Minor ion concentrations in OsmoSamplers that were recovered on R/V Atlantis Expedition AT39-01 with the ROV Jason-II (Depart October 2, 2018 and returned 11/2/2017).

Website: https://www.bco-dmo.org/dataset/820188
Data Type: Other Field Results
Version: 1
Version Date: 2020-08-28

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
Wheat, C. Geoffrey	University of Alaska Fairbanks (UAF)	Principal Investigator, Contact
Soenen, Karen	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Minor ion concentrations in OsmoSamplers that were recovered on R/V Atlantis Expedition AT39-01 with the ROV Jason-II (Depart October 2, 2018 and returned 11/2/2017).

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Coverage

Spatial Extent: **N**:22.802213 **E**:-46.052593 **S**:22.7520683 **W**:-46.081516
Temporal Extent: 2011-10-11 - 2017-10-20

Dataset Description

These data will be submitted in Orcutt *et al.*: “Subsurface oceanic crust microbe-mineral biogeography from multi-year incubations at North Pond, Mid-Atlantic Ridge”

Similar, relevant data were published in Wheat et al., 2020.

OsmoSampler descriptions:

- NP 2017 1383 B Acid-Addition OsmoSampler was deployed in IODP Hole 1383B on 4/22/12, removed from the borehole on 10/21/17 (J2-1032), and recovered on the ship on 10/22/17 (J2-1033). The pump worked as planned.
- 1383 C blue Acid-Addition OsmoSampler was deployed on the wellhead at IODP Hole 1383C on 4/08/14 (J2-771) and recovered on 10/21/17 (J2-1032). This sampler pumped more than expected, resulting in a salinity of 46 per mil in the fresh water reservoir. The timeline was adjusted for the excess pumping.
- 1383 C black Acid-Addition OsmoSampler was deployed on the wellhead of IODP Hole 1383C on 4/08/14 (J2-771) and recovered on 10/21/17 (J2-1032). This sampler pumped more than expected, resulting in a salinity of 24 per mil in the fresh water reservoir. The timeline was adjusted for excess pumping.
- 1383 C upper Acid-Addition osmoSampler was deployed in Hole U1383C on 11/6/11 and recovered on 10/16/17 (J2-1030). This sampler pumped more than expected, resulting in a salinity of 10 per mil in the fresh water reservoir. The

