Dissolved Gallium (Ga) from R/V Thomas G. Thompson cruise TN303 (GP16) in the Eastern Tropical Pacific in 2013 (U.S. GEOTRACES EPZT project)

Website: https://www.bco-dmo.org/dataset/756982
Data Type: Cruise Results
Version: 2
Version Date: 2020-12-15

Project
» U.S. GEOTRACES East Pacific Zonal Transect (GP16) (U.S. GEOTRACES EPZT)
» Geotraces Pacific Section: Gallium, vanadium, and associated elements indicative of dust input and redox cycling (EPZT_Ga_V_others)

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

Contributors	Affiliation	Role
Shiller, Alan M.	University of Southern Mississippi (USM)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset reports dissolved gallium (Ga) concentrations from samples collected on R/V Thomas G. Thompson cruise TN303 (GP16) in the Eastern Tropical Pacific in 2013 as part of the U.S. GEOTRACES EPZT project.

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Coverage

Spatial Extent: **N**:-10.224 **E**:-77.3761 **S**:-16.0006 **W**:-152.079
Temporal Extent: 2013-10-28 - 2013-12-17

Methods & Sampling

Clean seawater samples were collected from two sources; a GEOTRACES CTD referred to as GT-C/12L GoFlo, and the Super-GeoFISH towed surface vehicle. For more information on these methods, see the cruise report and the GeoFish Instrument Description.

Water column samples were filtered through pre-cleaned, 0.2 µm Pall Acropak Supor filter capsules as described elsewhere (e.g., Cutter & Bruland 2012; Hatta et al., 2015). Near surface water samples were collected using an underway towed-fish pumped seawater system (Bruland et al., 2005) with samples filtered through sequential 0.45 µm Osmonics and 0.2 µm Polycarbonate (PCTE) cartridge filters. Filtered water was collected in 125 mL HDPE bottles (Nalgene) that had been precleaned by soaking in hot 1.2 M HCl (reagent grade) for at least 8 h with subsequent thorough rinsing with ultrapure distilled deionized water (Barnstead E-pure). Samples were acidified in a laminar flow bench aboard ship using 0.5 mL of ultrapure HCl per 125 mL sample.

Dissolved Ga was determined by isotope dilution ICP-MS using a ThermoFisher Element 2 operated in low resolution. Samples were concentrated using $Mg(OH)_2$ co-precipitation (e.g., Shiller & Bairamadgi, 2006; Zurbrick et al., 2012). Briefly, in this technique, a small addition (~70 µL) of clean aqueous ammonia is added to the acidified seawater sample (~7.5 mL) which precipitates a fraction of the dissolved magnesium as the hydroxide, which in turn, scavenges the gallium from solution. An enriched isotope spike of known concentration was prepared using purified enriched ^{71}Ga (99.8%), obtained from Oak Ridge National Laboratories.

Because there is a significant interference of doubly charged ^{138}Ba with ^{69}Ga, the precipitate was washed three times with a solution of high purity 0.1% NH_4OH to minimize residual Ba. The precipitate was then dissolved in 550 mL ultrapure 3% HNO3 (Seastar Chemicals, Baseline) and analyzed in low resolution using a ThermoFinnigan Element 2 High Resolution Inductively Coupled Plasma Mass Spectrometer (HR-ICP-MS). Isotopes monitored on the ICP-MS were ^{69}Ga, ^{71}Ga, and ^{138}Ba. A slight correction for residual Ba was made based on the ratio of responses at masses 69 and 138 to a Ba standard solution. Because the residual salt content varied from sample to sample, it was not possible to matrix-match the Ba correction standard. However, typically, this correction affected the final result by < 2.5 pmol/kg; where higher Ba corrections were noted, the sample was reprecipitated and re-analyzed because of concerns about the accuracy of applying the Ba standard correction to samples of high salt content.

