Total aerosol trace elements from bulk aerosol 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 September to October 2018

Website: https://www.bco-dmo.org/dataset/834230
Data Type: Cruise Results
Version: 1
Version Date: 2020-12-17

Project
» US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)
» Collaborative Research: US GEOTRACES PMT: Quantification of Atmospheric Deposition and Trace Element Fractional Solubility (PMT Aerosol Collection)

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

Contributors	Affiliation	Role
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Abstract
This dataset contains concentrations of total aerosol trace elements collected from bulk aerosol samples on Leg 1 of the 2018 US GEOTRACES Pacific Meridional Transect.

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Coverage

Spatial Extent: **N**:55.5948 **E**:-129.0395 **S**:22 **W**:-156.3461
Temporal Extent: 2018-09-20 - 2018-10-20

Methods & Sampling

A total of 12 48-hour integrated aerosol samples were collected during Leg 1 of the US GEOTRACES Pacific Meridional Transect research cruise (GP15), which took place on the R/V Revelle (cruise RR1814) during September-October 2018. The cruise track consisted of a southward transect across the North Pacific Ocean originating off of Alaska and terminating at Hawaii.

Bulk aerosol samples for multiple trace element analyses were collected using one of five Tisch Environmental high-volume (~1 m^3 air min^{-1}) aerosol samplers (model 5170V-BL). For each deployment, 12 replicate 47 mm diameter

Whatman 41 filters were loaded on open-face filter holders (Advantec MFS) installed on the aerosol sampler on a PVC adaptor plate (Shelley et al., 2015). Filters were acid-washed before use to reduce trace element blanks, following the procedure described by Morton et al. (2013). The samplers were deployed on the forward rail of the ship's 03 deck approximately 16m above sea level, to minimize the influence of sea spray on samples. Samplers were controlled by wind speed and direction, through a Campbell Scientific CR800 data-logger interfaced with an anemometer and wind vane set up in close proximity to the samplers, in order to eliminate contamination from the ship's stack exhaust. This setup was used to restrict sampling to periods when relative wind speed and direction were >0.5 m s^{-1} and from within ±60° of the bow of the ship, respectively, for at least five continuous minutes.

Data Processing Description

Data Processing:
Data have been corrected for field and analytical blank. Reported total aerosol trace element concentrations values have been normalized to the volume of air filtered during sample collection. Each sample collection period produced 36 replicate filters. Three of those filters were digested to produce three replicate measurements of total particulate aerosol concentration. Data from the three replicates were averaged and reported along with the standard deviation. Outliers and replicate samples that were below the field blank value were not included in the mean. Data are marked as described in the datasheet.

Known Problems/Issues:
AEROS2 (Event 6546) was not analyzed due to exceptional contamination of the collection filters with sea spray.

Quality Flags:
Quality flags have been applied with the following definitions:
0 = No quality control;
1 = Good value;
2 = Probably good value;
3 = Probably bad value;
4 = Bad value;
5 = Value changed;
6 = Value Below Detection;
7 = Value in excess;
8 = Interpolated value;
9 = Missing value.

Detection Limits:
Method detection limit was calculated from 3*STDEV of the measured filter blank. Filter blank, and thus method detection limit, varied among the three filter lots used. Sample values were compared to the detection limit calculated from the blank in the corresponding lot. The detection limit of each of the 3 lots is reported in the attached Supplemental File (PDF). Reported detection limits were not normalized by air volume and sample data were evaluated relative to the method detection limit prior to the normalization step in data processing. Data below the detection limit are flagged with code 6 and no value reported ("nd").

Concentration Averages:
Data values are averages of 3 separate filter digestions, except when values were excluded because:
(a) a value was determined to be an outlier by the Grubbs Test;
(b) a value was below the method detection limit.

BCO-DMO Processing:
- renamed fields;
- added date/time fields in ISO8601 format and removed original day, month, year, and time columns.

