Geochemical data of permafrost brines from the Barrow Permafrost Tunnel in Utqiaġvik, Alaska

Website: https://www.bco-dmo.org/dataset/869472
Data Type: Other Field Results
Version: 1
Version Date: 2022-02-16

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
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Abstract
This dataset contains geochemical data of permafrost brines from the Barrow Permafrost Tunnel in Utqiaġvik, Alaska sampled from 2006 to 2018.

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Coverage

Spatial Extent: **Lat**:71.2945 **Lon**:-156.7154
Temporal Extent: 2006 - 2018

Methods & Sampling

Methodology:
Water stable isotopes were measured using a continuous-flow isotope ratio mass spectrometry. pH, salinity, and EC were measured by a LAQUAtwin (HORIBA). Ionic compositions of the brines and selected (melted) samples of massive ice and sediment pore water were determined by ion chromatography. Details of the methodology used for this dataset are described in Iwahana et al. (2021).

Sampling and Analytical Procedures:
We conducted two permafrost (including massive ground ice and frozen sediments) and cryopeg brine sampling campaigns in the permafrost tunnel (71.2945 N, 156.7154 W) in May of 2017 and 2018. We used brushes and spatulas to remove sample remains (ice and frozen or unfrozen sediment) from the geological tools prior to next use to avoid introducing sample material from one hole to another. During every drilling, the sampler was prewashed by massive ground ice until it reached permafrost or the brine-bearing layer. The recovered cores were subsampled into portions of 6 to 12 cm for geochemical analyses. When brine was encountered, we collected it until no further liquid could be withdrawn using a sterile pumping system (described by Cooper et al., 2019 as required for their microbial analyses, and in Supporting Information Text S3 of Iwahana et al., 2021). Collected massive ice and frozen sediments were labeled, packed, transferred without thawing, and kept frozen (below -20 ºC) until further subsampling and analyses (within a year) in the laboratory at the University of Alaska Fairbanks (UAF). All water samples were unfiltered.

Data Processing Description

BCO-DMO Processing:
- replaced "-" and "?" with "nd" (no data);
- renamed fields to comply with BCO-DMO naming conventions;
- converted dates to YYYY-MM-DD format;
- removed asterisks/comments from Sample_year field and moved to "remarks" column.

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Data Files

File
brine_geochem.csv (Comma Separated Values (.csv), 3.11 KB) MD5:16ee167dd19a67b5c9e6d987fbe99711 Primary data file for dataset ID 869472

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Related Publications

Colangelo-Lillis, J., Eicken, H., Carpenter, S. D., & Deming, J. W. (2016). Evidence for marine origin and microbial-viral habitability of sub-zero hypersaline aqueous inclusions within permafrost near Barrow, Alaska. FEMS Microbiology Ecology, 92(5), fiw053. doi:10.1093/femsec/fiw053
Methods

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

Iwahana, Cooper, Z. S., Carpenter, S. D., Deming, J. W., & Eicken, H. (2021). Intra-ice and intra-sediment cryopeg brine occurrence in permafrost near Utqiaġvik (Barrow). Permafrost and Periglacial Processes, 32(3), 427–446. Portico. https://doi.org/10.1002/ppp.2101
Results

Meyer, H., Schirrmeister, L., Andreev, A., Wagner, D., Hubberten, H.-W., Yoshikawa, K., Bobrov, A., Wetterich, S., Opel, T., Kandiano, E., & Brown, J. (2010). Lateglacial and Holocene isotopic and environmental history of northern coastal Alaska – Results from a buried ice-wedge system at Barrow. Quaternary Science Reviews, 29(27–28), 3720–3735. https://doi.org/10.1016/j.quascirev.2010.08.005
Methods

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Related Datasets

IsRelatedTo

Deming, J. W., Eicken, H., Iwahana, G. (2022) **Geochemical data of ground ice and pore water in frozen sediments from the Barrow Permafrost Tunnel in Utqiaġvik, Alaska in 2017 and 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-02-16 doi:10.26008/1912/bco-dmo.869389.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Location	Sampled location	unitless
Sample_ID	Sample ID	unitless
Material	Sample material type	unitless
Type	Type of water sample	unitless
Top	Top depth of sample	centimeters (cm)
Bottom	Bottom depth of sample	centimeters (cm)
Sample_date	Sample date in format YYYY-MM-DD (or for some samples, just year in format YYYY)	unitless
dD	Duterium ratio in VSMOW	per mil (‰)
d18O	18O ratio in VSMOW	per mil (‰)
d_excess	Duterium excess (dD - 8*d18O)	per mil (‰)
pH	pH of water sample	unitless
Electric_conductivity	Electric conductivity of water sample	milliSiemens per centimeter (mS/cm)
Salinity	Salinity of water sample	ppt
Ca2_plus	[Ca2+] ion conrentration	ppm
Mg2_plus	[Mg2+] ion conrentration	ppm
K_plus	[K+] ion conrentration	ppm
Na_plus	[Na+] ion conrentration	ppm
Cl_minus	[Cl-] ion conrentration	ppm
SO42_minus	[SO42-] ion conrentration	ppm
remarks	Remarks or comments	unitless

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Instruments

Dataset-specific Instrument Name	Horiba B-771 LAQUAtwin Conductivity Meter
Generic Instrument Name	Conductivity Meter
Generic Instrument Description	Conductivity Meter - An electrical conductivity meter (EC meter) measures the electrical conductivity in a solution. Commonly used in hydroponics, aquaculture and freshwater systems to monitor the amount of nutrients, salts or impurities in the water.

Dataset-specific Instrument Name	various types of corers
Generic Instrument Name	Ice Corer
Dataset-specific Description	A cordless electrical drill was used with various types of corers (including US Snow, Ice and Permafrost Research Establishment [SIPRE] corer manufactured by Jon's Machine Shop, Fox, Alaska) to sample permafrost below the tunnel floor.
Generic Instrument Description	An ice corer is used to drill into deep ice and remove long cylinders of ice from which information about the past and present can be inferred. Polar ice cores contain a record of the past atmosphere - temperature, precipitation, gas content, chemical composition, and other properties. This can reveal a broad spectrum of information on past environmental, and particularly climatic, changes. They can also be used to study bacteria and chlorophyll production in the waters from which the ice core was extracted.

Dataset-specific Instrument Name	ion chromatography
Generic Instrument Name	Ion Chromatograph
Dataset-specific Description	Ionic compositions of the brines and selected (melted) samples of massive ice and sediment pore water were determined by ion chromatography.
Generic Instrument Description	Ion chromatography is a form of liquid chromatography that measures concentrations of ionic species by separating them based on their interaction with a resin. Ionic species separate differently depending on species type and size. Ion chromatographs are able to measure concentrations of major anions, such as fluoride, chloride, nitrate, nitrite, and sulfate, as well as major cations such as lithium, sodium, ammonium, potassium, calcium, and magnesium in the parts-per-billion (ppb) range. (from http://serc.carleton.edu/microbelife/research_methods/biogeochemical/ic....)

Dataset-specific Instrument Name	continuous-flow isotope ratio mass spectrometry
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Water stable isotopes were measured using a continuous-flow isotope ratio mass spectrometry.
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	B-712 LAQUAtwin Compact pH Meter
Generic Instrument Name	pH Sensor
Generic Instrument Description	An instrument that measures the hydrogen ion activity in solutions. The overall concentration of hydrogen ions is inversely related to its pH. The pH scale ranges from 0 to 14 and indicates whether acidic (more H+) or basic (less H+).

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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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