The reagent blank contribution to the dissolved Ga analysis is typically 0.6 pmol/kg and the detection limit (based on 3 times the standard deviation of the blank) is 0.3 pmol/kg. Repeated runs of US GEOTRACES intercalibration samples (GS and GD) and in-house reference solutions suggest a precision of +/- 4.0%; the limit of detection for Ga was 1.5 pmol/kg. Recovery of the method, as determined by repeated analysis of a spiked and unspiked seawater sample was 101.3 +/- 4.7%.

Data Processing Description

The dataset includes the SeaDataNet quality assurance flags described in the GEOTRACES Quality Flag Policy, which is available at https://www.geotraces.org/geotraces-quality-flag-policy/.

Quality flag descriptions:
0 = no quality control;
1 = good value;
2 = probably good value;
3 = probably bad value;
4 = bad value;
5 = changed value;
6 = value below detection;
7 = value in excess;
8 = interpolated value;
9 = missing value.

Reporting units are picomoles per kg-seawater. Conversion of instrumental counts-per-second intensities to concentration was done in MS Excel.

For intercalibration procedures, refer to the GP16 Gallium dissolved Intercalibration Report (PDF).

BCO-DMO Processing:
- modified parameter names;

- 2019-03-06 (v1): served revised data file received on 05 March 2019;
- 2020-12-15 (v1): served the DOoR-formatted version of the dataset; added event number and event date/time start columns by joining to previous version based on Sample_ID.

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Data Files

File
Ga_dissolved.csv (Comma Separated Values (.csv), 86.88 KB) MD5:0cbc3c463bad6ffb0ca7d9224cdf097d Primary data file for dataset ID 756982

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Supplemental Files

File
GP16 Gallium dissolved Intercalibration Report filename: 0000-0002-2068-7909-TN303-multiple-param-intercal-report.pdf (Portable Document Format (.pdf), 1.21 MB) MD5:a86db6ea60b525d9389a32e60a4bfc1b GEOTRACES Intercalibration Report for the GP16 Dissolved Gallium dataset reported by Alan Shiller.

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Related Publications

Bruland, K. W., Rue, E. L., Smith, G. J., & DiTullio, G. R. (2005). Iron, macronutrients and diatom blooms in the Peru upwelling regime: brown and blue waters of Peru. Marine Chemistry, 93(2-4), 81–103. doi:10.1016/j.marchem.2004.06.011
Methods

Cutter, G. A., & Bruland, K. W. (2012). Rapid and noncontaminating sampling system for trace elements in global ocean surveys. Limnology and Oceanography: Methods, 10(6), 425–436. doi:10.4319/lom.2012.10.425
Methods

Hatta, M., Measures, C. I., Wu, J., Roshan, S., Fitzsimmons, J. N., Sedwick, P., & Morton, P. (2015). An overview of dissolved Fe and Mn distributions during the 2010–2011 U.S. GEOTRACES north Atlantic cruises: GEOTRACES GA03. Deep Sea Research Part II: Topical Studies in Oceanography, 116, 117–129. doi:10.1016/j.dsr2.2014.07.005
Methods

Ho, P., Resing, J. A., & Shiller, A. M. (2019). Processes controlling the distribution of dissolved Al and Ga along the U.S. GEOTRACES East Pacific Zonal Transect (GP16). Deep Sea Research Part I: Oceanographic Research Papers, 147, 128–145. doi:10.1016/j.dsr.2019.04.009
Results

Shiller, A. M., & Bairamadgi, G. R. (2006). Dissolved gallium in the northwest Pacific and the south and central Atlantic Oceans: Implications for aeolian Fe input and a reconsideration of profiles. Geochemistry, Geophysics, Geosystems, 7(8). doi:10.1029/2005gc001118 https://doi.org/10.1029/2005GC001118
Methods

Zurbrick, C. M., Morton, P. L., Gallon, C., Shiller, A. M., Landing, W. M., & Flegal, A. R. (2012). Intercalibration of Cd and Pb concentration measurements in the northwest Pacific Ocean. Limnology and Oceanography: Methods, 10(4), 270–277. doi:10.4319/lom.2012.10.270
Methods