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Data Files

File
Aerosols_Total_Leg1.csv (Comma Separated Values (.csv), 3.77 KB) MD5:0cb05b8415f536bbaae00b784940151f Primary data file for dataset ID 834230

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Supplemental Files

File
Total Aerosols PMT Leg 1 Detection Limits filename: Total_Aerosols_PMT_Leg1_Detection_Limits.pdf (Portable Document Format (.pdf), 177.73 KB) MD5:e007ed40a9c2c573bf46ba2ca553b0f7 Table of detection limits for each element reported in Clifton Buck's Total Aerosol data from Leg 1 of the GEOTRACES PMT cruise.

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Related Publications

Morton, P. L., Landing, W. M., Hsu, S.-C., Milne, A., Aguilar-Islas, A. M., Baker, A. R., ... Zamora, L. M. (2013). Methods for the sampling and analysis of marine aerosols: results from the 2008 GEOTRACES aerosol intercalibration experiment. Limnology and Oceanography: Methods, 11(2), 62–78. doi:10.4319/lom.2013.11.62
Methods

Shelley, R. U., Morton, P. L., & Landing, W. M. (2015). Elemental ratios and enrichment factors in aerosols from the US-GEOTRACES North Atlantic transects. Deep Sea Research Part II: Topical Studies in Oceanography, 116, 262–272. doi:10.1016/j.dsr2.2014.12.005
Methods

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Related Datasets

IsContinuedBy

Buck, C. S., Marsay, C., Landing, W. M. (2021) **Total aerosol trace elements from bulk aerosol 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.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2020-12-18 doi:10.26008/1912/bco-dmo.834243.1 [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
Cruise_id	Cruise identifier	unitless
GEOTRC_EVENTNO	Event number	unitless
GEOTRC_SAMPNO	GEOTRACES sample number	unitless
Julian_Day	Sampling start Julian day	unitless
Start_ISO_DateTime_UTC	Date and time (UTC) at start of sample collection; formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
Start_Lat	Latitude at start of sample collection	degrees North

Start_Long	Longitude at start of sample collection	degrees East
End_ISO_DateTime_UTC	Date and time (UTC) at end of sample collection; formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
End_Lat	Latitude at end of sample collection	degrees North
End_Long	Longitude at end of sample collection	degrees East
Air_Vol_Total	Total volume of air sampled per filter	cubic meters (m^3)
Al_A_T_CONC_HIVOL_vzysau	Total particulate aerosol Al concentration, average	picomoles per cubic meter (pmol/m^3)
SD1_Al_A_T_CONC_HIVOL_vzysau	One standard deviation of Al_A_T_CONC_HIVOL_vzysau	picomoles per cubic meter (pmol/m^3)
Flag_Al_A_T_CONC_HIVOL_vzysau	Quality flag for Al_A_T_CONC_HIVOL_vzysau	unitless
Co_A_T_CONC_HIVOL_t5blmu	Total particulate aerosol Co concentration, average	picomoles per cubic meter (pmol/m^3)
SD1_Co_A_T_CONC_HIVOL_t5blmu	One standard deviation of Co_A_T_CONC_HIVOL_t5blmu	picomoles per cubic meter (pmol/m^3)
Flag_Co_A_T_CONC_HIVOL_t5blmu	Quality flag for Co_A_T_CONC_HIVOL_t5blmu	unitless
Cr_A_T_CONC_HIVOL_urgmp9	Total particulate aerosol Cr concentration, average	picomoles per cubic meter (pmol/m^3)
SD1_Cr_A_T_CONC_HIVOL_urgmp9	One standard deviation of Cr_A_T_CONC_HIVOL_urgmp9	picomoles per cubic meter (pmol/m^3)
Flag_Cr_A_T_CONC_HIVOL_urgmp9	Quality flag for Cr_A_T_CONC_HIVOL_urgmp9	unitless
Cu_A_T_CONC_HIVOL_zcxec3	Total particulate aerosol Cu concentration, average	picomoles per cubic meter (pmol/m^3)
SD1_Cu_A_T_CONC_HIVOL_zcxec3	One standard deviation of Cu_A_T_CONC_HIVOL_zcxec3	picomoles per cubic meter (pmol/m^3)
Flag_Cu_A_T_CONC_HIVOL_zcxec3	Quality flag for Cu_A_T_CONC_HIVOL_zcxec3	unitless
Fe_A_T_CONC_HIVOL_lzv6fm	Total particulate aerosol Fe concentration, average	picomoles per cubic meter (pmol/m^3)
SD1_Fe_A_T_CONC_HIVOL_lzv6fm	One standard deviation of Fe_A_T_CONC_HIVOL_lzv6fm	picomoles per cubic meter (pmol/m^3)
Flag_Fe_A_T_CONC_HIVOL_lzv6fm	Quality flag for Fe_A_T_CONC_HIVOL_lzv6fm	unitless

