

Dataset: 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

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

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 EPZT 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 couple 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>). For a complete list of measurements, refer to the supplemental document 'Field_names.pdf', and a full dataset description is included in the supplemental file 'Dataset_description.pdf'. The most current version of this dataset is available at: <http://www.bco-dmo.org/dataset/709276>

Description: Acetic acid leachable trace metals from bulk aerosol samples collected during the 2013 US GEOTRACES EPZT section cruise

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.

Acquisition Description: 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, P. L., Landing, W.M., Hsu, S.-C., Milne, A., Aguilar-Islas, A.M., Baker, A.R., Bowie, A.R., Buck, C.S., Gao, Y., Gichuki, S., Hastings, M.G., Hatta, M., Johansen, A. M., Losno, R., Mead, C., Patey, M.D., Swarr, G., Vandermark, A., 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: 62-78. doi:[10.4319/lom.2013.11.62](https://doi.org/10.4319/lom.2013.11.62)

Berger, C. J. M., Lippiatt, S. M., Lawrence, M. G., and 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-Oceans*, 113. doi:[10.1029/2007JC004703](https://doi.org/10.1029/2007JC004703)

Processing Data have been corrected for field and analytical blank. Reported aerosol trace
Description: 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:

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 and "no value" with "nd";
- added ISO_DateTime fields using date and time fields provided in original

dataset;

- joined to the BCO-DMO master file to add station, event, etc. fields.

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, EXPOCODE, 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.

Project Information

U.S. GEOTRACES East Pacific Zonal Transect

From the NSF Award Abstract The mission of the International GEOTRACES Program (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 μM 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

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.

Deployment Information

Deployment description for R/V Thomas G. Thompson TN303

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

Instrument Information

Instrument	Tisch Environmental TSP TE5170V
Description	<i>local description not specified</i>
Generic Instrument Name	Aerosol Sampler
Generic Instrument Description	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.