Concentrations of dissolved argon, krypton, and xenon from Niskin bottle samples collected on 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 Oct-Nov 2018

Website: https://www.bco-dmo.org/dataset/877899
Data Type: Cruise Results
Version: 2
Version Date: 2025-04-09

Project
» US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)
» Measurement of Helium Isotopes on the U.S. GEOTRACES Alaska-Tahiti Section (GP15) (PMT Helium Isotopes)

Program
» U.S. GEOTRACES (U.S. GEOTRACES)

Contributors	Affiliation	Role
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Abstract
This dataset includes concentrations of dissolved argon (Ar), krypton (Kr), and xenon (Xe) from Niskin bottle samples collected on 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.

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Coverage

Spatial Extent: **N**:18.907 **E**:-151.986 **S**:-20 **W**:-155.258
Temporal Extent: 2018-10-25 - 2018-11-23

Methods & Sampling

Methodology: Quantitative vacuum extraction and mass spectrometry.

Sampling and Analytical Procedures:
Water samples were transferred from Niskin bottles and stored in crimped copper tubing. Gases were extracted from the water samples in a shore-based vacuum system (see references for description) and stored in aluminosilicate glass ampoules. The extracted gases were chemically purified and cryogenically separated, then analyzed for argon, krypton, and xenon concentrations using ion counting in a triple filter quadrupole mass spectrometer. Argon was measured using ion current manometry corrected for small linearity effects. Krypton and xenon were determined using ratiometric isotope dilution. All measurements were standardized to air abundances. Details are given in Jenkins

et al (2019) and Stanley et al (2007).

Samples were acquired at sea in replicate. During the generation of this dataset 53 pairs of replicates were analyzed to assess reproducibility. The results are summarized in the attached Supplemental File named "GP15_ArKrXe_Replicates.csv" (note the results listed in this Supplemental File are reported as molar quantities).

Dissolved helium, neon, and helium isotopes were also measured on the same samples and are available at BCO-DMO (see "Related Datasets").

Data Processing Description

Data Processing:
Raw data were acquired and reduced using custom software written in VB.NET. Data were processed using MATLAB (2020b) and stored in a PostgreSQL V9.3 database.

Quality Flags:
Quality flags follow the ODF (WOCE) scheme. Defined as:
1 = Sample for this measurement was drawn from water bottle but analysis not received.
2 = Acceptable measurement.
3 = Questionable measurement.
4 = Bad measurement.
5 = Not reported.
6 = Mean of replicate measurements
7 = Manual chromatographic peak measurement.
8 = Irregular digital chromatographic peak integration.
9 = Sample not drawn for this measurement from this bottle.

BCO-DMO Processing:
Version 1 (date 2022-08-10)
- renamed fields to comply with BCO-DMO naming conventions.

Version 2 (date 2025-04-09)
- Added the rows of data for station 19 from the leg 1 Excel file to Leg 2.
- Imported file "ArKrXe Template Leg 2_BCO.xlsx" into the BCO-DMO system.
- Renamed fields to comply with BCO-DMO naming conventions.
- Reordered columns to match order in Leg 1 dataset.
- Renamed the "Event_ID" and "Sample_ID" columns, which were incorrectly labeled.
- Changed Station number "186" to "18.6".
- Joined the data to the RR1815 bottle file using {Station_ID}{Cast_number}{SAMPNO}; added the following fields from the bottle file: GEOTRC_EVENTNO, GETORC_SAMPNO, DATE, TIME.
- Removed the PI-provided GT sample numbers and kept the ones from the bottle file.
- Sorted data by {Station_ID}{Cast_number}{Sample_Depth}.
- Saved final file as "877899_v2_gp15_arkrxe_leg2.csv".