timeline was adjusted for the excess pumping.
- 1382 A green Acid-Addition OsmoSampler was deployed on the wellhead of IODP Hole 1382A on 4/08/14 (J2-771) and recovered on 10/23/17 (J2-1028). This sampler pumped more than expected, resulting in a salinity of 71 per mil in the fresh water reservoir. The timeline was adjusted for the excess pumping.
- Acid was added to four of the five sample streams. The exception was the 1382A Green Acid-Addition Osmosampler. Concentrations account for the addition of acid (HCl).
- Hole U1383B downhole (DH) MBIO1 FLOCS OsmoSampler minor ion concentrations. The sampler was deployed on 4/22/12, removed from the borehole on 10/21/17, and recovered on 10/22/17. The pump worked as planned.
- Hole U1383B downhole (DH) MBIO2 FLOCS OsmoSampler minor ion concentrations. The sampler was deployed on 4/22/12, removed from the borehole on 10/21/17, and recovered on 10/22/17. The pump worked as planned.
- Hole U1383B downhole (DH) ENRICH FLOCS OsmoSampler minor ion concentrations. The ampler was deployed on 4/22/12, removed from the borehole on 10/21/17, and recovered on 10/22/17. The pump worked as planned.
- Hole U1383C upper downhole (DH) MBIO FLOCS OsmoSampler minor ion concentrations. The sampler was deployed on 11/6/11. Samplers were recovered on 10/16/17. This sampler pumped more than expected, resulting in a salinity of 24 per mil in the fresh water reservoir. An additional 168 ml of borehole fluid was pulled into the pump. This additional fluid was not considered in the time estimate.
- Hole U1383C lower downhole (DH) MBIO FLOCS OsmoSampler minor ion concentrations. The sampler was deployed on 11/6/11. Samplers were recovered on 10/16/17. This sampler pumped more than expected, resulting in a salinity of 40 per mil in the fresh water reservoir. An additional 279 ml of borehole fluid was pulled into the pump. This additional fluid was not considered in the time estimate.
- Hole U1383C downhole (DH) upper enrichment OsmoSampler minor ion concentrations. The sampler was deployed on 11/6/11 and recovered on 10/16/17. This sampler pumped more than expected, resulting in a salinity of 27 per mil in the fresh water reservoir. An additional 188 ml of borehole fluid was pulled into the pump. This additional fluid was not considered in the time estimate.
- Hole U1383C wellhead (WH) Blue JP FLOCS OsmoSampler minor ion concentrations. This Sampler was deployed on 4/08/14 (J2-771) and recovered on 10/20/17. This sampler pumped more than expected, resulting in a salinity o 33 per mil in the fresh water reservoir. An additional 255 ml of borehole fluid was pulled into the pump. This additional fluid was not considered in the time estimate.
- Hole U1383C wellhead (WH) Blue Orcutt FLOCS OsmoSampler minor ion concentrations. This Sampler was deployed on 4/08/14 (J2-771) and recovered on 10/20/17. This sampler pumped more than expected, resulting in a salinity o 35 per mil in the fresh water reservoir. An additional 271 ml of borehole fluid was pulled into the pump. This additional fluid was not considered in the time estimate.
- Hole U1383C wellhead (WH) JP middle horizon "black" FLOCS OsmoSampler minor ion concentrations. This sampler was deployed on 4/08/14 (J2-771) and recovered on 10/20/17. This sampler pumped more than expected, resulting in a salinity o 33 per mil in the fresh water reservoir. An additional 255 ml of borehole fluid was pulled into the pump. This additional fluid was not considered in the time estimate.
- Hole U1383C wellhead (WH) Orcutt middle horizon "black" FLOCS OsmoSampler minor ion concentrations. This sampler was deployed on 4/08/14 (J2-771) and recovered on 10/20/17. This sampler pumped more than expected, resulting in a salinity o 28 per mil in the fresh water reservoir. An additional 217 ml of borehole fluid was pulled into the pump. This additional fluid was not considered in the time estimate.
- Hole U1383C wellhead (WH) shallow horizon JP "red" FLOCS OsmoSampler minor ion concentrations. This sampler was deployed on 4/08/14 (J2-771) and recovered on 10/20/17. This sampler pumped more than expected, resulting in a salinity of more than 100 per mil in the fresh water reservoir. This additional fluid was not considered in the time estimate.
- Hole U1383C wellhead (WH) shallow horizon Orcutt "red" FLOCS OsmoSampler minor ion concentrations. This sampler was deployed on 4/08/14 (J2-771) and recovered on 10/20/17. This sampler pumped more than expected, resulting in a salinity of more than 100 per mil in the fresh water reservoir. This additional fluid was not considered in the time estimate.
- Hole U1382A downhole (DH) upper MBIO FLOCS OsmoSampler minor ion concentrations. This sampler was deployed on 10/11/11 and recovered on 10/20/17. The pump worked as planned.
- Hole U1382A downhole (DH) lower MBIO FLOCS OsmoSampler minor ion concentrations. This sampler was deployed on 10/11/11 and recovered on 10/20/17. This pump worked as planned.
- Hole U1382A wellhead (WH) green JP FLOCS OsmoSampler minor ion concentrations. Samplers deployed on 4/08/14 (J2-771) and recovered on 10/20/17. This sampler pumped more than expected, resulting in a salinity o 35 per mil in the fresh water reservoir. An additional 271 ml of borehole fluid was pulled into the pump. This additional fluid was not considered in the time estimate.
- Hole U1382A wellhead (WH) green Orcutt FLOCS OsmoSampler minor ion concentrations. Samplers deployed on 4/08/14 (J2-771) and recovered on 10/20/17. This sampler pumped more than expected, resulting in a salinity fo 45 per mil in the fresh water reservoir. An additional 349 ml of borehole fluid was pulled into the pump. This additional fluid was not considered in the time estimate.

Methods & Sampling

Once on deck, OsmoSamplers were sectioned. Individual coils of Teflon tubing (each ~300 m long) were removed, sealed, and labeled. Each coil was then sectioned into 1.2 m lengths and the fluid expelled into acid washed (60C for 14 hours in 10%HCl) and rinsed (18 mega ohm water) micro centrifuge tubes. Centrifuge tubes were labeled and packaged for shipment.

In the laboratory aliquots from these centrifuge tubes were diluted before being analyzed using an inductively coupled plasma optical emission spectrometer (ICPOES). In addition the fresh water reservoir for each of the OsmoSampler pumps was analyzed for salinity to asses if the samplers over pumped and if so, by how much.

Additional descriptions for the recovered samplers can be found at Edwards et al. (2012) and Wheat et al. (2011).

