

# d13C of Dissolved Inorganic Carbon (DIC) measured on bottle cast samples from Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from September to October 2018

**Website:** <https://www.bco-dmo.org/dataset/869595>

**Data Type:** Cruise Results

**Version:** 1

**Version Date:** 2022-02-21

## Project

- » [US GEOTRACES Pacific Meridional Transect \(GP15\)](#) (U.S. GEOTRACES PMT)
- » [Decadal trends in oceanic anthropogenic CO2 from the CLIVAR and GO-SHIP d13C datasets and in an ocean biogeochemistry model](#) (CO2 Decadal Trends)

## Program

- » [U.S. GEOTRACES](#) (U.S. GEOTRACES)

Contributors	Affiliation	Role
<a href="#">Quay, Paul</a>	University of Washington (UW)	Principal Investigator
<a href="#">Rauch, Shannon</a>	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

## Abstract

d13C of Dissolved Inorganic Carbon (DIC) measured on bottle cast samples from Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from September to October 2018

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## Table of Contents

- [Coverage](#)
  - [Dataset Description](#)
    - [Methods & Sampling](#)
    - [Data Processing Description](#)
  - [Data Files](#)
  - [Related Datasets](#)
  - [Parameters](#)
  - [Instruments](#)
  - [Deployments](#)
  - [Project Information](#)
  - [Program Information](#)
  - [Funding](#)
- 

## Coverage

**Spatial Extent:** N:55.08 E:-152 S:19.68 W:-155.72

**Temporal Extent:** 2018-09-24 - 2018-10-21

## Methods & Sampling

Niskin seawater samples were collected in 250 ml bottles and poisoned with 100  $\mu$ l of mercuric chloride. In the lab, approximately 100 ml was transferred from the bottle to a bubbler attached to a high vacuum line. Samples were acidified with 1 ml of 50% phosphoric acid before stripping with He gas at 200 ml min<sup>-1</sup>. CO<sub>2</sub> gas was collected cryogenically in a liquid nitrogen cold trap after removal of water vapor. CO<sub>2</sub> yield was calculated manometrically ( $1\sigma = 5 \mu$ mol kg<sup>-1</sup>) before transfer to a vacuum flask for isotopic analysis.

## Data Processing Description

### Data Quality Flags:

2 = good;  
3 = questionable;  
4 = bad.

#### BCO-DMO Processing:

- renamed fields to comply with BCO-DMO naming conventions;
- converted Start\_Time\_UTC field to 4 digits;
- created Start\_ISO\_DateTime\_UTC field.

[ [table of contents](#) | [back to top](#) ]

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## Data Files

File
<b>d13C-DIC_Leg1.csv</b> (Comma Separated Values (.csv), 34.51 KB) MD5:214be713aae3a0bcb105a36fc86b41f
Primary data file for dataset ID 869595

[ [table of contents](#) | [back to top](#) ]

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## Related Datasets

### IsContinuedBy

Quay, P. (2022) **d13C of Dissolved Inorganic Carbon (DIC) measured on bottle cast samples from Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1815) on R/V Roger Revelle from October to November 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-03-02 doi:10.26008/1912/bco-dmo.869611.1 [[view at BCO-DMO](#)]

*Relationship Description: GP15 was made up of two cruise legs, RR1814 (Leg 1) and RR1815 (Leg 2).*

[ [table of contents](#) | [back to top](#) ]

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## Parameters

Parameter	Description	Units
Station_ID	Station number	unitless
Start_Date_UTC	Start date; format: MM-DD-YY	unitless
Start_Time_UTC	Start time (UTC); format: hhmm	unitless
Start_ISO_DateTime_UTC	Start date and time (UTC) in ISO8601 format: YYYY-MM-DDThh:mmZ	unitless
End_Date_UTC	End date (no data)	unitless
End_Time_UTC	End time (UTC) (no data)	unitless
Start_Latitude	Start latitude	decimal degrees North
Start_Longitude	Start longitude	decimal degrees East
End_Latitude	End latitude (no data)	decimal degrees North
End_Longitude	End longitude (no data)	decimal degrees East
Event_ID	Event number	unitless
Sample_ID	GEOTRACES sample number	unitless
Sample_Depth	Maximum depth of cast	meters (m)
Sample_Pressure	Pressure at Niskin sampling depth	millibars (mbar)
DIC_13_12_D_DELTA_BOTTLE_ams5is	d13C of DIC	per mille (vs PDB)
SD1_DIC_13_12_D_DELTA_BOTTLE_ams5is	One standard deviation of DIC_13_12_D_DELTA_BOTTLE_ams5is	per mille (vs PDB)
Flag_DIC_13_12_D_DELTA_BOTTLE_ams5is	Quality flag for DIC_13_12_D_DELTA_BOTTLE_ams5is. 2 = good, 3 = questionable, 4 = bad.	unitless

