Particulate Po-210 and Pb-210 data from US GEOTRACES East Pacific Zonal Transect from R/V Thomas G. Thompson TN303, from Peru to Tahiti, October to December 2013 (U.S. GEOTRACES EPZT project)

Website: https://www.bco-dmo.org/dataset/675444
Data Type: Cruise Results
Version:
Version Date: 2017-01-24

Project
» U.S. GEOTRACES East Pacific Zonal Transect (GP16) (U.S. GEOTRACES EPZT)
» GEOTRACES - 210Po and 210Pb distribution at Eastern Pacific Interface Regimes (GEOTRACES EPZT Po Pb)

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

Contributors	Affiliation	Role
Stewart, Gillian	Queens College (CUNY QC)	Principal Investigator
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Methods & Sampling

Sampling:

Small (1-51 µm) and large (> 51 µm) particles for particulate 210Po and 210Pb analyses were collected at 8 stations (5 super stations, 1 shelf station, and 2 full station) using McLane Research in situ pumps that had been modified to accommodate two flow paths (Ohnemus and Lam, 2015). At super stations, three casts (shallow, mid, and deep) were deployed to collect a 24-depth profile. At full stations, one shallow and one deep cast was deployed while one cast was deployed at shelf station. A Seabird 19plus CTD was deployed to verify target depths during deployment.

Filter holders (142 mm diameter) had two stages for two sized particles with multiple baffle systems for allowing even particle distribution (Bishop et al., 2012). Two-sized particles were collected on 51 µm pore size Sefar polyester mesh prefilter followed by paired 1 µm Whatman QMA quartz fiber filters. All filters and filter holders were previously acid leached as recommended in the GEOTRACES sample and sample-handing Protocols (Cutter et al., 2014).

The “dipped blank” filters were also deployed during each cast, exposed to seawater for the length of the pumping period, and processed and analyzed as regular samples. A total of 28 dipped blank filters were used for process blank subtraction.

Analytical Methodology:

At each depth, we got a ~ 16.4% subsample of the 1 µm QMA filter and a 37.5-62.5% subsample of the 53 µm polyester prefilter. Filters were digested using a mixture of strong acids (i.e. HCl, HNO3) after being spiked with a pre-calibrated 209Po tracer and stable lead carrier to monitor the losses during sample processing. The residual filter material was removed from the solution after being rinsed 3-5 times with strong acids. The solution was evaporated to near-dryness and then made in 0.5 M HCl, during which ascorbic acid was added to reduce the Fe(III). Polonium isotopes were extracted from the solution by depositing onto a silver disc (Flynn, 1968). Sliver discs (purity > 99.99%), 2 cm in diameter, were cleaned with a commercial silver polish, ethanol, and Millipore water. Only one side of the silver disc was for deposition with the other side being covered by electronic spray. After deposition, the activities of 209Po and 210Po were measured using Alpha Analyst Integrated Alpha Spectrometer (Canberra Inc.). The plating solution was then run through AG-18 anion exchange resin to remove any remaining polonium isotopes (Sarin et al., 1992), re-spiked with 209Po tracer, and stored for at least 6 months to allow for 210Po ingrowth. The samples were reanalyzed for 210Pb by re-plating of 210Po on a new sliver disc. After second plating, aliquots were taken for Pb recovery determination by measuring stable lead concentrations using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). The determination of the initial activities of 210Po and 210Pb in the sample at the time of collection involved the correction for decay and ingrowth between the time of sample collection and processing, chemical recoveries of Po and Pb, and dipped blank and detector background subtraction(Rigaud et al., 2013). The uncertainty (median) of 210Pb activity at the time of collection is about 6.5% and 8.8% in small and large particles, respectively. In contrast, the uncertainty (median) of 210Po is about 5.3% and 7.1% in small and large particles, respectively.

Data Processing Description

Also see section above. The 210Po and 210Pb activities were corrected for decay, ingrowth, isotope recoveries, dipped blank, and detector background.

