Acetic acid leachable trace metals from bulk aerosol samples collected during the US GEOTRACES EPZT section cruise (R/V Thomas G. Thompson TN303) in the Eastern Tropical Pacific from October to December 2013

Website: https://www.bco-dmo.org/dataset/709276
Data Type: Cruise Results
Version: 2
Version Date: 2020-05-26

Project
» U.S. GEOTRACES East Pacific Zonal Transect (GP16) (U.S. GEOTRACES EPZT)
» GEOTRACES Pacific section: Collection and analysis of atmospheric deposition (EPZT Aerosol Collection)

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

Contributors	Affiliation	Role
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Abstract
Atmospheric input is important to the biogeochemical cycling of trace metals in the ocean. The fraction of aerosol trace metals that can potentially dissolve after deposition is of interest for improving knowledge of aerosol/surface ocean interactions. This dataset provides acetic acid leachable trace metal values from bulk aerosol from the Equatorial Pacific along the US GEOTRACES EPTZ transect (TN303) from Peru to Tahiti. This region is characterized as one of the lowest atmospheric deposition regimes in the ocean. Bulk aerosols were collected from the boundary layer (~15 m above sea level) using a high-volume aerosol sampler drawing approximately 1.2 cubic meters of air per minute over Whatman 41 ash-less filter discs. Despite low aerosol loadings, triplicate agreement for most samples was good for Al, Ti, V, Mn, Fe, and Cu. Away from the coast, Cd and Pb values in most samples were close to, or below detection limit. Acetic acid leaches were carried out with a combination of 25% acetic acid and a reducing agent. Leachable trace metal concentrations were determined at the University of Alaska Fairbanks by inductively coupled plasma mass spectrometry (Thermo Element-2) using external calibration curves. The aerosol trace metal fractional solubility was calculated as a percent of the total bulk aerosol data from the same cruise (https://www.bco-dmo.org/dataset/675632).

Table of Contents

- Coverage
- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Data Files
- Related Publications
- Parameters
- Instruments
- Deployments
- Project Information
- Program Information
- Funding

Coverage

Spatial Extent: **N**:-4.07 **E**:-77.657 **S**:-16.0003 **W**:-152.0003
Temporal Extent: 2013-10-26 - 2013-12-16

Dataset Description

This dataset contains acetic acid leachable trace metals from bulk aerosol samples collected during the 2013 US GEOTRACES EPZT section cruise, TN303, on R/V Thomas G. Thompson.

Methods & Sampling

Samples were collected using Florida State University's high vol aerosol sampler (Tisch Environmental TSP TE5170V), located on the 03 deck, forward railings. Samples were collected at the rate of 1 cubic meter per minute on Whatman 41, 47 mm discs (cellulose esters; W41) and were acid cleaned. Methods are described in Morton et al. (2013).

Data Processing Description

Data have been corrected for field and analytical blank. Reported aerosol trace element concentrations values have been normalized to the volume of air filtered during sample collection. Fractional solubility values are relative to total particulate aerosols. Each sample collection period (n = 17) produced 36 replicate filters. Three of those filters were digested to produce three replicate measurements of total particulate aerosols, and a second set of three filters were leached with acetic acid and a reducing agent to produce three replicate measurements of aerosol leachable trace metals. In the majority of cases, the triplicates were above the field blank value and were in good agreement. 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.

Quality flag codes:
Codes follow the SeaDataNet scheme (https://www.geotraces.org/geotraces-quality-flag-policy/)
BDL = below detection limit;
0 = No QC performed;
1 = Good data;
2 = Probably good data;
3 = Probably bad data that is potentially correctable;
4 = Bad data;
5 = Value changed;
6 = Sample < blank;
8 = Interpolated value;
9 = Missing value.

BCO-DMO Processing:
- modified parameter names to conform with BCO-DMO naming conventions;
- replaced missing data values of -999 and -9999 with "nd";
- added date-time columns in ISO8601 format.

