Physical profiles of temperature, salinity, and brine volume in sea ice from samples collected on R/V Nathaniel B. Palmer cruise NBP1910 along the Western Antarctic Peninsula from November to December 2019

Website: https://www.bco-dmo.org/dataset/913655
Data Type: Cruise Results
Version: 1
Version Date: 2023-10-23

Project
» Spring Blooms of Sea Ice Algae Along the Western Antarctic Peninsula: Effects of Warming and Freshening on Cell Physiology and Biogeochemical Cycles. (Controls on Sea-Ice Algae (COSA))

Contributors	Affiliation	Role
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Abstract
This dataset includes physical profiles of temperature, salinity, and brine volume in sea ice from samples collected on R/V Nathaniel B. Palmer cruise NBP1910 along the Western Antarctic Peninsula from November to December 2019.

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Coverage

Spatial Extent: **N**:-66.523 **E**:-67.281 **S**:-67.774 **W**:-68.196
Temporal Extent: 2019-11-21 - 2019-12-05

Methods & Sampling

Field sampling:
Ice samples for primary production measurements were collected mid-morning from 6 stations along the western Antarctic Peninsula in November and December of 2019 on board the R/V Nathaniel B. Palmer along a north-south transect from 64.8°S to 67.8°S. For Stations (Stns) 2 and 3, the ice was "rotten" (sufficiently melted to be disintegrating structurally, present only in small pieces) and collected as an ice–seawater slurry so no profile was collected. Stns 4 and 7 were rafted floes with a flooded internal layer, with Stn 7 > square meters (m^2) in size. Stns 5 and 6 were on landfast sea ice, where the algae were collected from the bottom 10 centimeters (cm) of the ice. At these 4 stations (Stns 4-7), ice cores were taken with a 7.5 cm Kovacs corer separated by at least 1 meter (m) horizontally. At Stns 5-7, "physical cores" were taken and temperature was measured with a digital thermometer with a probe at 5 cm intervals along physical cores, which were then cut into 5 cm sections and placed in separate Whirlpak bags for conductivity measurements measured with both a

refractometer and conductivity probe after melting. Brine volumes and salinity were calculated from bulk salinity and temperature (Frankenstein and Garner 1967; Cox and Weeks 1986).

Data Processing Description

Measured temperature was used to calculate brine salinity according to Cox and Weeks (1986). Brine salinity and measured bulk salinity were used to calculate brine volume using Frankenstein and Garner (1967).

BCO-DMO Processing Description

- Imported original file "Phys_cores_Temp_Sal.xlsx" into the BCO-DMO system.
- Flagged '*', 'NA', and '#VALUE!' as missing data values (missing data are blank/empty in the final CSV file).
- Concatenated data from separate sheets (one per core) into one dataset, creating columns for Station and Core.
- Renamed fields to comply with BCO-DMO naming conventions.
- Added columns for station Latitude, Longitude, and Date as provided in the metadata.
- Saved the final file as "913655_v1_physical_profiles.csv".

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Data Files

File	
913655_v1_physical_profiles.csv	(Comma Separated Values (.csv), 19.64 KB) MD5:5a5fef4ee518ba4897600e88bf3ad19c
Primary data file for dataset ID 913655, version 1.	

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Related Publications

Cox, G. F. N., & Weeks, W. F. (1986). Changes in the Salinity and Porosity of Sea-Ice Samples During Shipping and Storage. Journal of Glaciology, 32(112), 371–375. https://doi.org/10.3189/s0022143000012065
https://doi.org/10.3189/S0022143000012065
Methods

Frankenstein, G., & Garner, R. (1967). Equations for Determining the Brine Volume of Sea Ice from −0.5° to −22.9°C. Journal of Glaciology, 6(48), 943–944. https://doi.org/10.3189/s0022143000020244
https://doi.org/10.3189/S0022143000020244
Methods

Young, Jodi N., Rundell, Susan, Cooper, Zachary S., Dawson, Hannah M., Carpenter, Shelly D., Ryan-Keogh, Thomas, Rowland, Elden, Bertrand, Erin M., Deming, Jody W. (in review) Photosynthetic processes in Antarctic sea ice during the spring melt. Limnology and Oceanography.
Results

