)	Principal Investigator
Biddle, Mathew	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
CTD data from AT39-01 (North Pond 2017 expedition).

Table of Contents

Coverage

Spatial Extent: **N**:22.81 **E**:-46.0507 **S**:22.7553 **W**:-46.0817
Temporal Extent: 2017-10-14 - 2017-10-27

Dataset Description

CTD data from AT39-01 (North Pond 2017 expedition)

Cast at3901001 was a test cast. No bottles were fired. Pumps were turned on at a depth of approximately 27 meters. Data above this depth should not be considered valid and were removed before submission. The oxygen sensor encountered at problem at approximately 310 meters on the upcast. Oxygen data should not be considered valid between this depth and the end of the cast at 100 meters. Only the downcast data is provided here.

On cast at3901002, fouling caused intermittent pump operation in the plumbing line between the Temp1, Cond1, and Oxygen sensors. These data were manually replaced with 9.99e-29. Data from Temp2, Cond2, and all other sensors is valid for this cast.

On cast at3901009, a noticeable offset was present in the Oxygen data for the upcast, following a prolonged (12+ hour) deployment. The sensor was cleaned following the cast and values returned to normal on all subsequent casts. Only the downcast data is provided here

Methods & Sampling

Software Version Seasave V 7.23.2

Data Processing Description

BCO-DMO Processing Notes:
- combined all files into one large file
- reformatted latitude and longitude into degrees
- reformatted date/time to ISO 8601 format
- appended lat, lon, time_ut, cast_id, and cast_no to the data from the headers
- added conventional header with dataset name, PI name, version date
- sorted by date/time and depth

[table of contents | back to top]

Data Files

File
ctd.csv (Comma Separated Values (.csv), 9.80 MB) MD5:b739990744b620d0d1d109293b11f627 Primary data file for dataset ID 757722

[table of contents | back to top]

Supplemental Files

File
at3901001_header filename: at3901001_header.txt (Octet Stream, 11.88 KB) MD5:8031873fad524ac2c3d2faa2892af7df Header Information Sample from first cast (at3901001)

[table of contents | back to top]

Related Datasets

IsRelatedTo

Girguis, P., Shah Walter, S. R. (2024) **Concentrations, d13C and D14C data for DOC and DIC in fluids collected from North Pond Cork Observatories U1382A and U1383C and from bottom seawater in 2012, 2014 and 2017.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2) Version Date 2024-06-11 doi:10.26008/1912/bco-dmo.876729.2 [view at BCO-DMO]

[table of contents | back to top]

Parameters

Parameter	Description	Units
press	Pressure. Originally named 'prDM'.	decibars
temp	Primary temperature measurement. Originally named 't090C'.	degrees Celsius
temp_2	Secondary tempearture measurement. Originally named 't190C'.	degrees Celsius
cond	Primary conductivity measurement. Originally named 'c0S/m'.	Siemens/meter [S/m]
cond_2	Secondary conductivity measurement. Originally named 'c1S/m'.	Siemens/meter [S/m]
trans	Beam transmission expressed as percent. Originally named 'CStarTr0'.	unitless
fluor	Fluorescence measured by WET Labs ECO-AFL/FL in milligrams per cubic meter. Originally named 'flECO-AFL'.	milligrams/cubic meter [mg/m^3]
turbidity	Turbidity measured by WET Labs ECO. Originally named 'turbWetntu0'.	NTU
O2_v	Raw voltage from SBE43 oxygen sensor. Originally named 'Sbeox0V'.	volts
depth	Depth. Originally named 'depSM'.	meters
density	Primary measure of density in kilograms per cubic meter. Originally named 'density00'.	kilograms/cubic meter [kg/m^3]
density_2	Secondary measure of density in kilograms per cubic meter. Originally named 'density11'.	kilograms/cubic meter [kg/m^3]
sal	Primary salinity measurement. Originally named 'sal00'.	practical salinity units [PSU]
sal_2	Secondary salinity measurement. Originally named 'sal11'.	practical salinity units [PSU]
sound_vel	Sound velocity in meters per second. Originally named 'svCM'.	meters/second [m/s]
sound_vel_2	Sound velocity in meters per second from secondary sensor. Originally named 'svCM1'.	meters/second [m/s]
O2	Oxygen concentration from SBE 43. Originally named 'sbeox0Mm/L'.	micromol/liter [umol/l]
flag	Quality flag; bad flag = -9.99e-29.	unitless
time_utc	date and time in ISO 8601 format yyyy-m-ddTHH:MM:SS	unitless
lon	longitude. East is positive; negative denotes West.	decimal degrees
lat	latitude. North is positive; negative denotes South	decimal degrees
cast_id	identifier for the cast	unitless
cast_no	number for the cast	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Sea-Bird SBE 9
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Dataset-specific Description	Sea-Bird SBE 9 Data File
Generic Instrument Description	The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

