Concentrations and radiocarbon signatures of SPE-DOC extracted from seawater samples on GO-SHIP cruises P16N, P18, and IO7N in the North Pacific, Eastern Pacific, and Western Indian Oceans

Website: https://www.bco-dmo.org/dataset/853101
Data Type: Cruise Results
Version: 1
Version Date: 2021-06-28

Project
» Cycling of Dissolved Organic Matter in the Pacific and Indian Oceans Using Radiocarbon (DOC 14C and 13C)

Contributors	Affiliation	Role
Druffel, Ellen R.M.	University of California-Irvine (UC Irvine)	Principal Investigator, Contact
Lewis, Christian Blair	University of California-Irvine (UC Irvine)	Student
Heyl, Taylor	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset includes concentrations and radiocarbon signatures of solid-phase extracted dissolved organic carbon (SPE-DOC) from seawater samples. Water samples were collected on GO-SHIP cruises P16N, P18, and IO7N in the North Pacific, Eastern Pacific, and Western Indian Oceans from 2015 to 2018.

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Coverage

Spatial Extent: **N**:56.7 **E**:68.5 **S**:-69 **W**:-152
Temporal Extent: 2015-04-10 - 2018-06-06

Methods & Sampling

Seawater was sampled from Niskin bottles on GO-SHIP P16N, P18, and IO7N cruises using acid-cleaned silicone tubing (soaked in 10% HCl). Seawater from depths shallower than 200m was filtered using pre-combusted Whatman GF/F 0.7 micrometer (µm) filters. Solid-phase extracted dissolved organic carbon (SPE-DOC) was extracted using Bond Elut PPL 1 gram resins and established protocols (Dittmar et al., 2008). On

P18 and IO7N, SPE-DOC was extracted on the vessel. Seawater from P16N was stored frozen until processing at the laboratory at University of California, Irvine (UCI).

SPE-DOC elutions in methanol follow established protocols (Dittmar et al., 2008), that have been slightly adapted to increase carbon yields (Lewis et al., 2020). After elution, SPE-DOC was dried using a centrifugal evaporator, sealed on a vacuum line, and combusted at 850C for 2 hours. SPE-DOC concentrations were measured manometrically on a vacuum line, and radiocarbon measurements were performed at the Keck Carbon Cycle Accelerator Mass Spectrometry Lab at the University of California, Irvine.

Refer to "Related Datasets" for the related Niskin bottle data from these GO-SHIP cruises. Seawater from multiple Niskin bottles was integrated for solid-phase extraction. The stations and depth ranges listed (between the minimum and maximum depths) refer to the Niskin bottles from the GO-SHIP bottle file in related datasets.

Data Processing Description

Data were processed using Microsoft Excel spreadsheets. SPE-DOC PPL recovery was calculated by dividing [SPE-DOC] by total [DOC]. Total [DOC] measurements can be found at https://doi.org/10.7289/v5cv4g1w or in (Druffel et al., 2021) currently in press at *Geophysical Research Letters.*

BCO-DMO Processing Description:
- Adjusted field/parameter names to comply with BCO-DMO naming conventions
- Missing data identifier '-999' replaced with 'nd'
- Added a conventional header with dataset name, PI names, version date

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Data Files

File
SPE-DOC.csv (Comma Separated Values (.csv), 4.25 KB) MD5:f7bf4ceb502f14fcc620310112b265d8 Primary data file for dataset ID 853101

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Related Publications

Dittmar, T., Koch, B., Hertkorn, N., & Kattner, G. (2008). A simple and efficient method for the solid-phase extraction of dissolved organic matter (SPE-DOM) from seawater. Limnology and Oceanography: Methods, 6(6), 230–235. doi:10.4319/lom.2008.6.230
Methods

Druffel, E. R. M., Griffin, S., Lewis, C. B., Rudresh, M., Garcia, N. G., Key, R. M., … Walker, B. D. (2021). Dissolved Organic Radiocarbon in the Eastern Pacific and Southern Oceans. Geophysical Research Letters, 48(10). doi:10.1029/2021gl092904 https://doi.org/10.1029/2021GL092904
Results

Lewis, C. B., Walker, B. D., & Druffel, E. R. M. (2020). Isotopic and optical heterogeneity of solid phase extracted marine dissolved organic carbon. Marine Chemistry, 219, 103752. doi:10.1016/j.marchem.2020.103752
Methods

Lewis, C. B., Walker, B. D., & Druffel, E. R. M. (2021). New Radiocarbon Constraints on the Global Cycling of Solid-Phase Extractable Dissolved Organic Carbon. Geophysical Research Letters, 48(14). doi:10.1029/2020gl090995 https://doi.org/10.1029/2020GL090995
Results

