Unprocessed holographic data of cryopeg fluids viewed at sub-micron resolution from Alaskan Arctic Coast Permafrost Tunnel and landfast sea ice from May 2017

Website: https://www.bco-dmo.org/dataset/817454
Data Type: Other Field Results
Version: 1
Version Date: 2020-07-01

Project
» Understanding How Virus Infection Affects Gene Flow and Microbial Evolution in Extreme Polar Environments (Arctic Subzero Brines)

Program
» Marine Microbiology Initiative (MMI)

Contributors	Affiliation	Role
Deming, Jody W.	University of Washington (UW)	Principal Investigator
Biddle, Mathew	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Unprocessed (raw) holographic data of cryopeg and sea ice brines viewed using a digital holographic microscope at sub-micron resolution. Samples collected from Alaskan Arctic Coast Permafrost Tunnel and landfast sea ice near Utqiagvik in May 2017.

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Coverage

Spatial Extent: **N**:71.473 **E**:-156.5049 **S**:71.2944 **W**:-156.7294
Temporal Extent: 2017-05-06 - 2017-05-10

Dataset Description

Brine samples were collected from both sea ice and cryopeg near Utqiaġvik, Alaska, USA. Snow and ice thickness along with sackhole core depth information are available for sea ice samples. Bacterial and viral abundances along with temperature, pH, salinity, inorganic nutrients, organic nutrients, EPS, and water isotopes were measured for select samples.

Methods & Sampling

Sackhole and cryopeg brines were collected according to Cooper et al., 2019 FEMS Environmental Microbiology and inserted into the holographic microscope using a syringe as described in Lindensmith et al., 2016 PLOS

One.

Experiments were completed at the sample site or in the field-laboratory using a chemotactic chamber as described in Lindensmith, et al., 2016 PLOS One. Chemical gradients of serine (prepared to 1 molar concentration in self-same salinity solution) or gradients of salinity (established from sample salinity to seawater) were used to stimulate taxis across the chamber, or the a heating block was used to create temperature gradients in a cold room. Motility was observed in the microscope sub-sampling over periods of seconds or hours, according to timestamp data (available in the hologram folder).

Data Processing Description

BCO-DMO Processing Notes:
- packaged all images into tar gzipped file.

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Data Files

File
Cryopeg Holographic Microscopy Images filename: images.tar.gz (GZIP (.gz), 29.82 GB) MD5:64834f891e9de0228564641b4546f63c Unprocessed holographic data of cryopeg fluids viewed at sub-micron resolution. Below is a list of the directories contained in the package with a brief description of the conditions. 2017.05.06 16-12 Sea ice sackhole brine in situ, (115 ppt) 2017.05.07 18-54 Cryopeg brine, -6C, diluted 1:100 in seawater 2017.05.07 19-11 Cryopeg brine, -6C, diluted 1:100 in seawater 2017.05.07 22-15 Sackhole brine 2, +5c, chemotaxis experiment toward 1 M serine 2017.05.08 01-06 Permafrost tunnel brine, room temperature 2017.05.08 01-14 Permafrost tunnel brine, room temperature 2017.05.08 01-18 Permafrost tunnel brine, room temperature 2017.05.08 22-46 Cryopeg brine, -6C 2017.05.08 23-00 Cryopeg brine, 5C 2017.05.09 01-23 Cryopeg brine, +4C 2017.05.09 02-53 Cryopeg brine, -1C, halotaxis experiment toward seawater salinity 2017.05.09 03-10 Cryopeg brine, -1C, thermotaxis experiment toward 32C 2017.05.09 03-12 Cryopeg brine, -1C, thermotaxis experiment toward 16C 2017.05.09 03-15 Cryopeg brine, -1C, thermotaxis experiment toward 8C 2017.05.09 12-39 Cryopeg brine, -1C, chemotaxis experiment toward 1 M serine 2017.05.10 01-39 Sackhole 2 brine, -1C, haloxtaxis experiment toward seawater salinity

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Related Publications

Cooper, Z. S., Rapp, J. Z., Carpenter, S. D., Iwahana, G., Eicken, H., & Deming, J. W. (2019). Distinctive microbial communities in subzero hypersaline brines from Arctic coastal sea ice and rarely sampled cryopegs.