Mn_A_T_CONC_HIVOL_6xvnxr	Total particulate aerosol Mn concentration, average	picomoles per cubic meter (pmol/m^3)
SD1_Mn_A_T_CONC_HIVOL_6xvnxr	One standard deviation of Mn_A_T_CONC_HIVOL_6xvnxr	picomoles per cubic meter (pmol/m^3)
Flag_Mn_A_T_CONC_HIVOL_6xvnxr	Quality flag for Mn_A_T_CONC_HIVOL_6xvnxr	unitless
Ni_A_T_CONC_HIVOL_bornuk	Total particulate aerosol Ni concentration, average	picomoles per cubic meter (pmol/m^3)
SD1_Ni_A_T_CONC_HIVOL_bornuk	One standard deviation of Ni_A_T_CONC_HIVOL_bornuk	picomoles per cubic meter (pmol/m^3)
Flag_Ni_A_T_CONC_HIVOL_bornuk	Quality flag for Ni_A_T_CONC_HIVOL_bornuk	unitless
Pb_A_T_CONC_HIVOL_ngecen	Total particulate aerosol Pb concentration, average	picomoles per cubic meter (pmol/m^3)
SD1_Pb_A_T_CONC_HIVOL_ngecen	One standard deviation of Pb_A_T_CONC_HIVOL_ngecen	picomoles per cubic meter (pmol/m^3)
Flag_Pb_A_T_CONC_HIVOL_ngecen	Quality flag for Pb_A_T_CONC_HIVOL_ngecen	unitless
Ti_A_T_CONC_HIVOL_nzb78m	Total particulate aerosol Ti concentration, average	picomoles per cubic meter (pmol/m^3)
SD1_Ti_A_T_CONC_HIVOL_nzb78m	One standard deviation of Ti_A_T_CONC_HIVOL_nzb78m	picomoles per cubic meter (pmol/m^3)
Flag_Ti_A_T_CONC_HIVOL_nzb78m	Quality flag for Ti_A_T_CONC_HIVOL_nzb78m	unitless
V_A_T_CONC_HIVOL_nclmcz	Total particulate aerosol V concentration, average	picomoles per cubic meter (pmol/m^3)
SD1_V_A_T_CONC_HIVOL_nclmcz	One standard deviation of V_A_T_CONC_HIVOL_nclmcz	picomoles per cubic meter (pmol/m^3)
Flag_V_A_T_CONC_HIVOL_nclmcz	Quality flag for V_A_T_CONC_HIVOL_nclmcz	unitless
Zn_A_T_CONC_HIVOL_jsnc4j	Total particulate aerosol Zn concentration, average	picomoles per cubic meter (pmol/m^3)
SD1_Zn_A_T_CONC_HIVOL_jsnc4j	One standard deviation of Zn_A_T_CONC_HIVOL_jsnc4j	picomoles per cubic meter (pmol/m^3)
Flag_Zn_A_T_CONC_HIVOL_jsnc4j	Quality flag for Zn_A_T_CONC_HIVOL_jsnc4j	unitless

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Instruments

Dataset-specific Instrument Name	Tisch Environmental high-volume (~1 m3 air min-1) aerosol samplers (model 5170V-BL)
Generic Instrument Name	Aerosol Sampler
Generic Instrument Description	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

Dataset-specific Instrument Name	anemometer
Generic Instrument Name	Anemometer
Generic Instrument Description	An anemometer is a device for measuring the velocity or the pressure of the wind. It is commonly used to measure wind speed. Aboard research vessels, it is often mounted with other meteorological instruments and sensors.