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Parameters

Parameter	Description	Units
Station_ID	Station number	unitless
Start_Date_UTC	Start date	unitless
Start_Time_UTC	Start time	unitless
ISO_DATETIME_UTC_START_EVENT	Date and time (UTC) at start of event; added by BCO-DMO; format: YYYY-MM-DDThh:mmZ	unitless
End_Date_UTC	End date	unitless
End_Time_UTC	End time	unitless
Start_Latitude	Latitude at start of sample collection	degrees North
Start_Longitude	Longitude at start of sample collection	degrees East
End_Latitude	Latitude at end of sample collection	degrees North
End_Longitude	Longitude at end of sample collection	degrees East
Event_ID	Event number; added by BCO-DMO	unitless
Cast	Cast number	unitless
Sample_ID	GEOTRACES sample number	unitless
Sample_Depth	Sample depth	meters (m)
Ga_D_CONC_FISH_ndt0dj	Dissolved Gallium (Ga) concentration from GeoFish samples	picomoles per kilogram (pmol/kg)
SD1_Ga_D_CONC_FISH_ndt0dj	One standard deviation of Ga_D_CONC_FISH_ndt0dj	picomoles per kilogram (pmol/kg)
Flag_Ga_D_CONC_FISH_ndt0dj	Quality flag for Ga_D_CONC_FISH_ndt0dj	unitless
Ga_D_CONC_BOTTLE_qmbktp	Dissolved Gallium (Ga) concentration from bottle samples	picomoles per kilogram (pmol/kg)
SD1_Ga_D_CONC_BOTTLE_qmbktp	One standard deviation of Ga_D_CONC_BOTTLE_qmbktp	picomoles per kilogram (pmol/kg)
Flag_Ga_D_CONC_BOTTLE_qmbktp	Quality flag for Ga_D_CONC_BOTTLE_qmbktp	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	GeoFish Towed near-Surface Sampler
Dataset-specific Description	Clean seawater samples were collected from two sources; a GEOTRACES CTD referred to as GT-C/12L GoFlo, and the Super-GeoFISH towed surface vehicle.
Generic Instrument Description	The GeoFish towed sampler is a custom designed near surface (

Dataset-specific Instrument Name	
Generic Instrument Name	GO-FLO Teflon Trace Metal Bottle
Dataset-specific Description	Clean seawater samples were collected from two sources; a GEOTRACES CTD referred to as GT-C/12L GoFlo, and the Super-GeoFISH towed surface vehicle.
Generic Instrument Description	GO-FLO Teflon-lined Trace Metal free sampling bottles are used for collecting water samples for trace metal, nutrient and pigment analysis. The GO-FLO sampling bottle is designed specifically to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

Dataset-specific Instrument Name	ThermoFisher Element 2
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

