DOC and TOC of seawater collected during CCGS John P. Tully cruises in the northeast Pacific Ocean from Vancouver Island to Station P from 2018 to 2020

Website: https://www.bco-dmo.org/dataset/865829
Data Type: Cruise Results
Version: 1
Version Date: 2021-12-06

Project
» Constraining Upper-Ocean Carbon Export with Biogeochemical Profiling Floats (EXPORTS BGC Floats)

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Abstract
This dataset includes observations of dissolved organic carbon and total organic carbon from seawater samples collected during CCGS John P. Tully cruises from 2018 to 202 in the northeast Pacific Ocean from Vancouver Island to Station P.

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Coverage

Spatial Extent: **N**:50.613 **E**:-125.998 **S**:48.598 **W**:-145.002
Temporal Extent: 2018-09-13 - 2020-02-17

Methods & Sampling

Samples
Sampling was conducted aboard the CCGS John P. Tully during five cruises (2018-2020) in the northeast Pacific Ocean from Vancouver Island to Station P (50°N, 145°W).
Fisheries and Oceans Canada (DFO) Cruise numbers: 2018-40, 2019-001, 2019-006, 2019-008, 2020-001

Seawater samples for dissolved and total organic carbon (DOC, TOC) were collected from 10 L Niskin bottles into pre-cleaned 40 mL scintillation vials, with 0.125 cm Teflon low-bleed septa. The vials had been cleaned in Extran 300 and rinsed several times with Type I Ultrapure water. Vials were then soaked in 10% HCl for a minimum of four hours and rinsed several times with Type I Ultrapure water. Cleaned vials were allowed to dry and were then baked at 450°C for a minimum of 5 hours. Septa were briefly washed in 10% HCl, rinsed with Type I Ultrapure water and allowed to air dry.

Samples for TOC were collected directly from the spigot of the Niskin bottle. Samples for DOC were filtered through a Millipore Opticap XL Durapore 0.22 µm inline filter cartridge (Product No. KVGLA04HH3) attached to the spigot. Vials were rinsed three times with sample water and then filled to about three-quarter capacity, to avoid breakage during freezing. The samples were quick-frozen immediately after collection, using a stainless-steel freezer block, and then stored frozen at -20°C until analysis.

DOC and TOC were measured at the Institute of Ocean Sciences, using a Shimadzu TOC-L DOC/TOC analyzer (measurement reproducibilty of ± 1.5 %), following Standard Operating Procedure 7 from Chapter 4 in Dickson et al. (2007), with the following modifications: 1) sulphuric acid was used in place of phosphoric acid to reduce vitrification of the column with saline samples; and 2) the sparging time was increased to 150 seconds.

Standards

- A 1000ppm standard of potassium hydrogen phthalate was prepared using Type 1 water (defined below). The standard stock solution was stored refrigerated for up to 2 months.
- Standard dilutions were done by calibrated pipette into volumetric flasks. They were made with Type 1 water that had been further processed to reduce TOC into the 2-3 ppb range. Dilution standards have a shelf life of two weeks. The very low standard concentrations (0.1-0.5 ppm) were made in larger volume flasks to reduce the errors associated with pipetting small amounts.
- Type I - Ultrapure, Type I water is defined by the American Society for Testing and Materials (ASTM) as having a resistivity of >18 MΩ-cm, a conductivity of <0.056 µS/cm and <50 ppb of Total Organic Carbons (TOC).
- Low Carbon Water (LCW) is a purchased, 2 µM, reference standard used to determine the instrument blank. Miami Seawater is a purchased, 42-45 µM, reference standard used to determine when the column/instrument was running cleanly enough to measure low concentrations in seawater.

Data Processing Description

Raw voltage peak areas were converted to organic carbon concentration, using a standard curve (0–176.7 µM). The calculated concentration of the LCW water minus 2 µM was subtracted as an instrument blank. Calculations were done using Microsoft Excel.

Problem/Error report:
Data from a few stations were omitted. These reflected missing data or suspected mislabeling of samples.

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BCO-DMO Processing:

- Imported data from source file "LineP_DOCTOC.xlsx.xlsx" into the BCO-DMO data system.
- Data file imported using missing data identifier "NaN”. The missing data identifier "NaN" in the original source file will be displayed as appropriate based on the type of file you download from the BCO-DMO data system. For example, missing data will be shown as blank (null) values in the csv files. In MATLAB .mat files it will be displayed as NaN. When viewing data at BCO-DMO the missing value will be shown as "nd" meaning "no data."
- Combined separate date and time columns to single datetime column with ISO8601 format.
- Added column for vessel/ship
- Added conventional header with dataset name, PI name, version date.
- Modified parameter (column) names to conform with BCO-DMO naming conventions. (The only allowed characters are A-Z,a-z,0-9, and underscores. No spaces, hyphens, commas, parentheses, or Greek letters).

