

# The $^{13}\text{C}/^{12}\text{C}$ stable carbon isotopic ratio of the dissolved inorganic carbon from samples collected on the GEOTRACES EPZT cruise (R/V Thomas G. Thompson TN303) in the Eastern Tropical South Pacific from October to December 2013

Website: <https://www.bco-dmo.org/dataset/676537>

Data Type: Cruise Results

Version: 1

Version Date: 2017-01-26

## Project

- » [U.S. GEOTRACES East Pacific Zonal Transect](#) (U.S. GEOTRACES EPZT)
- » [US GEOTRACES Pacific: Measuring the  \$\delta^{13}\text{C}\$ -DIC distribution and quantifying the impact of organic matter export on  \$\delta^{13}\text{C}\$ , nutrients and trace metals](#) (EPZT  $\delta^{13}\text{C}$ -DIC)

## 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

The  $^{13}\text{C}/^{12}\text{C}$  stable carbon isotopic ratio of the dissolved inorganic carbon from samples collected on the GEOTRACES EPZT cruise (R/V Thomas G. Thompson TN303) in the Eastern Tropical South Pacific from October to December 2013.

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## Coverage

**Spatial Extent:** N:-10.50017 E:-77.37617 S:-16.00067 W:-152.0005

**Temporal Extent:** 2013-10-29 - 2013-12-18

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## Dataset Description

The <sup>13</sup>C/<sup>12</sup>C stable carbon isotopic ratio of the dissolved inorganic carbon from samples collected on the R/V Thomas G. Thompson cruise TN303 in the Eastern Tropical South Pacific (GEOTRACES EPZT).

## Acquisition Description

**Shipboard Sample Collection Methods:** Sampling was done using the ODF CTD rosette (12 30L Niskins). Samples were collected in pre-washed and baked 250 ml ground glass stoppered bottles that were poisoned with 100 ul of a saturated HgCl<sub>2</sub> solution. The stored sealed samples were returned to the Stable Isotope Laboratory at the University of Washington for extraction and measurement.

**Laboratory Methods:** CO<sub>2</sub> was extracted from the DIC seawater sample using a modification of the helium stripping technique described in Quay and Stutsman (2003). The  $\delta^{13}\text{C}$  was measured on a Thermo Delta Plus XL mass spectrometer.

## Processing Description

### Data quality flag definitions:

2 = good data;

3 = questionable data;

9 = no data.

### BCO-DMO Processing:

- modified parameter names to conform with BCO-DMO and GEOTRACES naming conventions;
- joined to BCO-DMO master EPZT events file and removed duplicate/unnecessary columns.

### Additional GEOTRACES Processing:

As was done for the GEOTRACES-NAT data, BCO-DMO added standard US GEOTRACES information, such as the US GEOTRACES event number, to each submitted dataset lacking this information. To accomplish this, BCO-DMO compiled a 'master' dataset composed of the following parameters:

cruise\_id, EXPCODE, SECT\_ID, STNNBR, CASTNO, GEOTRC\_EVENTNO, GEOTRC\_SAMPNO, GEOTRC\_INSTR, SAMPNO, GF\_NO, BTLNBR, BTLNBR\_FLAG\_W, DATE\_START\_EVENT, TIME\_START\_EVENT, ISO\_DATETIME.UTC\_START\_EVENT, EVENT\_LAT, EVENT\_LON, DEPTH\_MIN, DEPTH\_MAX, BTL\_DATE, BTL\_TIME, BTL\_ISO\_DATETIME.UTC, BTL\_LAT,

BTL\_LON, ODF\_CTDPRS, SMDEPTH, FMDEPTH, BTMDEPTH, CTDPRS, CTDDEPTH.

This added information will facilitate subsequent analysis and inter comparison of the datasets.