Dataset-specific Instrument Name	WET Labs ECO-AFL/FL
Generic Instrument Name	Wet Labs ECO-AFL/FL Fluorometer
Dataset-specific Description	WET Labs ECO-AFL/FL Serial No.: FLTURT-964 Calibration Date: 22-Nov-16
Generic Instrument Description	The Environmental Characterization Optics (ECO) series of single channel fluorometers delivers both high resolution and wide ranges across the entire line of parameters using 14 bit digital processing. The ECO series excels in biological monitoring and dye trace studies. The potted optics block results in long term stability of the instrument and the optional anti-biofouling technology delivers truly long term field measurements. more information from Wet Labs

Dataset-specific Instrument Name	WET Labs C Star
Generic Instrument Name	WET Labs {Sea-Bird WETLabs} C-Star transmissometer
Dataset-specific Description	WET Labs C Star serial number: CST-854DR caibration date: 8-Dec-16
Generic Instrument Description	The C-Star transmissometer has a novel monolithic housing with a highly intgrated opto-electronic design to provide a low cost, compact solution for underwater measurements of beam transmittance. The C-Star is capable of free space measurements or flow-through sampling when used with a pump and optical flow tubes. The sensor can be used in profiling, moored, or underway applications. Available with a 6000 m depth rating. More information on Sea-Bird website: https://www.seabird.com/c-star-transmissometer/product?id=60762467717

Dataset-specific Instrument Name	WET Labs, ECO-NTU
Generic Instrument Name	WETLabs ECO-FLNTU
Dataset-specific Description	WET Labs, ECO-NTU Serial no.: FLTURT-964 Calibration date: 22-Nov-16
Generic Instrument Description	The ECO FLNTU is a dual-wavelength, single-angle sensor for simultaneously determining both chlorophyll fluorescence and turbidity.

[table of contents | back to top]

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

[table of contents | back to top]

Project Information

Collaborative Research: A multidimensional approach to understanding microbial carbon cycling beneath the seafloor during cool hydrothermal circulation (Subseafloor Microbial Carbon Cycling)

Coverage: The “North Pond” sedimented site in the Mid-Atlantic ridge. This is an IODP study site. The coordinates are 22 ° and 23°N by 44°30 ' to 46°20'W

NSF abstract:

The global ocean comprises Earth’s largest microbiome, with at least half of the ocean’s microbial biomass occurring beneath the ocean floor. In particular, oceanic crust encompasses the largest aquifer on Earth, with a liquid volume equal to approximately 2% of the ocean’s volume. It also harbors a substantial reservoir of microbial life that may influence global-scale biogeochemical cycles. This project investigates this largest actively flowing aquifer system on Earth- the fluids circulating through oceanic crust underlying the oceans and sediments. Despite advancing knowledge about life in the deep ocean, the understanding of microorganisms in the rocky oceanic crust and the fluids flowing through it remains rudimentary. This project is focused on understanding the linkages between microbial activity and the cycling of carbon in the cool, subseafloor biosphere. The balance between organic carbon-consuming and organic carbon-producing metabolisms within the crustal biosphere will be determined using seafloor observatories put in place by the International Ocean Discovery Program (IODP) on the flanks of the Mid-Atlantic Ridge, likely representative of the majority of global hydrothermal fluid circulation. The rates of microbial transformations of carbon will be determined using both geochemical and biological approaches. Results will help establish the extent to which microbially-mediated processes in the subseafloor influence carbon cycling in the ocean. This work will represent the first comprehensive description of carbon cycling in the cold oxic crustal aquifer. Two female postdocs will be supported on the grant, and both high school and community college students will also be involved through collaborations with Cape Cod Community College and Cambridge-Rindge and Latin School. The goal is to promote science, technology, engineering and math literacy among high-school and community college students through hand-on research experiences, peer-to-peer mentoring, and professional development opportunities.

The goal of the project is to answer the question "is the cool crustal subseafloor biosphere net autotrophic or net heterotrophic?" The focus of the effort is at North Pond, an isolated sediment pond located on ridge flank oceanic crust 7-8 million years old on the western side of the Mid-Atlantic Ridge. The two objectives of the project are to:

1. Characterize suspended particles in subseafloor fluids with respect to their inorganic and organic carbon content, and natural ^{14}C and ^{13}C isotopic ratios, to determine microbially-mediated fluxes and processes.