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Data Files

File	
877899_v2_gp15_arkrxe_leg2.csv	(Comma Separated Values (.csv), 46.73 KB) MD5:45e62186e3fcedda3c2b160e727edc63
Primary data file for dataset ID 877899, version 2	

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Supplemental Files

File	
gp15_arkrxe_replicates_v2.csv	(Comma Separated Values (.csv), 12.29 KB) MD5:1c1d952da4943d3e4d1b754cfaa99266
Supplemental file for GP15 ArKrXe datasets, v2. Samples were acquired at sea in replicate. During the generation of this dataset 53 pairs of replicates were analyzed to assess reproducibility. The results are summarized in this Supplemental file. Version 2 contains a correction: at station 5, cast 5, sample bottle 36, the GTNum has been changed from 14551 to 14539. 14539 is the correct number for that station-cast-bottle per the GP15 bottle file and cast sheets.	

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Related Publications

Jenkins, W. J., Lott, D. E., & Cahill, K. L. (2019). A determination of atmospheric helium, neon, argon, krypton, and xenon solubility concentrations in water and seawater. Marine Chemistry, 211(1), 94–107. doi:10.1016/j.marchem.2019.03.007
Methods

Stanley, R. H. R., Baschek, B., Lott, D. E., & Jenkins, W. J. (2009). A new automated method for measuring noble gases and their isotopic ratios in water samples. Geochemistry, Geophysics, Geosystems, 10(5), n/a–n/a. doi:10.1029/2009GC002429
Methods

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Related Datasets

IsRelatedTo

Jenkins, W. J., German, C. R. (2021) **Helium isotope with helium and neon concentration data 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 Oct-Nov 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-09-30 doi:10.26008/1912/bco-dmo.862220.1 [view at BCO-DMO]
Relationship Description: Both datasets were generated from the same samples.

Continues

Jenkins, W. J., German, C. R. (2025) **Concentrations of dissolved argon, krypton, and xenon from Niskin bottle samples collected on Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from Sept-Oct 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2) Version Date 2025-04-09 doi:10.26008/1912/bco-dmo.877873.2 [view at BCO-DMO]
Relationship Description: GP15 was made up of two cruise legs, RR1814 (Leg 1) and RR1815 (Leg 2).

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Parameters

Parameter	Description	Units
Station_ID	Station number	unitless
DATE	Sample date; BCO-DMO added from GP15 bottle file	unitless
TIME	Sample time; BCO-DMO added from GP15 bottle file	unitless

Start_Latitude	Latitude at start of sample collection	degrees North
Start_Longitude	Longitude at start of sample collection	degrees East
Cast_number	Cast number	unitless
SAMPNO	Bottle sample number	unitless
GEOTRC_EVENTNO	Event number; BCO-DMO added from GP15 bottle file	unitless
GEOTRC_SAMPNO	GEOTRACES sample number; BCO-DMO added from GP15 bottle file	unitless
Sample_Depth	Sample depth	meters (m)
Kr_D_CONC_BOTTLE_uo0lmf	Dissolved krypton	nanomoles per kilogram (nmol/kg)
SD1_Kr_D_CONC_BOTTLE_uo0lmf	One standard deviation of Kr_D_CONC_BOTTLE_uo0lmf	nanomoles per kilogram (nmol/kg)
Flag_Kr_D_CONC_BOTTLE_uo0lmf	Quality flag for Kr_D_CONC_BOTTLE_uo0lmf	unitless
Ar_D_CONC_BOTTLE_unjql9	Dissolved argon	micromoles per kilogram (umol/kg)
SD1_Ar_D_CONC_BOTTLE_unjql9	One standard deviation of Ar_D_CONC_BOTTLE_unjql9	micromoles per kilogram (umol/kg)
Flag_Ar_D_CONC_BOTTLE_unjql9	Quality flag for Ar_D_CONC_BOTTLE_unjql9	unitless
Xe_D_CONC_BOTTLE_xoirom	Dissolved xenon	nanomoles per kilogram (nmol/kg)
SD1_Xe_D_CONC_BOTTLE_xoirom	One standard deviation of Xe_D_CONC_BOTTLE_xoirom	nanomoles per kilogram (nmol/kg)
Flag_Xe_D_CONC_BOTTLE_xoirom	Quality flag for Xe_D_CONC_BOTTLE_xoirom	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	The helium isotope mass spectrometer is a custom-built unit manufactured at the Woods Hole Oceanographic Institution.
Generic Instrument Description	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.

