Particulate organic carbon and particulate nitrogen 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/913566
Data Type: Cruise Results
Version: 1
Version Date: 2023-10-17

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 concentrations of particulate organic carbon (POC) and particulate nitrogen (PN) from samples collected on R/V Nathaniel B. Palmer cruise NBP1910 along the Western Antarctic Peninsula from November to December 2019.

Table of Contents

Coverage

Spatial Extent: **N**:-64.805 **E**:-64.02 **S**:-67.774 **W**:-68.196
Temporal Extent: 2019-11-10 - 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. Small ice chunks were collected directly from the sea surface via a crane-suspended "personnel basket". At the additional 4 stations, sea ice was collected by coring the ice. At Stns 4 and 7, algal samples were collected from internal ice-core layers. Stns 4 and 7 were rafted floes with a flooded internal layer, with Stn 7 > 2500 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 through 7), ice cores were taken with a 7.5 cm Kovacs corer separated by at least 1 m horizontally. Cores were shaded from direct sunlight, while 5 to 10 cm of the

visible algal band at the bottom or middle was sectioned with an ethanol-cleaned saw and placed into acid-washed (10% HCl) containers. Each replicate consisted of either a single core (for 10 cm sections) or pools of two cores (for 5 cm sections).

All ice samples were stored in dark, insulated containers for a maximum of 4 hours. On the ship, all ice samples used for primary production measurements were melted in a 3:1 volumetric ratio of melting solution to ice to minimize the effect of the melt on sea-ice communities. The melting solution was a 0.2 micrometer (µm) filtered artificial salt mixture containing three main sea salts plus bicarbonate according to ESAW artificial seawater (3.63×10^{-1} molar (M) NaCl, 4.71×10^{-2} M $MgCl_2.6H_2O$, 2.5×10^{-2} M Na_2SO_4, and 2×10^{-3} M $NaHCO_3^-$, salinity 35). Additional ice cores collected for ancillary biological measurements were melted in a 1:1 volumetric ratio of melting solution to ice. Melts were conducted in the dark at approximately 20° Celsius (C). To speed the melting process, ice samples were further broken into pieces with acid-washed pickaxes with most ice completely melted within 5 hours. Volume and salinity were measured as soon as the ice was completely melted, with sample temperatures remaining below 0°C. All reported volumes were corrected to the original ice volume.

POC and PN:
All samples were collected and processed according to protocols of the Marine Chemistry Laboratory (MCL) at the University of Washington. Samples for particulate organic carbon (POC) and particulate nitrogen (PN) were filtered through combusted (450°C, 4 hours) 25-millimeter (mm) glass fiber filters (GF/F, pore size 0.7 µm pre-combustion) and frozen at -80°C until analysis. Following fuming with HCl to remove inorganic carbon, POC and PN were measured on a CEC440 Elemental Analyzer. For nutrients, ~50 milliliters (mL) of samples were filtered through surfactant-free cellulose syringe filters (25 mm, 0.45 µm, Nalgene) with filtrate collected in sample-rinsed HDPE bottles and frozen at -20°C until analyzed using a Technicon AutoAnalyzer II at MCL. Trace metals were not measured. While every effort was done to minimize trace metal contamination, the ice corer is metal and the facilities are not trace metal clean. Blanks for the collection protocol (bottles, filters) and for the melting solution were subtracted from all samples. Unless otherwise stated, all values were reported as concentrations within bulk ice (ice plus brine).

Data Processing Description

Protocols can be found at the University of Washington, Marine Chemistry labs website:
https://www.ocean.washington.edu/story/Marine_Chemistry_Laboratory

BCO-DMO Processing Description

- Imported original file "POC_PN.csv" into the BCO-DMO system.
- Flagged 'nan' as a missing data value (missing data are blank/empty in the final CSV file).
- Converted the Date field to YYYY-MM-DD format.
- Split the Location column into two separate columns for Latitude and Longitude and made the values negative (for South and West directions).
- Renamed fields to comply with BCO-DMO naming conventions.
- Saved the final file as "913566_v1_poc_pn.csv".

[table of contents | back to top]

Data Files

File
913566_v1_poc_pn.csv (Comma Separated Values (.csv), 1.90 KB) MD5:a77b3f42b4098beb7c7163b3dc8c2d7c Primary data file for dataset ID 913566, version 1.

[table of contents | back to top]

Related Publications

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

[table of contents | back to top]

Parameters

Parameter	Description	Units
Date	date sample was collected	unitless
Latitude	latitude where sample was collected; negative values = South	decimal degrees
Longitude	longitude where sample was collected; negative values = West	decimal degrees
Description	short description of the sample	unitless
Station_Label	unique identifier of sample	unitless
particulate_organic_carbon_av	Average concentration of particulate organic carbon in moles per litre of bulk sea ice	moles per liter (mol/L)
particulate_organic_carbon_stdev	Standard deviation of the concentration of particulate organic carbon in moles per litre of bulk sea ice	moles per liter (mol/L)
particulate_nitrogen_av	Average concentration of particulate nitrogen in moles per litre of bulk sea ice	moles per liter (mol/L)
particulate_nitrogen_stdev	Standard deviation of the concentration of particulate nitrogen in moles per litre of bulk sea ice	moles per liter (mol/L)
no_replicates	number of replicates for each sample	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	CEC440 Elemental Analyzer
Generic Instrument Name	Elemental Analyzer
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

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.

Dataset-specific Instrument Name	
Generic Instrument Name	Technicon AutoAnalyzer II
Generic Instrument Description	A rapid flow analyzer that may be used to measure nutrient concentrations in seawater. It is a continuous segmented flow instrument consisting of a sampler, peristaltic pump, analytical cartridge, heating bath, and colorimeter. See more information about this instrument from the manufacturer.

[table of contents | back to top]

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

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

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

[table of contents | back to top]