Version History:

26 May 2020 (current version) - replaced entire dataset using GEOTRACES DOoR format.
19 Jul 2017 - original version.

[table of contents | back to top]

Data Files

File
acetic_acid_leachable.csv (Comma Separated Values (.csv), 4.70 KB) MD5:a36d168ae7ff40d2592e555ae341bb5b Primary data file for dataset ID 709276

[table of contents | back to top]

Related Publications

Berger, C. J. M., Lippiatt, S. M., Lawrence, M. G., & Bruland, K. W. (2008). Application of a chemical leach technique for estimating labile particulate aluminum, iron, and manganese in the Columbia River plume and coastal waters off Oregon and Washington. Journal of Geophysical Research, 113. doi:10.1029/2007jc004703
https://doi.org/10.1029/2007JC004703
Methods

Kadko, D., Aguilar-Islas, A., Buck, C. S., Fitzsimmons, J. N., Landing, W. M., Shiller, A., … Anderson, R. F. (2020). Sources, fluxes and residence times of trace elements measured during the U.S. GEOTRACES East Pacific Zonal Transect. Marine Chemistry, 222, 103781. doi:10.1016/j.marchem.2020.103781
General

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

[table of contents | back to top]

Parameters

Parameter	Description	Units
Station_ID	Station number	unitless
Start_Date_UTC	Sampling date; format: DD/MM/YYYY	unitless
Start_Time_UTC	Sampling start time; format: hh:mm	unitless
Start_ISO_DateTime_UTC	Sampling start date and time (UTC) formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
End_Date_UTC	Sampling end date; format: DD/MM/YYYY	unitless
End_Time_UTC	Sampling end time; format: hh:mm	unitless
End_ISO_DateTime_UTC	Sampling end date and time (UTC) formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
Start_Latitude	Sampling start latitude	degrees North
Start_Longitude	Sampling start longitude	degrees East
End_Latitude	Sampling end latitude	degrees North
End_Longitude	Sampling end longitude	degrees East
Event_ID	Event number	unitless
Sample_ID	GEOTRACES sample number	unitless
Sample_Depth	Sample depth	meters (m)
air_vol_total	Total volume of air sampled	cubic meters (m3)
Al_A_SSLHAC_CONC_HIVOL_88qmbp	Acetic Acid Leachable particulate aerosol Al concentration, average of 3 replicates. Detection limit = 0.19 ng/m3.	nanograms per cubic meter (ng/m3)
SD1_Al_A_SSLHAC_CONC_HIVOL_88qmbp	One standard deviation of Al_A_SSLHAC_CONC_HIVOL_88qmbp	nanograms per cubic meter (ng/m3)
Flag_Al_A_SSLHAC_CONC_HIVOL_88qmbp	Quality flag for Al_A_SSLHAC_CONC_HIVOL_88qmbp	unitless