FEMS Microbiology Ecology, 95(12). doi:10.1093/femsec/fiz166
Methods

Lindensmith, C. A., Rider, S., Bedrossian, M., Wallace, J. K., Serabyn, E., Showalter, G. M., … Nadeau, J. L. (2016). A Submersible, Off-Axis Holographic Microscope for Detection of Microbial Motility and Morphology in Aqueous and Icy Environments. PLOS ONE, 11(1), e0147700. doi:10.1371/journal.pone.0147700
Methods

Wallace, J. K., Rider, S., Serabyn, E., Kühn, J., Liewer, K., Deming, J., … Nadeau, J. (2015). Robust, compact implementation of an off-axis digital holographic microscope. Optics Express, 23(13), 17367. doi:10.1364/oe.23.017367 https://doi.org/10.1364/OE.23.017367
Methods

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Parameters

Parameters for this dataset have not yet been identified

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Instruments

Dataset-specific Instrument Name	holographic microscope
Generic Instrument Name	Digital inline holographic microscope
Dataset-specific Description	Sackhole and cryopeg brines were collected according to Cooper et al., 2019 FEMS Environmental Microbiology and inserted into the holographic microscope using a syringe as described in Lindensmith et al., 2016 PLOS One.
Generic Instrument Description	A Digital Inline Holographic Microscope (DIHM) uses coherent (laser) light and a digital camera to image objects with micrometer scale resolution. A portion of the light scattered by illuminated objects interferes with incident light in a predictable manner. The resulting interference patterns projected onto a two-dimensional plane (i.e. digital camera sensor) are recorded as holograms. These digital holograms are then numerically reconstructed to produce an in-focus image at a given distance from the recording plane. A relatively large illuminated volume (>100 mL) can be reconstructed in this manner to produce a single image with an extended depth of field.

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Project Information

Understanding How Virus Infection Affects Gene Flow and Microbial Evolution in Extreme Polar Environments (Arctic Subzero Brines)

GBMF Summary:

In support of developing a virus–bacterium–alga culture system and advancing methods to investigate how virus infection and stress impact gene flow and microbial evolution in cold, highly saline environments.

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Program Information

Marine Microbiology Initiative (MMI)

Website: https://www.moore.org/initiative-strategy-detail?initiativeId=marine-microbiology-initiative

A Gordon and Betty Moore Foundation Program.

Forging a new paradigm in marine microbial ecology:

Microbes in the ocean produce half of the oxygen on the planet and remove vast amounts of carbon dioxide, a greenhouse gas, from the atmosphere. Yet, we have known surprisingly little about these microscopic organisms. As we discover answers to some long-standing puzzles about the roles that marine microorganisms play in supporting the ocean's food webs and driving global elemental cycles, we realized that we still need to learn much more about what these organisms do and how they do it—including how they evolved and contribute to our ocean's health and productivity.

The Marine Microbiology Initiative seeks to gain a comprehensive understanding of marine microbial communities, including their diversity, functions and behaviors; their ecological roles; and their origins and evolution. Our focus has been to enable researchers to uncover the principles that govern the interactions among microbes and that govern microbially mediated nutrient flow in the sea. To address these opportunities, we support leaders in the field through investigator awards, multidisciplinary team research projects, and efforts to create resources of broad use to the research community. We also support development of new instrumentation, tools, technologies and genetic approaches.

Through the efforts of many scientists from around the world, the initiative has been catalyzing new science through advances in methods and technology, and to reduce interdisciplinary barriers slowing progress. With our support, researchers are quantifying nutrient pools in the ocean, deciphering the genetic and biochemical bases of microbial metabolism, and understanding how microbes interact with one another. The initiative has five grant portfolios:

Individual investigator awards for current and emerging leaders in the field.
Multidisciplinary projects that support collaboration across disciplines.
New instrumentation, tools and technology that enable scientists to ask new questions in ways previously not possible.
Community resource efforts that fund the creation and sharing of data and the development of tools, methods and infrastructure of widespread utility.
Projects that advance genetic tools to enable development of experimental model systems in marine microbial ecology.
We also bring together scientists to discuss timely subjects and to facilitate scientific exchange.

Our path to marine microbial ecology was a confluence of new technology that could accelerate science and an opportunity to support a field that was not well funded relative to potential impact. Around the time we began this work in 2004, the life sciences were entering a new era of DNA sequencing and genomics, expanding possibilities for scientific research – including the nascent field of marine microbial ecology. Through conversations with pioneers inside and outside the field, an opportunity was identified: to apply these new sequencing tools to advance knowledge of marine microbial communities and reveal how they support and influence ocean systems.

After many years of success, we will wind down this effort and close the initiative in 2021. We will have invested more than $250 million over 17 years to deepen understanding of the diversity, ecological activities and evolution of marine microbial communities. Thanks to the work of hundreds of scientists and others involved with the initiative, the goals have been achieved and the field has been profoundly enriched; it is now positioned to address new scientific questions using innovative technologies and methods.

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Funding

Funding Source	Award
Gordon and Betty Moore Foundation: Marine Microbiology Initiative (MMI)	GBMF5488

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