2. Characterize the net influence of particle-associated and free-living microbial communities on subseafloor fluid primary production and remineralization, as well as the taxon-specific contributions to these same processes.

The integration of isotope geochemical and molecular biological approaches represents a significant cross-disciplinary advance in the understanding of the microbial ecology and geochemistry of the subseafloor biosphere in young oceanic crust and their role in maintaining global deep-sea redox balance. Expected outcomes include identifying signatures of autotrophic and heterotrophic metabolism in particle-associated and free-living subseafloor microbial communities as well as quantification of autotrophic and heterotrophic metabolism and associated taxon-abundances to provide insights into the net and specific microbial processes in crustal fluids on carbon fluxes.

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.

Investigation of viruses and microbes circulating deep in the seafloor (North Pond Viruses)

Coverage: Mid-Atlantic Ridge flank; North Pond CORK sites

NSF Award Abstract:
The ocean does not end at the seafloor. Seawater penetrates deep into the ocean crust forming an enormous subseafloor aquifer. Interactions among seawater, rocks, and microorganisms alter the properties of seawater as it passes through this aquifer. The flux of the altered fluid out of the basaltic rocks and back into the sea is equivalent to the flux of all the rivers on the planet and this exchange of deep-sea fluids influences the chemical balance of the ocean. Obtaining samples of these fluids has been a major obstacle to understanding the biological processes that occur within the ocean basement aquifer, but the development and installation of special wellheads, called CORKs, into boreholes on the seafloor now provides opportunities to probe the biology of the most remote habitat on earth. Recent analyses of fluids sampled from CORKs have shown that the microbial communities in the ocean basement are very different from those of the overlying seawater, but little is known of their ecology. In particular, nothing is known about how viruses interact with the cells in this habitat. When a lytic virus infects a cell, it will lyse and kill the cell, but temperate viruses often establish a stable, symbiotic relationship with the host cell that changes how the cell functions. Because of these important roles, viruses exert a major influence on the size, composition, and activity of microbial communities. Investigating the contributions of lytic and temperate viruses in the ocean basement is therefore central to understanding how activities of microbes in the basement are regulated. For this project, the researchers will sample fluids from the ocean basement in the central Atlantic Ocean to conduct the first investigation of the importance of viruses in a slow spreading crustal system. In addition to publishing the detailed results in scientific journals, the researchers will produce a book (in English and Hawaiian) targeting upper elementary to middle schoolchildren that captures the excitement and challenges of deep-sea exploration and introduces the mysteries of the life forms being discovered deep in the earth?s crust. The book will align with National Ocean Literacy Principles and Common Core Standards. Distribution will be focused on the minority-serving schools in Hawaii with the goal of fostering interest in the ocean, earth, and life sciences in groups traditionally underrepresented in STEM fields.

To collect the viruses and microorganisms in the fluids, the researchers will use both passive and active collection methods with the help of a remotely operated vehicle. For passive collection, micro- and ultrafilters will be connected in series to the wellhead and fluids will be driven through the filters by the pressure differential between aquifer and bottom seawater. For active sampling, mechanical pumps will be used to direct either basement fluids or bottom seawater into sample bags for retrieval and processing aboard ship. Microorganisms and viruses harvested from the fluids will be fractionated to separate populations. The viruses and cells will be examined by electron microscopy to quantify morphological diversity and to determine the proportion of infected cells. Nucleic acids from the cells and viruses will be sequenced to 1) characterize the genetic diversity of the viruses, 2) determine the proportion of cells with integrated viral genomes, 3) identify the functional genes contributed to the cells by the viruses, and 4) link specific viruses to their likely hosts based on analysis of CRISPR elements. The researchers hypothesize that the basement viruses will be distinct from those of bottom seawater and that, compared to surface seawater where cells are more abundant, active lytic infections in the basement will be low, but infections by temperate viruses will be exceptionally common. The data from this project will help to constrain the importance of viruses in recycling of organic carbon in the ocean basement and shed light on how viral genes may be altering the microbial activities that influence ocean chemistry.

[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.

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[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1635208
NSF Division of Ocean Sciences (NSF OCE)	OCE-1635365
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536539
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536601
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536623
NSF Division of Ocean Sciences (NSF OCE)	OCE-1634025
NSF Division of Ocean Sciences (NSF OCE)	OCE-1745589
NSF Division of Ocean Sciences (NSF OCE)	OCE-1636402

[table of contents | back to top]