Cd_A_SSLHAC_CONC_HIVOL_9mt6ne	Acetic Acid Leachable particulate aerosol Cd concentration, average of 3 replicates. Detection limit = 0.0026 ng/m3.	nanograms per cubic meter (ng/m3)
SD1_Cd_A_SSLHAC_CONC_HIVOL_9mt6ne	One standard deviation of Cd_A_SSLHAC_CONC_HIVOL_9mt6ne	nanograms per cubic meter (ng/m3)
Flag_Cd_A_SSLHAC_CONC_HIVOL_9mt6ne	Quality flag for Cd_A_SSLHAC_CONC_HIVOL_9mt6ne	unitless
Cu_A_SSLHAC_CONC_HIVOL_zmurzd	Acetic Acid Leachable particulate aerosol Cu concentration, average of 3 replicates. Detection limit = 0.001 ng/m3.	nanograms per cubic meter (ng/m3)
SD1_Cu_A_SSLHAC_CONC_HIVOL_zmurzd	One standard deviation of Cu_A_SSLHAC_CONC_HIVOL_zmurzd	nanograms per cubic meter (ng/m3)
Flag_Cu_A_SSLHAC_CONC_HIVOL_zmurzd	Quality flag for Cu_A_SSLHAC_CONC_HIVOL_zmurzd	unitless
Fe_A_SSLHAC_CONC_HIVOL_9ytn8o	Acetic Acid Leachable particulate aerosol Fe concentration, average of 3 replicates. Detection limit = 0.72 ng/m3.	nanograms per cubic meter (ng/m3)
SD1_Fe_A_SSLHAC_CONC_HIVOL_9ytn8o	One standard deviation of Fe_A_SSLHAC_CONC_HIVOL_9ytn8o	nanograms per cubic meter (ng/m3)
Flag_Fe_A_SSLHAC_CONC_HIVOL_9ytn8o	Quality flag for Fe_A_SSLHAC_CONC_HIVOL_9ytn8o	unitless
Mn_A_SSLHAC_CONC_HIVOL_wq15vx	Acetic Acid Leachable particulate aerosol Mn concentration, average of 3 replicates. Detection limit = 0.004 ng/m3.	nanograms per cubic meter (ng/m3)
SD1_Mn_A_SSLHAC_CONC_HIVOL_wq15vx	One standard deviation of Mn_A_SSLHAC_CONC_HIVOL_wq15vx	nanograms per cubic meter (ng/m3)
Flag_Mn_A_SSLHAC_CONC_HIVOL_wq15vx	Quality flag for Mn_A_SSLHAC_CONC_HIVOL_wq15vx	unitless
Pb_A_SSLHAC_CONC_HIVOL_nr31qu	Acetic Acid Leachable particulate aerosol Pb concentration, average of 3 replicates. Detection limit = 0.091 ng/m3.	nanograms per cubic meter (ng/m3)
SD1_Pb_A_SSLHAC_CONC_HIVOL_nr31qu	One standard deviation of Pb_A_SSLHAC_CONC_HIVOL_nr31qu	nanograms per cubic meter (ng/m3)
Flag_Pb_A_SSLHAC_CONC_HIVOL_nr31qu	Quality flag for Pb_A_SSLHAC_CONC_HIVOL_nr31qu	unitless
Ti_A_SSLHAC_CONC_HIVOL_bdezwf	Acetic Acid Leachable particulate aerosol Ti concentration, average of 3 replicates. Detection limit = 0.003 ng/m3.	nanograms per cubic meter (ng/m3)
SD1_Ti_A_SSLHAC_CONC_HIVOL_bdezwf	One standard deviation of Ti_A_SSLHAC_CONC_HIVOL_bdezwf	nanograms per cubic meter (ng/m3)
Flag_Ti_A_SSLHAC_CONC_HIVOL_bdezwf	Quality flag for Ti_A_SSLHAC_CONC_HIVOL_bdezwf	unitless
V_A_SSLHAC_CONC_HIVOL_bsytua	Acetic Acid Leachable particulate aerosol V concentration, average of 3 replicates. Detection limit = 0.0002 ng/m3.	nanograms per cubic meter (ng/m3)
SD1_V_A_SSLHAC_CONC_HIVOL_bsytua	One standard deviation of V_A_SSLHAC_CONC_HIVOL_bsytua	nanograms per cubic meter (ng/m3)
Flag_V_A_SSLHAC_CONC_HIVOL_bsytua	Quality flag for V_A_SSLHAC_CONC_HIVOL_bsytua	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Tisch Environmental TSP TE5170V
Generic Instrument Name	Aerosol Sampler
Generic Instrument Description	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

[table of contents | back to top]

Deployments

TN303

Website	https://www.bco-dmo.org/deployment/499719
Platform	R/V Thomas G. Thompson
Report	http://dmoserv3.whoi.edu/data_docs/GEOTRACES/EPZT/GT13_EPZT_ODFReport_All.pdf
Start Date	2013-10-25
End Date	2013-12-20
Description	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] Additional cruise information is available from the Rolling Deck to Repository (R2R): http://www.rvdata.us/catalog/TN303

[table of contents | back to top]

Project Information

U.S. GEOTRACES East Pacific Zonal Transect (GP16) (U.S. GEOTRACES EPZT)