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

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Project Information

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

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

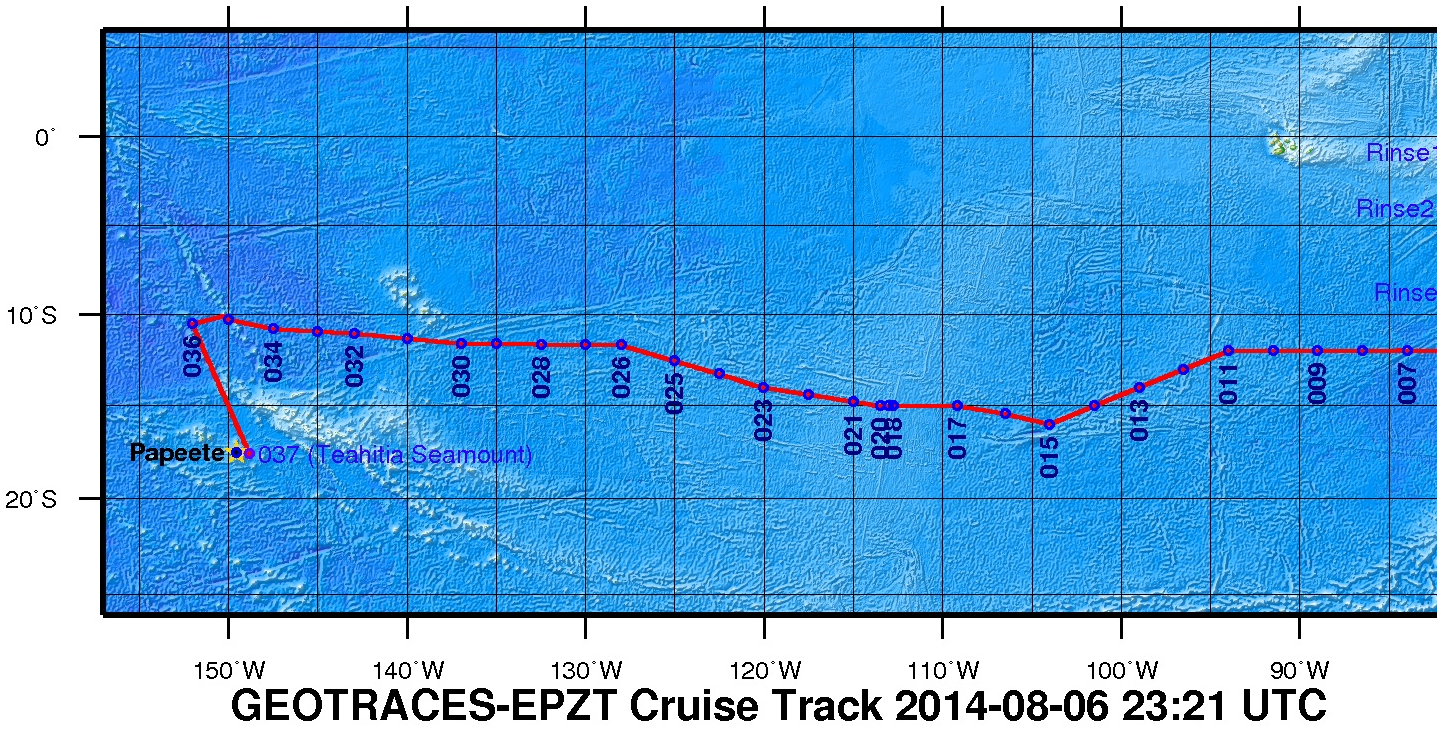
Coverage: Eastern Tropical Pacific - Transect from Peru to Tahiti (GP16)

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: Gallium, vanadium, and associated elements indicative of dust input and redox cycling (EPZT_Ga_V_others)

Coverage: Eastern Pacific

Extracted from the NSF award abstract:

During the 2013 GEOTRACES Eastern Pacific Zonal Section cruise, a scientist from the University of Southern Mississippi will determine the distributions of gallium (Ga) and vanadium (V), as well as V redox speciation. The planned cruise track is ideal for this effort because it will traverse various oceanic environments that influence the biogeochemistry of these elements namely, the Peru margin/upwelling zone and the associated oxygen minimum zone, gradients in atmospheric inputs and biological productivity from the Peru margin to Tahiti, and hydrothermal vents along the East Pacific Rise. Specific goals of the project include: (1) examine the discrepancy between surface water Ga and aluminum (Al) distributions and estimate dust inputs; (2) confirm the relationship observed in the North Pacific between the surface ocean Ga/Al ratio and the chlorophyll distribution; (3) compare the surface ocean manganese distribution with that of Ga, Al, and lead to differentiate between shelf and aerosol inputs; (4) determine if there is evidence of shelf V removal which contributes to the surface ocean V depletion; (5) test for hydrothermal influences on the V distribution downstream from the East Pacific Rise; and (6) compare V redox speciation with that of other elements including selenium, arsenic, and iodine as a means of examining the importance of water column reduction versus advective interactions with reducing coastal sediments. As such, the elements selected as the focus of this study, will provide information on dust input and redox cycling, especially when compared with other elements being determined by other cruise participants.

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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-1261214

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