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Related Datasets

IsRelatedTo

Lewis, C. B., Walker, B. D., Druffel, E. R. (2024) **Stable carbon isotopic signatures of solid-phase extracted DOC from seawater collected on three GO-SHIP Repeat Hydrography Cruises in 2015-2018 along transects P16N, P18, and I07N.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-04-09 doi:10.26008/1912/bco-dmo.924605.1 [view at BCO-DMO]

IsSupplementedBy

Cross, J. (2015). P16N/1 2015 [Data set]. CCHDO: CLIVAR and Carbon Hydrographic Data Office. https://doi.org/10.7942/C2WC7C

Rolf Sonnerup, B. C. (2016). P18 2016 [Data set]. CCHDO: CLIVAR and Carbon Hydrographic Data Office. https://doi.org/10.7942/C21T0F

Volkov, D. L. (2018). I07N 2018 [Data set]. CCHDO: CLIVAR and Carbon Hydrographic Data Office. https://doi.org/10.7942/C25H2B

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Parameters

Parameter	Description	Units
UCI_AMS_Number	UCI AMS Number (ID number from the Keck CCAMS Lab)	unitless
UCID	UCID: Identification number from Druffel Research Group	unitless
GO_SHIP_Cruise	GO-SHIP Cruise identifier	unitless
Latitude	Latitude (North)	decimal degrees
Longitude	Longitude (West is negative)	decimal degrees
Station	Station	unitless
Sample_Depth_Range	Sample depth range mininum (SPE-DOC was extracted from seawater compiled from a few Niskin bottles)	meters
SPE_DOC	Solid-phase extracted dissolved organic carbon (SPE-DOC) concentration	micromoles per liter (uM)
SPE_DOC_std_err	Standard error	micromoles per liter (uM)
SPE_DOC_Fraction_Modern	SPE-DOC Fraction Modern	dimensionless
SPE_DOC_Fraction_Modern_std_err	Standard error	dimensionless
SPE_DOC_delta_14C	SPE-DOC radiocarbon signature	permil (0/00)
SPE_DOC_delta_14C_std_err	Standard error	permil (0/00)
PPL_Recovery	The percent of total organic matter that was captured through solid-phase extraction	percent (%)
PPL_Recovery_std_err	Standard error	percent (%)

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Accelerator Mass Spectrometer
Dataset-specific Description	SPE-DOC delta14C values measured using Accelerator Mass Spectrometry in the Keck Carbon Cycle Accelerator Mass Spectrometry Lab at the University of California, Irvine.
Generic Instrument Description	An AMS measures "long-lived radionuclides that occur naturally in our environment. AMS uses a particle accelerator in conjunction with ion sources, large magnets, and detectors to separate out interferences and count single atoms in the presence of 1x1015 (a thousand million million) stable atoms, measuring the mass-to-charge ratio of the products of sample molecule disassociation, atom ionization and ion acceleration." AMS permits ultra low-level measurement of compound concentrations and isotope ratios that traditional alpha-spectrometry cannot provide. More from Purdue University: http://www.physics.purdue.edu/primelab/introduction/ams.html

Dataset-specific Instrument Name	
Generic Instrument Name	Niskin bottle
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.

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Deployments

RB1503_leg2

Website	https://www.bco-dmo.org/deployment/852236
Platform	NOAA Ship Ronald H. Brown
Report	http://dx.doi.org/10.7942/C2RP43
Start Date	2015-05-25
End Date	2015-06-27
Description	2015 P16N, Climate Variability and Predictability (CLIVAR), R/V Ronald H Brown, RB1503, leg 2. The Cruise Report and additional data from the cruise are available from CCHDO: Macdonald, A. and Mecking, S. (2015). Hydrographic Cruise 33RO20150525, exchange version. Accessed from CCHDO https://cchdo.ucsd.edu/cruise/33RO20150525. Access date 2021-05-21. CCHDO cruise DOI: 10.7942/C2RP43. Cruise information is also available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RB1503

RB1606_leg1

Website	https://www.bco-dmo.org/deployment/821809
Platform	NOAA Ship Ronald H. Brown
Report	http://dx.doi.org/10.7942/C21T0F
Start Date	2016-11-19
End Date	2016-12-24
Description	P18 US GO-SHIP Reoccupation Leg 1 (2016/2017). Leg 1 of the 2016/2017 occupation of the P18 hydrographic section aboard the National Oceanic and Atmospheric Administration (NOAA) vessel the Ronald H. Brown acting under the auspices of the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP). The Cruise Report and additional data from the cruise are available from CCHDO: Sonnerup, R., Carter, B., Purkey, S., and Bourbonnais, A. (2017) . Hydrographic Cruise: 33RO20161119, exchange version. Accessed from CCHDO https://cchdo.ucsd.edu/cruise/33RO20161119. Access date 2021-05-21. CCHDO cruise DOI: 10.7942/C21T0F