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Data Files

File
doc_toc.csv(Comma Separated Values (.csv), 27.34 KB) MD5:9641491bf8e77791cf5a94d300e3545c Primary data file for dataset ID 865829

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Related Publications

Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. Guide to Best Practices for Ocean CO2 Measurements. PICES Special Publication 3, 191 pp https://isbnsearch.org/isbn/1-897176-07-4
Methods

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Related Datasets

IsRelatedTo

Fassbender, A. J., Johannessen, S., Long, J. S., Wright, C. (2021) **Dissolved and particulate carbon and nitrogen data from seawater collected during CCGS John P. Tully cruises in the northeast Pacific Ocean from Vancouver Island to Station P from 2018 to 2020.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-12-07 doi:10.26008/1912/bco-dmo.865893.1 [view at BCO-DMO]

Fassbender, A. J., Long, J. S., Takeshita, Y. (2021) **Underway pH of seawater sampled during CCGS John P. Tully cruises in the northeast Pacific Ocean from Vancouver Island to Station P from 2019 to 2020.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-12-13 doi:10.26008/1912/bco-dmo.866582.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
ISO_DateTime_UTC	Date and time in ISO8601 standard format (YYYY-MM-DDThh:mm:ssZ)	unitless
Vessel	Vessel	unitless
Cruise_ID	Cruise	unitless
Station	Station number	unitless
Sample_Number	Sample number	unitless
Latitude	Latitude of sample collection	decimal degrees
Longitude	Longitude of sample collection	decimal degrees
Depth	Depth of sample collection	meters (m)
DOC	Dissolved organic carbon	micromoles (uM)
DOC_QF	Quality Flag for DOC measurement where 2=acceptable; 3=questionable; 4=bad; 5=not reported; 6=mean of replicates; 9=not sampled	unitless
TOC	Total organic carbon	micromoles (uM)
TOC_QF	Quality Flag for TOC measurement where 2=acceptable; 3=questionable; 4=bad; 5=not reported; 6=mean of replicates; 9=not sampled	unitless

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Instruments

Dataset-specific Instrument Name	Niskin bottle
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Seawater samples for dissolved and total organic carbon were collected from 10 L Niskin bottles
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	Shimadzu TOC-L DOC/TOC analyzer
Generic Instrument Name	Shimadzu TOC-L Analyzer
Dataset-specific Description	DOC and TOC were measured at the Institute of Ocean Sciences, using a Shimadzu TOC-L DOC/TOC analyzer
Generic Instrument Description	A Shimadzu TOC-L Analyzer measures DOC by high temperature combustion method. Developed by Shimadzu, the 680 degree C combustion catalytic oxidation method is now used worldwide. One of its most important features is the capacity to efficiently oxidize hard-to-decompose organic compounds, including insoluble and macromolecular organic compounds. The 680 degree C combustion catalytic oxidation method has been adopted for the TOC-L series. http://www.shimadzu.com/an/toc/lab/toc-l2.html

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Deployments

Line-P_cruises

Website	https://www.bco-dmo.org/deployment/744516
Platform	CCGS John P. Tully
Description	Line P is an oceanic transect of 26 periodically sampled stations running from southern Vancouver Island to "Ocean Station Papa", situated at 50°N 145°W. Ocean (Weather) Station Papa, station P26, was originally operated as an ocean weather station from December of 1949 through 1981. After 1981, the Line-P / Station-P program was then taken over by the Institute of Ocean Sciences from Fisheries and Oceans Canada (DFO). While hydrographic (CTD-based) measurements are made at all of the 26 sites, water chemistry (bottle rosettes) and plankton (bongo) samples are only made at stations P4, P8, P12, P16, P20, and P26. Of those expanded sampling variables sites, all but P8 are featured in this web summary. See: https://www.st.nmfs.noaa.gov/copepod/time-series/ca-50903/ https://www.waterproperties.ca/linep/index.php

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Project Information

Constraining Upper-Ocean Carbon Export with Biogeochemical Profiling Floats (EXPORTS BGC Floats)

Coverage: Eastern Subarctic Pacific near Ocean Station Papa (50°N, 145°W)

OCE-1756932 Start Date: 2018-03-01
OCE-2032754 Start Date: 2020-05-28

NSF abstract:
A goal in chemical oceanography is to advance our understanding of the global carbon cycle, specifically to quantify the transfer of carbon from the surface ocean to depth through the sinking of particles produced by marine organisms. Yet, modern global estimates of this process (commonly called carbon export) differ by over 100%. These estimates are often derived from regional relationships between ocean measurements and satellite observations that are then applied globally. Persistent differences between the satellite and field-based estimates of carbon export have been found throughout the ocean, suggesting that improvements are needed. This project will determine whether profiling floats equipped with chemical sensors can be used to estimate the export of carbon in the ocean. Floats will be deployed at Ocean Station Papa, but the approach is scalable in nature and could be used to validate and improve the satellite algorithms used for global carbon export determinations. The project will support a female, early career scientist and a postdoc, as well as facilitate international collaboration with Canadian scientists. Additionally, the results may assist the National Aeronautics and Space Administration (NASA) EXPORTS campaign as well as other satellite carbon export development efforts.

Modern global estimates of the biological pump differ by over 100% (~5 to >12 Pg C yr-1) making it challenging to determine the role of marine biogeochemical (BGC) cycling in modern climate and climate variability. Global carbon export estimates are often derived from regional empirical relationships between field and satellite observations that are then applied globally. Persistent discrepancies between unique satellite algorithms and unique geochemical approaches suggest that accurately quantifying the biological pump remains a fundamental research goal. This project will assess the capability of using BGC profiling floats to estimate the export of distinct biogenic carbon pools (dissolved and particulate organic carbon, and particulate inorganic carbon). By using BGC floats to close multiple upper ocean tracer budgets this project will address two known issues common to other geochemical approaches: assumptions about (1) dissolved organic carbon cycling and (2) the integration depth used for annual carbon export assessments. The method will be tested at Ocean Station Papa, but is scalable in nature and could be used to develop a carbon export database suitable for the validation and training of satellite algorithms required for global carbon export determinations. Results from the floats will be compared to satellite carbon export algorithm estimates over the 5-year float lifetimes. Ten years of existing BGC data from profiling floats and a mooring in the region will also be used to provide further context about interannual variability.

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 Division of Ocean Sciences (NSF OCE)	OCE-2032754
NSF Division of Ocean Sciences (NSF OCE)	OCE-1756932

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