[ [table of contents](#) | [back to top](#) ]

## Instruments

<b>Dataset-specific Instrument Name</b>	Thermo Scientific MAT253
<b>Generic Instrument Name</b>	Isotope-ratio Mass Spectrometer
<b>Dataset-specific Description</b>	The d13C of the CO <sub>2</sub> gas was measured on a Thermo Scientific MAT253 isotope ratio mass spectrometer.
<b>Generic Instrument Description</b>	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).

<b>Dataset-specific Instrument Name</b>	Niskin
<b>Generic Instrument Name</b>	Niskin bottle
<b>Generic Instrument Description</b>	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.

[ [table of contents](#) | [back to top](#) ]

## Deployments

### RR1814

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/776913">https://www.bco-dmo.org/deployment/776913</a>
<b>Platform</b>	R/V Roger Revelle
<b>Report</b>	<a href="https://datadocs.bco-dmo.org/docs/geotraces/GEOTRACES_PMT/casciotti/data_docs/GP15_Cruise_Report_with_ODF_Report.pdf">https://datadocs.bco-dmo.org/docs/geotraces/GEOTRACES_PMT/casciotti/data_docs/GP15_Cruise_Report_with_ODF_Report.pdf</a>
<b>Start Date</b>	2018-09-18
<b>End Date</b>	2018-10-21
<b>Description</b>	Additional cruise information is available from the Rolling Deck to Repository (R2R): <a href="https://www.rvdata.us/search/cruise/RR1814">https://www.rvdata.us/search/cruise/RR1814</a>

[ [table of contents](#) | [back to top](#) ]

## Project Information

### US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)

**Website:** <http://www.geotraces.org/>

**Coverage:** Pacific Meridional Transect along 152W (GP15)

A 60-day research cruise took place in 2018 along a transect from Alaska to Tahiti at 152° W. A description of the project titled "*Collaborative Research: Management and implementation of the US GEOTRACES Pacific Meridional Transect*", funded by NSF, is below. Further project information is available on the [US GEOTRACES website](#) and on the [cruise blog](#). A detailed [cruise report is also available](#) as a PDF.

#### *Description from NSF award abstract:*

GEOTRACES is a global effort in the field of Chemical Oceanography in which the United States plays a major role. The goal of the GEOTRACES program is to understand the distributions of many elements and their isotopes in the ocean. Until quite recently, these elements could not be measured at a global scale. Understanding the distributions of these elements and isotopes will increase the understanding of processes that shape their distributions and also the processes that depend on these elements. For example, many "trace elements" (elements that are present in very low amounts) are also important for life, and their presence or absence can play a vital role in the population of marine ecosystems. This project will launch the next major U.S. GEOTRACES expedition in the Pacific Ocean between Alaska and Tahiti. The award made here would support all of the major infrastructure for this expedition, including the research vessel, the sampling equipment, and some of the core oceanographic measurements. This project will also support the personnel needed to lead the expedition and collect the samples.

This project would support the essential sampling operations and infrastructure for the U.S. GEOTRACES Pacific Meridional Transect along 152° W to support a large variety of individual science projects on trace element and isotope (TEI) biogeochemistry that will follow. Thus, the major objectives of this management proposal are: (1) plan and

coordinate a 60 day research cruise in 2018; (2) obtain representative samples for a wide variety of TEIs using a conventional CTD/rosette, GEOTRACES Trace Element Sampling Systems, and in situ pumps; (3) acquire conventional CTD hydrographic data along with discrete samples for salinity, dissolved oxygen, algal pigments, and dissolved nutrients at micro- and nanomolar levels; (4) ensure that proper QA/QC protocols are followed and reported, as well as fulfilling all GEOTRACES intercalibration protocols; (5) prepare and deliver all hydrographic data to the GEOTRACES Data Assembly Centre (via the US BCO-DMO data center); and (6) coordinate all cruise communications between investigators, including preparation of a hydrographic report/publication. This project would also provide baseline measurements of TEIs in the Clarion-Clipperton fracture zone (~7.5°N-17°N, ~155°W-115°W) where large-scale deep sea mining is planned. Environmental impact assessments are underway in partnership with the mining industry, but the effect of mining activities on TEIs in the water column is one that could be uniquely assessed by the GEOTRACES community. In support of efforts to communicate the science to a wide audience the investigators will recruit an early career freelance science journalist with interests in marine science and oceanography to participate on the cruise and do public outreach, photography and/or videography, and social media from the ship, as well as to submit articles about the research to national media. The project would also support several graduate students.

