

# CFC-12, CFC-11, and SF6 concentrations from the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15) from September to November 2018

**Website:** <https://www.bco-dmo.org/dataset/820232>

**Data Type:** Cruise Results

**Version:** 1

**Version Date:** 2020-08-13

## Project

» [US GEOTRACES Pacific Meridional Transect \(GP15\)](#) (U.S. GEOTRACES PMT)

» [GEOTRACES Pacific Meridional Transect: Measurement of chlorofluorocarbons and sulfur hexafluoride](#) (PMT CFC SF6)

## Program

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

Contributors	Affiliation	Role
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## Abstract

CFC-12, CFC-11, and SF6 concentrations from the US GEOTRACES Pacific Meridional Transect (PMT) cruises, RR1814 and RR1814 (GP15), on the R/V Roger Revelle from September to November 2018.

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## Coverage

**Spatial Extent:** N:56.0585 E:-151.9862 S:-20 W:-156.9628

**Temporal Extent:** 2018-09-24 - 2018-11-23

## Dataset Description

CFC-12, CFC-11, and SF6 concentrations from the US GEOTRACES Pacific Meridional Transect (PMT) cruises, RR1814 and RR1814 (GP15), on the R/V Roger Revelle from September to November 2018.

## Methods & Sampling

Samples were taken from Niskin bottles. They were unfiltered. Note there is no SF6 data for the first leg of the cruise (RR1814).

Procedures:

Fill 300 ml and flush BOD bottles with water in a one liter overflow bottle. Cap bottle underwater. Analysis is on a

custom-built purge and trap gas chromatography with electron capture detection. Data were processed using Labview and Excel.

## Data Processing Description

BCO-DMO Processing:

- renamed parameters;
- added date/time field in ISO8601 format;
- replaced "-99" with "nd" ("no data");
- rounded CFC\_12\_D\_CONC\_BOTTLE and CFC\_11\_D\_CONC\_BOTTLE values to 4 decimal places.

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## Data Files

File
<b>CFC_SF6.csv</b> (Comma Separated Values (.csv), 112.18 KB) MD5:0741ad7ee2c7120ea4c4db7efab9c1fc Primary data file for dataset ID 820232

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## Parameters

Parameter	Description	Units
STNNBR	Station number	unitless
CASTNO	Cast number	unitless
SAMPNO	Sample bottle number	unitless
BTLNBR	Bottle number	unitless
BTLNBR_FLAG_W	Bottle quality flag; see WHP quality codes for the water bottle itself	unitless
GEOTRC_EVENTNO	Event number	unitless
GEOTRC_SAMPNO	GEOTRACES sample number	unitless
DATE	Date; format: YYYYMMDD	unitless
TIME	Time; format: hh:mm	unitless
ISO_DateTime_UTC	Sampling date and time (UTC) formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
LATITUDE	Latitude	decimal degrees North
LONGITUDE	Longitude	decimal degrees East
DEPTH	Bottom depth	meters (m)
CTDPRS	Sample/sensor pressure from CTD	decibars
CTDTMP	Temperature from CTD sensor in the ITS-90 convention	degrees Celsius
CTDSAL	Practical salinity from CTD sensor on the PSS-1978 scale	psu
SF6_D_CONC_BOTTLE	SF6 concentration	femtomole/kg (fmol/kg)
SF6_D_CONC_BOTTLE_FLAGW	WOCE data quality flag for SF6_D_CONC_BOTTLE	unitless
CFC_12_D_CONC_BOTTLE	CFC-12 concentration	picomole/kg (pmol/kg)
CFC_12_D_CONC_BOTTLE_FLAGW	WOCE data quality flag for CFC_12_D_CONC_BOTTLE	unitless
CFC_11_D_CONC_BOTTLE	CFC-11 concentration	picomole/kg (pmol/kg)
CFC_11_D_CONC_BOTTLE_FLAGW	WOCE data quality flag for CFC_11_D_CONC_BOTTLE	unitless

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## Instruments

<b>Dataset-specific Instrument Name</b>	custom-built purge and trap gas chromatography with electron capture detection
<b>Generic Instrument Name</b>	Automated Purge and Trap System
<b>Generic Instrument Description</b>	This equipment removes dissolved gases from the water samples, traps the extracted compounds on a cold trap and then heats the trap and injects the trapped gases into the gas chromatograph. It is automated and controlled by a laptop computer.

<b>Dataset-specific Instrument Name</b>	custom-built purge and trap gas chromatography with electron capture detection
<b>Generic Instrument Name</b>	Gas Chromatograph
<b>Generic Instrument Description</b>	Instrument separating gases, volatile substances, or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay. (from SeaDataNet, BODC)

<b>Dataset-specific Instrument Name</b>	
<b>Generic Instrument Name</b>	Niskin bottle
<b>Dataset-specific Description</b>	Samples were taken from Niskin bottles. They were unfiltered.
<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.

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## 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>

### RR1815

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/776917">https://www.bco-dmo.org/deployment/776917</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>	2018-10-24
<b>End Date</b>	2018-11-24
<b>Description</b>	Additional cruise information is available from the Rolling Deck to Repository (R2R): <a href="https://www.rvdata.us/search/cruise/RR1815">https://www.rvdata.us/search/cruise/RR1815</a>

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## 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.

### **GEOTRACES Pacific Meridional Transect: Measurement of chlorofluorocarbons and sulfur hexafluoride (PMT CFC SF6)**

#### *NSF Award Abstract:*

The goal of the international GEOTRACES program is to understand the distributions of trace chemical elements and their isotopes in the oceans. The National Science Foundation is supporting a U.S. GEOTRACES sampling expedition in the Pacific Ocean in 2018, that will conduct full ocean depth at sites extending south from Alaska to Tahiti. The purpose of this project is to measure the concentrations of chlorofluorocarbon (CFC) compounds and of sulfur hexafluoride (SF6) along this transect of stations. These gas measurements can be used to determine the "ages" of water parcels and the rates of important oceanographic and biogeochemical processes. Such information is essential to the interpretation of the trace element and isotope data that will be gathered as part of GEOTRACES. The trace gas concentrations, ventilation ages, and rate data will all be made available to other investigators within six months of collection, forming an important foundation for the GEOTRACES Pacific program.

The project team will measure CFC-11, CFC-12, and SF6 concentrations aboard the 2018 Pacific Meridional Transect. Beyond the concentration measurements, the project has the following specific objectives: 1) Calculate tracer ages and identify the relative extent of ventilation and dilution of thermocline and intermediate water masses within which Trace Elements and their Isotopes (TEIs) reside across different circulation regimes, 2) Calculate rates of biochemically

important processes (including apparent oxygen utilization and denitrification rates) and distinguish between the contributions from physical and biogeochemical processes across the different circulation regimes, 3) Put tracer and hydrographic GEOTRACES data into context of larger space and time scales using historical tracer, hydrographic, ARGO CTD and oxygen data. The CFC and SF6 tracer data will contribute to interpretation of the key GEOTRACES trace elements and isotopes by characterizing physical processes, which can affect trace element speciation and internal cycling. Calculated tracer ages are the backbone of this project and are the primary service for other GEOTRACES PIs. Tracer ages will be used to address each of the objectives. As tracer ages are an important part of the contribution to the GEOTRACES program, uncertainties will be estimated for the ages related to internal ocean variability and effects of mixing due to non-stationarity of the atmospheric transients.

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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-1737041</a>

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