Dataset-specific Instrument Name	Campbell Scientific CR800 data-logger
Generic Instrument Name	Data Logger
Generic Instrument Description	Electronic devices that record data over time or in relation to location either with a built-in instrument or sensor or via external instruments and sensors.

Dataset-specific Instrument Name	Perkin Elmer Nexion 300D ICP-Mass Spectrometer
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Generic Instrument Description	An ICP Mass Spec is an instrument that passes nebulized samples into an inductively-coupled gas plasma (8-10000 K) where they are atomized and ionized. Ions of specific mass-to-charge ratios are quantified in a quadrupole mass spectrometer.

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Deployments

RR1814

Website	https://www.bco-dmo.org/deployment/776913
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	2018-09-18
End Date	2018-10-21
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RR1814

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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.

Collaborative Research: US GEOTRACES PMT: Quantification of Atmospheric Deposition and Trace Element Fractional Solubility (PMT Aerosol Collection)

Coverage: Pacific Ocean along 152 W

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 of which is from the atmosphere: dust falling from the air, and rain, both deliver elements to the sea surface. This project would collect and analyze samples of rainwater and of particles from the atmosphere, along a U.S. GEOTRACES expedition from Alaska to Tahiti in the fall of 2018. The timing of the expedition corresponds to the part of the year with the highest atmospheric dust concentrations in the Gulf of Alaska and may also capture the tail end of peak fire season in Asia. In contrast, the southern end of the proposed ship track is known to have very low atmospheric dust. Aerosols will be influenced by human activity in Asia as well. The anticipated differences in atmospheric deposition along the ship track will allow the assessment of the role of this process on trace element and isotope cycling. The project will support a postdoctoral investigator. The relevance of ocean-atmosphere studies to the public will be communicated at campus open house events and in online forums in collaboration with the GEOTRACES management team.

In alignment with the mission of GEOTRACES, the proposed research will address the following biogeochemical and oceanographic questions: 1) What is the magnitude of atmospheric aerosol deposition (wet and dry) to the surface of the Pacific Ocean? 2) What is the chemical composition of these aerosols and how does composition vary based on source (e.g. Alaskan glacial flour, Asian mineral dust, emissions from biomass burning, anthropogenic emissions)? 3)

What is the fractional solubility of trace elements in Pacific aerosols and does solubility vary based on aerosol source? 4) What is the potential bioavailability of soluble aerosol Fe? 5) How is the soluble fraction of aerosol trace elements distributed across operationally defined size classes? 6) How does atmospheric deposition impact distributions of other GEOTRACES parameters? Atmospheric aerosol and precipitation samples will be collected over the 70-day expedition and the investigators will provide sub-samples to collaborators and other interested scientists. These samples will be analyzed for a suite of key trace elements from bulk and size-fractionated aerosol samples, aerosol leachates, and rain samples. A sequential extraction scheme designed to solubilize aerosol Fe as a function of its FeOx morphology and particle size will be used on selected samples because an understanding of aerosol trace element fractional solubility is fundamental to future work to assess the bioavailability of aerosol derived trace elements. The proposed work will provide data that directly contribute to the GEOTRACES objectives related to atmospheric deposition and will help to address temporal variability as this cruise section follows the CLIVAR/Repeat Hydrography P16N line.

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-1756103
NSF Division of Ocean Sciences (NSF OCE)	OCE-1756104

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