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Parameters

Parameter	Description	Units
Station	station number	unitless

Core	core replicate (A or B)	unitless
Latitude	latitude where sample was collected; negative values = South	decimal degrees
Longitude	longitude where sample was collected; negative values = West	decimal degrees
Date	date sample was collected	unitless
Station_Description	description of station/sample	unitless
Depth_cm	depth from ice surface measurement was taken	centimeters (cm)
temp_range_for_calculations	temperature range from Cox and Weeks that is applicable to our dataset	degrees Celsius
Temperature	measured temperature	degrees Celsius
Brine_salinity	brine salinity calculated from temperature from Cox and Weeks (1986)	unitless
Bulk_Salinity	measured bulk salinity from conductivity probe	unitless
brine_volume_fraction_Cox_Weeks	calculated brine volume from brine volume and core volume; calculated using the equations from Cox and Weeks (1983)	unitless (ratio)
Ice_density	ice density from Cox and Weeks (1983)	milligrams per cubic meter (mg/m-3)
F1	constants from Cox and Weeks (1983)	milligrams per cubic meter (mg/m-3)
F2	constants from Cox and Weeks (1983)	milligrams per cubic meter (mg/m-3)
Core_volume	measured bulk volume of sea ice sample	milliliters (mL)
Brine_Volume	calculated brine volume from (Frankenstien and Gardner, 1967)	milliliters (mL)

brine_volume_fraction_Frankenstein_Garner	calculated brine volume from brine volume and core volume; calculated using the equation from Frankenstein and Gardner (1967)	unitless (ratio)

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Instruments

Dataset-specific Instrument Name	
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	
Generic Instrument Name	digital thermometer
Generic Instrument Description	An instrument that measures temperature digitally.

Dataset-specific Instrument Name	
Generic Instrument Name	Ice Corer
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.

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Deployments

NBP1910

Website	https://www.bco-dmo.org/deployment/913227
Platform	RVIB Nathaniel B. Palmer
Start Date	2019-11-01
End Date	2019-12-15
Description	See more information in R2R: https://www.rvdata.us/search/cruise/NBP1910

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Project Information

Spring Blooms of Sea Ice Algae Along the Western Antarctic Peninsula: Effects of Warming and Freshening on Cell Physiology and Biogeochemical Cycles. (Controls on Sea-Ice Algae (COSA))

Coverage: Western Antarctic Peninsula

NSF Award Abstract
Rapid changes in the extent and thickness of sea ice during the austral spring subject microorganisms within or attached to the ice to large fluctuations in temperature, salinity, light and nutrients. This project aims to identify cellular responses in sea-ice algae to increasing temperature and decreasing salinity during the spring melt along the western Antarctic Peninsula and to determine how associated changes at the cellular level can potentially affect dynamic, biologically driven processes. Understanding how sea-ice algae cope with, and are adapted to, their environment will not only help predict how polar ecosystems may change as the extent and thickness of sea ice change, but will also provide a better understanding of the widespread success of photosynthetic life on Earth. The scientific context and resulting advances from the research will be communicated to the general public through outreach activities that includes work with Science Communication Fellows and the popular Polar Science Weekend at the Pacific Science Center in Seattle, Washington. The project will provide student training to college students as well as provide for educational experiences for K-12 school children.

There is currently a poor understanding of feedback relationships that exist between the rapidly changing environment in the western Antarctic Peninsula region and sea-ice algal production. The large shifts in temperature and salinity that algae experience during the spring melt affect critical cellular processes, including rates of enzyme-catalyzed reactions involved in photosynthesis and respiration, and the production of stress-protective compounds. These changes in cellular processes are poorly constrained but can be large and may have impacts on local ecosystem productivity and biogeochemical cycles. In particular, this study will focus on the thermal sensitivity of enzymes and the cycling of compatible solutes and exopolymers used for halo- and cryo-protection, and how they influence primary production and the biogeochemical cycling of carbon and nitrogen. Approaches will include field sampling during spring melt, incubation experiments of natural sea-ice communities under variable temperature and salinity conditions, and controlled manipulation of sea-ice algal species in laboratory culture. Employment of a range of techniques, from fast repetition rate fluorometry and gross and net photosynthetic measurements to metabolomics and enzyme kinetics, will tease apart the mechanistic effects of temperature and salinity on cell metabolism and primary production with the goal of quantifying how these changes will impact biogeochemical processes along the western Antarctic Peninsula.

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 Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1744645

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