Website: http://www.geotraces.org/

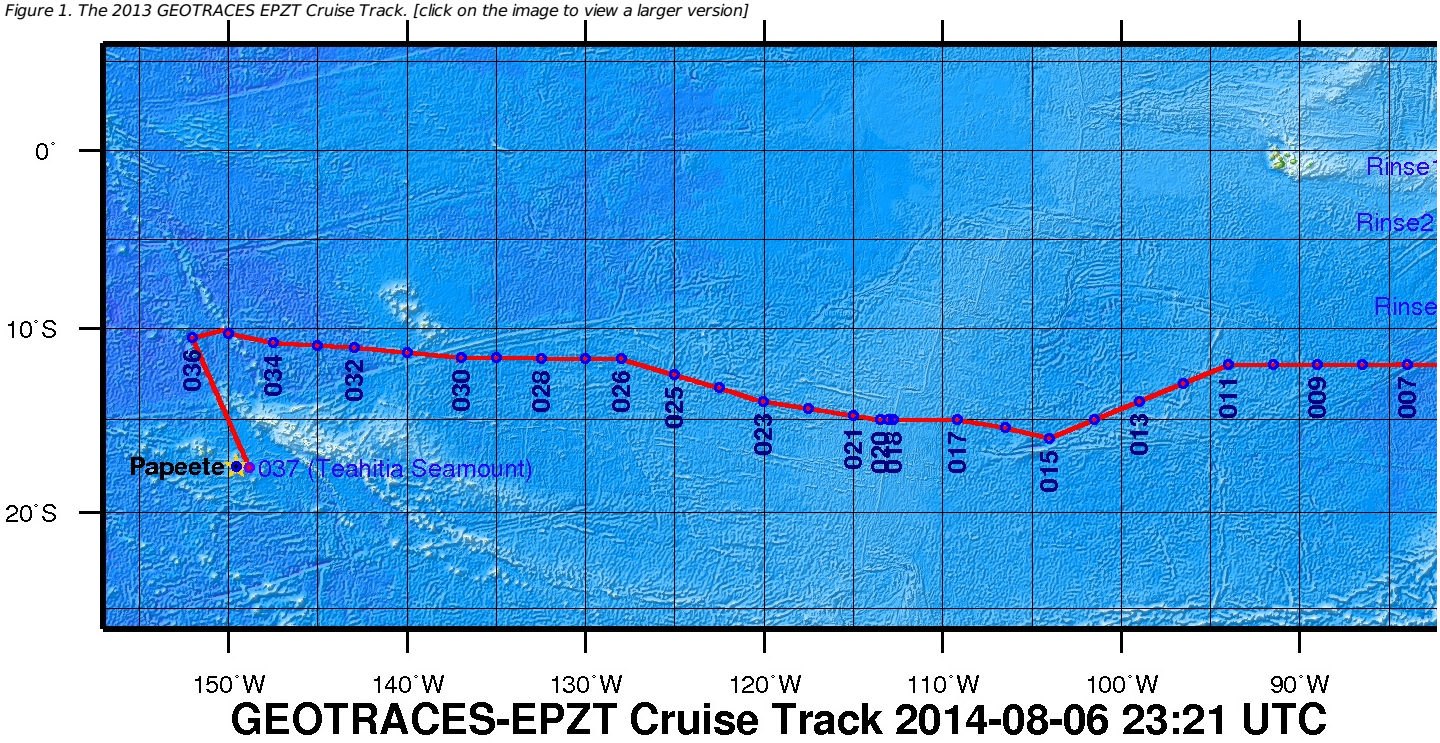
Coverage: Eastern Tropical Pacific - Transect from Peru to Tahiti (GP16)

From the NSF Award Abstract
The mission of the International GEOTRACES Program (https://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 uM 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]



GEOTRACES Pacific section: Collection and analysis of atmospheric deposition (EPZT Aerosol Collection)

Coverage: Eastern Tropical South Pacific

During the 2013 GEOTRACES Eastern Pacific zonal transect, a gradient in aerosol inputs to surface waters will be encountered with higher inputs near Peru and decreasing offshore. This zonal section contrasts sharply to the high aerosol deposition areas found and sampled during the GEOTRACES North Atlantic Zonal Section in the fall of 2010 and 2011. As such, this Pacific section represents a unique opportunity to characterize aerosol and rainfall chemistry in a low deposition environment. Scientists from the University of Alaska and Florida State University plan to collect and characterize aerosol and rainfall samples along this transect, as well as distribute samples to the community. Bulk and size-fractionated aerosol samples collected on a 24 to 48-hour integrated basis and event-based rain samples will be analyzed for trace elements and isotopes (TEIs) to quantify their atmospheric input. The TEIs to be analyzed will be aluminum, vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc, cadmium, lead, and thorium, as well as the major ions sodium, magnesium, potassium, calcium, nitrate, phosphate, chlorine, and fluorine. Other efforts to be carried out as part of this study include (1) aerosol leaches to determine seawater-soluble and ultrapure-water-soluble TEI fractions: (2) determine the size fractionation and redox speciation of seawater-soluble iron: (3) obtain subsamples of water column samples from other GEOTRACES scientists for the analysis of the TEIs of interest to help interpret the atmospheric deposition data; and (4) collaborate with researchers from other institutions to characterize and constrain estimates of atmospheric deposition. This project will contribute towards the overall goal of the GEOTRACES Program by establishing the range of fractional aerosol solubility and better quantify deposition across the global ocean.

One graduate student from the University of Alaska would be supported and trained as part of this project. Relying on a cruise blog, email, and project website updates, the scientist from the University of Alaska plans to continue her interactions with students in Alaska, Arizona, and Florida and results from the study would be incorporated into class curricula, as well as disseminated via public outreach and web dissemination.

[table of contents | back to top]

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]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1234417
NSF Division of Ocean Sciences (NSF OCE)	OCE-1454368

[table of contents | back to top]