Dataset-specific Instrument Name	Niskin bottle
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.

Dataset-specific Instrument Name	HIDEN P/N PCI 1000 1.2HAL/3F 1301-9 PIC type 570,309
Generic Instrument Name	Quadrupole Mass Spectrometer
Generic Instrument Description	A piece of apparatus that consists of an ion source, a mass-to-charge analyser, a detector and a vacuum system and is used to measure mass spectra. The detector is a quadrupole mass-to-charge analyser, which holds the ions in a stable orbit by an electric field generated by four parallel electrodes.

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Deployments

RR1815

Website	https://www.bco-dmo.org/deployment/776917
Platform	R/V Roger Revelle
Report	https://datadocs.bco-dmo.org/docs/geotraces/GEOTRACES_PMT/casciotti/data_docs/GP15_Cruise_Report_with_ODF_Report.pdf
Start Date	2018-10-24
End Date	2018-11-24
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RR1815

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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 form 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.

Measurement of Helium Isotopes on the U.S. GEOTRACES Alaska-Tahiti Section (GP15) (PMT Helium Isotopes)

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. An essential part of this effort is determining the sources of trace elements to the oceans. One important such source comes from seafloor hydrothermal venting. This project will support the measurement of helium isotopes on the 2018 U.S. GEOTRACES expedition in the Pacific Ocean, running south from Alaska to Tahiti. Helium isotopes provide important information on the presence and dispersion of hydrothermal plumes. On a larger scale, they can also be used to calculate global-scale inputs of hydrothermally-sourced trace elements and isotopes. Thus, the proposed work is closely tied to many other projects associated with this expedition. The measurement of helium isotopes will also allow enable the investigation of physical mixing rates within the upper ocean to help interpret the fate of other trace elements. At the northern end of the section, this approach will also be used to investigate the rate at which other trace elements and isotopes from seafloor hydrothermal venting are delivered to the more biologically productive surface ocean. In addition to supporting the GEOTRACES effort and participating in community-scale outreach efforts associated with the expedition, the investigators will also work with a visual artist to communicate their science to the public in new ways.

The U.S. GEOTRACES Pacific Meridional Transect (56°N to 20°S, along 152°W) in late 2018 will intercept: strong margin fluxes, sub-Arctic high-nutrient, low-chlorophyll waters, the oldest deep waters in the world's oceans, the distal ends of multiple hydrothermal plumes, oxygen minimum zones, subpolar and equatorial upwelling, and, in the South Pacific

near 20°S, some of the most oligotrophic waters known. This section, together with the US GEOTRACES East Pacific Zonal Transect (EPZT) conducted in 2013, will also close off a large volume of the Pacific Ocean. Consequently, this work will facilitate new, improved evaluations of regional-scale fluxes of hydrothermally-sourced trace elements and isotopes (TEIs) to the oceans. Because the 2018 expedition will intercept multiple hydrothermal plumes, this project will also allow the investigation of three key questions emerging from the larger U.S. and international GEOTRACES programs: 1) Is there a significant source of hydrothermally-sourced Fe and other TEIs to the euphotic zone in the North Pacific, through upwelling, as was demonstrated for the Southern Ocean from the 2013 EPZT results? 2) How do TEI:He-3 ratios in hydrothermal plumes vary with different geologic settings of their vent-sources? 3) How do the TEI:He-3 ratios imparted to hydrothermal plumes vary along the thermohaline conveyor as a function of varying water column chemistry? Throughout the section the investigators will also combine upper-water column helium-3 measurements with water column tritium concentrations (extrapolated from data collected on past expeditions) to estimate water column ventilation time scales that can be used to quantify rates of TEI transformation across the wide range of biogeochemical regimes to be intercepted (tropical, subtropical, subpolar). In regions characterized by upwelling, precise measurements of helium isotopes can be combined with canonical gas-exchange rate estimates to make flux-gauge determinations of upwelling rates for some key TEIs.

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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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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1756138

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