Data Processing Description

Fluids were analyzed with an inductively coupled plasma optical emission spectrometer (ICPOES) as described in Wheat et al. (2020). Analytical precision is listed as 2%, but individual runs were ofter lower.

BCO-DMO processing notes:

- Reformatted table structure to flat file format
- Adjusted column names to comply with database requirements
- Adjusted date format to yyyy-mm-dd
- Added latitude and longitude of samples

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Data Files

File	
ion_concentrations.csv	(Comma Separated Values (.csv), 55.58 KB) MD5:f8a0b9f52a82dd3756592ced50e90564
Primary data file for dataset ID 820188	

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Related Publications

Edwards, K. J., Wheat, C. G., Orcutt, B. N., Hulme, S., Becker, K., Jannasch, H., ... Klaus, A. (2012). Design and deployment of borehole observatories and experiments during IODP Expedition 336, Mid-Atlantic Ridge flank at North Pond. Proceedings of the IODP. doi:10.2204/iodp.proc.336.109.2012
Methods

Wheat, C. G., Becker, K., Villinger, H., Orcutt, B. N., Fournier, T., Hartwell, A., & Paul, C. (2020). Subseafloor Cross-Hole Tracer Experiment Reveals Hydrologic Properties, Heterogeneities, and Reactions in Slow-Spreading Oceanic Crust. Geochemistry, Geophysics, Geosystems, 21(1). doi:10.1029/2019gc008804 https://doi.org/10.1029/2019GC008804
Methods

Wheat, C. G., Jannasch, H. W., Kastner, M., Hulme, S., Cowen, J., Edwards, K. J., ... Glazer, B. (2011). Fluid sampling from oceanic borehole observatories: design and methods for CORK activities (19902010). Proceedings of the IODP. doi:10.2204/iodp.proc.327.109.2011
Methods

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Parameters

Parameter	Description	Units
Borehole_type_coil	Borehole, type and coil	unitless
Sample_number	Sample number	unitless
Date	Samling data in ISO format (yyyy-mm-dd)	unitless
Ba	Barium (Ba) concentration	micromoles per kg (umol/kg)
B	Boron (B) concentration	micromoles per kg (umol/kg)
Mn	Manganese (Mn) concentration	micromoles per kg (umol/kg)
Fe	Iron (Fe) concentration	micromoles per kg (umol/kg)
Li	Lithium (Li) concentration	micromoles per kg (umol/kg)
Si	Silicon (Si) concentration	micromoles per kg (umol/kg)
Longitude	Sampling location - longitude, west is negative	decimal degrees
Latitude	Sampling location - latitude, south is negative	decimal degrees

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Instruments

Dataset-specific Instrument Name	ICPOES
Generic Instrument Name	Inductively Coupled Plasma Optical Emission Spectrometer
Generic Instrument Description	Also referred to as an Inductively coupled plasma atomic emission spectroscope (ICP-AES). These instruments pass nebulised samples into an inductively-coupled gas plasma (8-10000 K) where they are atomised and excited. The de-excitation optical emissions at characteristic wavelengths are spectroscopically analysed. It is often used in the detection of trace metals.

Dataset-specific Instrument Name	ROV Jason-II
Generic Instrument Name	ROV Jason
Dataset-specific Description	OsmoSamplers that were recovered on R/V Atlantis Expedition AT39-01 with the ROV Jason-II
Generic Instrument Description	The Remotely Operated Vehicle (ROV) Jason is operated by the Deep Submergence Laboratory (DSL) at Woods Hole Oceanographic Institution (WHOI). WHOI engineers and scientists designed and built the ROV Jason to give scientists access to the seafloor that didn't require them leaving the deck of the ship. Jason is a two-body ROV system. A 10-kilometer (6-mile) fiber-optic cable delivers electrical power and commands from the ship through Medea and down to Jason, which then returns data and live video imagery. Medea serves as a shock absorber, buffering Jason from the movements of the ship, while providing lighting and a bird’s eye view of the ROV during seafloor operations. During each dive (deployment of the ROV), Jason pilots and scientists work from a control room on the ship to monitor Jason’s instruments and video while maneuvering the vehicle and optionally performing a variety of sampling activities. Jason is equipped with sonar imagers, water samplers, video and still cameras, and lighting gear. Jason’s manipulator arms collect samples of rock, sediment, or marine life and place them in the vehicle’s basket or on "elevator" platforms that float heavier loads to the surface. More information is available from the operator site at URL.

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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-1634025

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