Bottle parameters in the master file were taken from the GT-C\_Bottle and ODF\_Bottle datasets. Non-bottle parameters, including those from GeoFish tows, Aerosol sampling, and McLane Pumps, were taken from the TN303 Event Log (version 30 Oct 2014). Where applicable, pump information was taken from the PUMP\_Nuts\_Sals dataset.

A standardized BCO-DMO method (called "join") was then used to merge the missing parameters to each US GEOTRACES dataset, most often by matching on sample\_GEOTRC or on some unique combination of other parameters.

If the master parameters were included in the original data file and the values did not differ from the master file, the original data columns were retained and the names of the parameters were changed from the PI-submitted names to the standardized master names. If there were differences between the PI-supplied parameter values and those in the master file, both columns were retained. If the original data submission included all of the master parameters, no additional columns were added, but parameter names were modified to match the naming conventions of the master file.

See the dataset parameters documentation for a description of which parameters were supplied by the PI and which were added via the join method.

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## Related Publications

Quay, P., & Stutsman, J. (2003). Surface layer carbon budget for the subtropical N. Pacific: constraints at station ALOHA. Deep Sea Research Part I: Oceanographic Research Papers, 50(9), 1045–1061. doi:10.1016/s0967-0637(03)00116-x [https://doi.org/10.1016/S0967-0637\(03\)00116-X](https://doi.org/10.1016/S0967-0637(03)00116-X) [[details](#)]

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## Parameters

Parameter	Description	Units
cruise_id	Cruise identification	unitless
EXPOCODE	Cruise EXPO code.	unitless
GEOTRC_INSTR	Sampling instrument; added from BCO-DMO EPZT master events file.	unitless
STNNBR	Station number	unitless
GEOTRC_SAMPNO	Unique GEOTRACES sample number	unitless

GEOTRC_EVENTNO	GEOTRACES event number	unitless
CASTNO	Cast number	unitless
DIC_13_D_DELTA_BOTTLE	d13C-DIC; Carbon 13 to Carbon 12 ratio of DIC: $1000 * [(13C/12C)_{\text{sample}} - (13C/12C)_{\text{standard}}] / (13C/12C)_{\text{standard}}$ . Reported in units of per mil.	per mil
DIC_13_D_DELTA_BOTTLE_FLAG	Quality flag for DIC_13_D_DELTA_BOTTLE. 2 = good data; 3 = questionable data; 9 = no data.	unitless
SAMPNO	Sequential sample number within the cast (usually corresponds to bottle number).	unitless
BTLNBR	Bottle number; typically 1-24.	unitless
BTLNBR_FLAG_W	Bottle number quality flag; follows WOCE conventions. 2 = good; 3 = questionable; 4 = bad; 9 = missing data.	unitless
ISO_DATETIME.UTC_START_EVENT	Date and time, formatted to the ISO 8601 standard, at the start of the sampling event, according to the event log. Format: YYYY-MM-DDTHH:MM:SS[.xx]Z. Added from BCO-DMO EPZT master events file.	unitless
EVENT_LAT	Latitude at the start of the event; north is positive; added from BCO-DMO EPZT master events file.	decimal degrees
EVENT_LON	Longitude at the start of the event; east is positive; added from BCO-DMO EPZT master events file.	decimal degrees
BTL_ISO_DATETIME.UTC	Date and time, formatted to the ISO 8601 standard, at the time of bottle firing. Format: YYYY-MM-DDTHH:MM:SS[.xx]Z. Added from BCO-DMO EPZT master events file.	unitless
BTL_LAT	Latitude of bottle firing; north is positive. Added from BCO-DMO EPZT master events file.	decimal degrees
BTL_LON	Longitude of bottle firing; east is positive. Added from BCO-DMO EPZT master events file.	decimal degrees
CTDDEPTH	CTD bottle firing depth obtained from the CTD bottle files; added from BCO-DMO EPZT master events file.	meters

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## Instruments

<b>Dataset-specific Instrument Name</b>	
<b>Generic Instrument Name</b>	Niskin bottle
<b>Dataset-specific Description</b>	Samples were collected by the ODF CTD rosette (12 30L Niskins).
<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.