## **Decadal trends in oceanic anthropogenic CO<sub>2</sub> from the CLIVAR and GO-SHIP d13C datasets and in an ocean biogeochemistry model (CO<sub>2</sub> Decadal Trends)**

### *NSF Award Abstract:*

The ocean has absorbed about a third of the fossil fuel carbon dioxide (CO<sub>2</sub>) that humans have emitted, slowing the accumulation of CO<sub>2</sub> and its associated trapping of thermal energy in the atmosphere. The research aims to improve our understanding of how this ocean uptake of CO<sub>2</sub> will change when ocean circulation responds to continuing changes in climate. Researchers will use observations of the isotopic ratio of carbon (13C/12C) of seawater and atmospheric samples, as a high signal/noise method to determine air-sea transfer rates and storage in the ocean interior of fossil-fuel CO<sub>2</sub>. Also, a state-of the art ocean C-cycling model will be used to validate the model's air-sea exchange rates and upper ocean storage of fossil-fuel CO<sub>2</sub>. The additional information provided by 13CO<sub>2</sub> will establish important benchmarks on ocean-atmosphere and biosphere-atmosphere C exchanges in models used for forecasting future changes in climate. Results would be incorporated into an outreach program through the University of Washington's Program on Climate Change to educate the public on the impact of human activity and climate on the ocean, atmosphere, and earth. One postdoc would be supported and trained as part of this project.

To better understand the processes that control the evolution of the anthropogenic carbon dioxide (CO<sub>2</sub>) signal in the ocean, we will utilize two characteristics of dissolved inorganic 13Carbon (DIC13) that distinguish it from DIC. First, the 10x longer air-sea equilibration time for DIC13 yields a well-constrained air-sea 13CO<sub>2</sub> flux in all basins that is resolvable on decadal time scales. Second, the anthropogenic DIC13 accumulation in the ocean is quantifiable to better signal to noise than anthropogenic DIC itself. The availability of ocean del13C and DIC data from WOCE, CLIVAR and GO-SHIP provide the opportunity to quantify, based on observations alone, the evolution and transports of the anthropogenic DIC and DIC13 signal on regional and global scales in the ocean. Implementation of the anthropogenic DIC and DIC13 perturbations into an ocean model, driven by interannually varying winds, will yield simulations of the DIC and DIC13 evolution that we will compare to observations, helping to identify likely processes causing interdecadal shifts in the rate of this evolution. The combination of observations and model analysis tracking the decadal DIC13 and DIC perturbations are designed to improve our insight into the ocean's important role in modulating climate by taking up and storing anthropogenic CO<sub>2</sub>.

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](#) ]

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## **Program Information**

### **U.S. GEOTRACES (U.S. GEOTRACES)**

**Website:** <http://www.geotraces.org/>

**Coverage:** Global

**GEOTRACES** is a [SCOR](#) sponsored program; and funding for program infrastructure development is provided by the [U.S. National Science Foundation](#).

GEOTRACES gained momentum following a special symposium, S02: Biogeochemical cycling of trace elements and isotopes in the ocean and applications to constrain contemporary marine processes (GEOSECS II), at a 2003 Goldschmidt meeting convened in Japan. The GEOSECS II acronym referred to the Geochemical Ocean Section Studies. To determine full water column distributions of selected trace elements and isotopes, including their concentration, chemical speciation, and physical form, along a sufficient number of sections in each ocean basin to establish the principal relationships between these distributions and with more traditional hydrographic parameters;

- \* To evaluate the sources, sinks, and internal cycling of these species and thereby characterize more completely the physical, chemical and biological processes regulating their distributions, and the sensitivity of these processes to global change; and

- \* To understand the processes that control the concentrations of geochemical species used for proxies of the past environment, both in the water column and in the substrates that reflect the water column.

GEOTRACES will be global in scope, consisting of ocean sections complemented by regional process studies. Sections and process studies will combine fieldwork, laboratory experiments and modelling. Beyond realizing the scientific objectives identified above, a natural outcome of this work will be to build a community of marine scientists who understand the processes regulating trace element cycles sufficiently well to exploit this knowledge reliably in future interdisciplinary studies.

Expand "Projects" below for information about and data resulting from individual US GEOTRACES research projects.

[ [table of contents](#) | [back to top](#) ]

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1829796</a>

[ [table of contents](#) | [back to top](#) ]