RB1606_leg2

Website	https://www.bco-dmo.org/deployment/821815
Platform	NOAA Ship Ronald H. Brown
Report	http://dx.doi.org/10.7942/C21T0F
Start Date	2016-12-30
End Date	2017-02-03
Description	P18 US GO-SHIP Reoccupation Leg 2 (2016/2017). Leg 2 or the 2016/2017 occupation of the P18 hydrographic section aboard the National Oceanic and Atmospheric Administration (NOAA) vessel the Ronald H. Brown acting under the auspices of the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP). The Cruise Report and additional data from the cruise are available from CCHDO: Sonnerup, R., Carter, B., Purkey, S., and Bourbonnais, A. (2017). Hydrographic Cruise: 33RO20161119, exchange version. Accessed from CCHDO https://cchdo.ucsd.edu/cruise/33RO20161119. Access date 2021-05-21. CCHDO cruise DOI: 10.7942/C21T0F

RB1503_leg1

Website	https://www.bco-dmo.org/deployment/787503
Platform	NOAA Ship Ronald H. Brown
Report	http://dx.doi.org/10.7942/C2WC7C
Start Date	2015-04-10
End Date	2015-05-12
Description	2015 P16N, Climate Variability and Predictability (CLIVAR), R/V Ronald H Brown, RB1503, leg 1. Cruise aboard the National Oceanic and Atmospheric Administration (NOAA) vessel the Ronald H. Brown (the Brown) acting under the auspices of the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP). Expocode: 33RO20150525. The Cruise Report and additional data from the cruise are available from CCHDO: Cross, J. and Siedlecki, S. (2015). Hydrographic Cruise 33RO20150410, exchange version. Accessed from CCHDO https://cchdo.ucsd.edu/cruise/33RO20150410. Access date 2021-05-21. CCHDO cruise DOI: 10.7942/C2WC7C Cruise information is also available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RB1503

RB1803

Website	https://www.bco-dmo.org/deployment/852241
Platform	NOAA Ship Ronald H. Brown
Report	http://dx.doi.org/10.7942/C25H2B
Start Date	2018-04-23
End Date	2018-06-06
Description	IO7N GO-SHIP/CO2 Repeat Hydrography Cruise aboard the National Oceanic and Atmospheric Administration (NOAA) vessel the Ronald H. Brown acting under the auspices of the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP). Expocode 33RO20180423. Ports: Durban (South Africa) to Victoria (Seychelles) The Cruise Report and additional data from the cruise are available from CCHDO: Volkov, D. and Menezes, V. (2018). Hydrographic Cruise 33RO20180423, exchange version. Accessed from CCHDO https://cchdo.ucsd.edu/cruise/33RO20180423. Access date 2021-05-21. CCHDO cruise DOI: 10.7942/C25H2B

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Project Information

Cycling of Dissolved Organic Matter in the Pacific and Indian Oceans Using Radiocarbon (DOC 14C and 13C)

Coverage: East Pacific, Southern, and Indian oceans

NSF Award Abstract:
Controls on the Aging of Marine Dissolved Organic Carbon

Most of the organic carbon in ocean water is in the dissolved form. Surprisingly, the age of this dissolved organic carbon is thousands of years old, even though it is thought to form during photosynthesis in the surface ocean. One explanation for the age of this carbon is the amount of time that it takes for carbon to circulate through the ocean. Investigators at the University of California Irvine (UCI) will investigate the aging of dissolved organic carbon in the Pacific, Southern and Indian oceans using C-14 isotopes. This work is important for knowing how carbon produced from human activities will be distributed on Earth in the future. This project will support the work of two graduate and two undergraduate students, providing hands-on experience that will prepare them for careers as scientists and educators. Both graduate students will be involved in a variety of educational activities. They will also help teach a short course on applications of C-14 in Ecology and Earth System Science for graduate students, technicians, postdocs and researchers during summer. UCI is a Hispanic-serving institution (27% of undergraduates identify as Hispanic), and 60% of students who attend UCI are first generation family representatives.

This study will examine the concentration, isotopic (14C, 13C) and molecular composition of dissolved organic carbon (DOC) in depth profiles from the Pacific, Southern and Indian Oceans. This information will help to determine the main controls on DOC cycling in the world's oceans. The project will test the hypothesis that circulation is the primary control on DOC cycling in the deepest water (>3500 meters). The research will also investigate two alternative processes that could influence the age of DOC in deep water (2000-3000 meters): (1) dissolution of surface-derived particles and (2) input of ancient carbon from hydrothermal vents and flanks. Spectroscopic and spectrometric measurements designed to characterize a portion of the DOC will be performed on surface and deep water. Results will be incorporated into an inverse model of DOC cycling to determine the main processes controlling the DOC cycle in the ocean. DOC may serve as a sink for excess carbon dioxide produced from human activities and the size of the refractory DOC pool in the ocean could increase as circulation slows. Measuring the 14C age of DOC in the surface and deep ocean is important for understanding how the global carbon cycle will change as the Earth's climate shifts.

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-1951073

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