<b>Dataset-specific Instrument Name</b>	Thermo Delta Plus XL mass spectrometer
<b>Generic Instrument Name</b>	Mass Spectrometer
<b>Dataset-specific Description</b>	The del13C is measured on a Thermo Delta Plus XL mass spectrometer.
<b>Generic Instrument Description</b>	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

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## Deployments

TN303

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/499719">https://www.bco-dmo.org/deployment/499719</a>
<b>Platform</b>	R/V Thomas G. Thompson
<b>Report</b>	<a href="http://dmoserv3.whoi.edu/data_docs/GEOTRACES/EPZT/GT13_EPZT_ODFReport_All.pdf">http://dmoserv3.whoi.edu/data_docs/GEOTRACES/EPZT/GT13_EPZT_ODFReport_All.pdf</a>
<b>Start Date</b>	2013-10-25
<b>End Date</b>	2013-12-20
<b>Description</b>	A zonal transect in the eastern tropical South Pacific (ETSP) from Peru to Tahiti as the second cruise of the U.S.GEOTRACES Program. This Pacific section includes a large area characterized by high rates of primary production and particle export in the eastern boundary associated with the Peru Upwelling, a large oxygen minimum zone that is a major global sink for fixed nitrogen, and a large hydrothermal plume arising from the East Pacific Rise. This particular section was selected as a result of open planning workshops in 2007 and 2008, with a final recommendation made by the U.S.GEOTRACES Steering Committee in 2009. It is the first part of a two-stage plan that will include a meridional section of the Pacific from Tahiti to Alaska as a subsequent expedition. Figure 1. The 2013 GEOTRACES EPZT Cruise Track. [click on the image to view a larger version] Original data are available from the NSF R2R data catalog

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## Project Information

### U.S. GEOTRACES East Pacific Zonal Transect (U.S. GEOTRACES EPZT)

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

**Coverage:** Eastern Tropical Pacific - Transect from Peru to Tahiti

From the NSF Award Abstract The mission of the International GEOTRACES Program ([www.geotraces.org](http://www.geotraces.org)), of which the U.S. chemical oceanography research community is a founding member, is "to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions" (GEOTRACES Science Plan, 2006). In the United States, ocean chemists are currently in the process of organizing a zonal transect in the eastern tropical South Pacific (ETSP) from Peru to Tahiti as the second cruise of the U.S.GEOTRACES Program. This Pacific section includes a large area characterized by high rates of primary production and particle export in the eastern boundary associated with the Peru Upwelling, a large oxygen minimum zone that is a major global sink for fixed nitrogen, and a large hydrothermal plume arising from the East Pacific Rise. This particular section was selected as a result of open planning workshops in 2007 and 2008, with a final recommendation made by the U.S.GEOTRACES Steering Committee in 2009. It is the first part of a two-

stage plan that will include a meridional section of the Pacific from Tahiti to Alaska as a subsequent expedition. This award provides funding for management of the U.S.GEOTRACES Pacific campaign to a team of scientists from the University of Southern California, Old Dominion University, and the Woods Hole Oceanographic Institution. The three co-leaders will provide mission leadership, essential support services, and management structure for acquiring the trace elements and isotopes samples listed as core parameters in the International GEOTRACES Science Plan, plus hydrographic and nutrient data needed by participating investigators. With this support from NSF, the management team will (1) plan and coordinate the 52-day Pacific research cruise described above; (2) obtain representative samples for a wide variety of trace metals of interest using conventional CTD/rosette and GEOTRACES Sampling Systems; (3) acquire conventional JGOFS/WOCE-quality hydrographic data (CTD, transmissometer, fluorometer, oxygen sensor, etc) along with discrete samples for salinity, dissolved oxygen (to 1  $\mu\text{M}$  detection limits), plant pigments, redox tracers such as ammonium and nitrite, 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-type data to the GEOTRACES Data Center (and US data centers); and (6) coordinate cruise communications between all participating investigators, including preparation of a hydrographic report/publication. Broader Impacts: The project is part of an international collaborative program that has forged strong partnerships in the intercalibration and implementation phases that are unprecedented in chemical oceanography. The science product of these collective missions will enhance our ability to understand how to interpret the chemical composition of the ocean, and interpret how climate change will affect ocean chemistry. Partnerships include contributions to the infrastructure of developing nations with overlapping interests in the study area, in this case Peru. There is a strong educational component to the program, with many Ph.D. students carrying out thesis research within the program. Figure 1. The 2013 GEOTRACES EPZT Cruise Track. [click on the image to view a larger version]

### **US GEOTRACES Pacific: Measuring the $\delta^{13}\text{C}$ -DIC distribution and quantifying the impact of organic matter export on $\delta^{13}\text{C}$ , nutrients and trace metals (EPZT $\delta^{13}\text{C}$ -DIC)**

**Coverage:** Eastern Tropical Pacific

Text from the NSF award abstract: The international GEOTRACES program has two major goals: (1) to determine global ocean distributions of selected trace elements and isotopes and evaluate the sources, sinks, and internal cycling of these species to characterize more completely the physical, chemical and biological processes regulating their distributions; and (2) to understand the processes that control the concentrations of geochemical species used for proxies of the past environment. Because the cycling of trace elements and isotopes in the sea is intimately connected with both the organic and the inorganic biogeochemical transformations of carbon, the achievement of the goals of GEOTRACES would be very difficult if not impossible unless synoptic measurements are also made on the organic and inorganic marine carbon system. In this project, researchers at the University of Washington will participate in the U.S.GEOTRACES Pacific campaign in 2013 to characterize the regional ocean carbon system. They will use two approaches. First, they will measure the depth distribution of the  $^{13}\text{C}/^{12}\text{C}$  stable carbon isotopic ratio of the dissolved inorganic carbon ( $\delta^{13}\text{C}$ ), which has been designated in the international GEOTRACES Science Plan as a key parameter and has the highest measurement priority. Second,

they will estimate the rate of organic matter (OM) export from the surface layer based on dissolved O<sub>2</sub>/Ar gas ratios. Measurements of  $\delta^{13}\text{C}$  will be made at about 22 stations for a total of ~525 samples. Additionally, they will measure the dissolved O<sub>2</sub>/Ar gas ratio at ~5 km spatial resolution in the surface layer using an underway measurement method that has been used extensively in other oceanic regions. The cruise track will cross a wide range of biological productivity regimes from the coastal upwelling zone off Peru to the oligotrophic gyre surrounding Tahiti. The proposed high resolution O<sub>2</sub>/Ar-based OM export rates should clearly detect the expected offshore decrease in OM export and locate transition zones or fronts in productivity. The expected large offshore productivity gradient will provide the opportunity to determine the impact of OM export from the surface layer and OM degradation at depth on upper ocean depth distribution of  $\delta^{13}\text{C}$ , trace elements (TEs), O<sub>2</sub> and nutrients along the section. The initial  $\delta^{13}\text{C}$  and TE measurements during GEOTRACES illustrate the potential to improve our understanding of the processes that control  $\delta^{13}\text{C}$ , TEs and nutrient distributions in the modern ocean and, as a result, improve the utility of  $\delta^{13}\text{C}$  and TEs as tracers of past changes in the ocean circulation and carbon cycling, which is a long term goal of this research. Broader Impacts. The data and research results will be broadly distributed to the international oceanographic and paleoclimate communities and incorporated into the PI's graduate and undergraduate teaching curricula. Additionally, there will be active undergraduate participation (5 students currently) in preparing samples for  $\delta^{13}\text{C}$  analyses.

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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.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1233005</a>

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