All data quality are evaluated as:
0=good quality: no problems noted
4=questionable quality: anomalously high or low
8=bad quality: known issue with sample

BCO-DMO Processing:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- changed parameter from Po_LP_STDEV to Pb_LP_CONC_PUMP_STDEV
- reduced digits of PUMP_LAT and PUMP_LON from 8 to 4
- replaced blank cells with nd (no data)
- added the following columns by joining the submitted data with an Events Master file: GEOTRC_SAMPNO, GEOTRC_EVENTNO, GEOTRC_INSTR, EVENT_LAT, EVENT_LON, ISO_DATETIME_UTC_START_EVENT, DEPTH_MIN, DEPTH_MAX
- corrected ISO_DateTime_UTC for events #4013 and 4150

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.

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Data Files

File
PoPb_part_join.csv (Comma Separated Values (.csv), 28.59 KB) MD5:f49d735c8df51b9f09f6b58bf3b4852c Primary data file for dataset ID 675444

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Related Publications

Bishop, J. K. B., Lam, P. J., & Wood, T. J. (2012). Getting good particles: Accurate sampling of particles by large volume in-situ filtration. Limnology and Oceanography: Methods, 10(9), 681–710. doi:10.4319/lom.2012.10.681
Methods

Cutter, G.A., Andersson, P., Codispoti, L., Croot, P., Francois, R., Lohan, M., Obata, H., van der Loeff, M. R. (2014) Sampling and Sample-Handing Protocols for GEOTRACES Cruises (cookbook) Version 2.0; December 2014. http://www.geotraces.org/images/stories/documents/intercalibration/Cookbook_v2.pdf
Methods

Flynn, W. W. (1968). The determination of low levels of polonium-210 in environmental materials. Analytica Chimica Acta, 43, 221–227. doi:10.1016/s0003-2670(00)89210-7 https://doi.org/10.1016/S0003-2670(00)89210-7
Methods

Ohnemus, D. C., & Lam, P. J. (2015). Cycling of lithogenic marine particles in the US GEOTRACES North Atlantic transect. Deep Sea Research Part II: Topical Studies in Oceanography, 116, 283–302. doi:10.1016/j.dsr2.2014.11.019
Methods

Rigaud, S., Puigcorbé, V., Cámara-Mor, P., Casacuberta, N., Roca-Martí, M., Garcia-Orellana, J., … Church, T. (2013). A methods assessment and recommendations for improving calculations and reducing uncertainties in the determination of210Po and210Pb activities in seawater. Limnology and Oceanography: Methods, 11(10), 561–571. doi:10.4319/lom.2013.11.561
Methods

Sarin, M.M., Bhushan, R., Rengarajan, R., Yadav, D.N. (1992) Aquatic Surface Chemistry. Indian Journal of Marine Sciences 21, 121–127.
Methods

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Parameters

Parameter	Description	Units
CRUISE_ID	Cruise identifier	unitless
STNNBR	Station number	unitless
BTMDEPTH	Bottom depth	meters
PUMP_LAT	Latitude of pump sample; north is positive	decimal degrees
PUMP_LON	Longitude of pump sample; east is positive	decimal degrees
CASTNO	Cast number	unitless
GEOTRC_EVENTNO	GEOTRACES event number	unitless
EVENT_LAT	Latitude of cast event; north is positive. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	decimal degrees
EVENT_LON	Longitude of cast event; east is positive. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	decimal degrees
ISO_DATETIME_UTC_START_EVENT	ISO 8601:2004 standard date and time at start of event. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	YYYY-MM-DDTHH:MM:SS[.xx]Z
ISO_DateTime_UTC	ISO 8601:2004 standard date and time of the midpoint of pumping	YYYY-MM-DDTHH:MM:SS[.xx]Z
GEOTRC_SAMPNO	GEOTRACES sample number	unitless
DEPTH	Pump sampling depth	meters
DEPTH_MIN	minimum sampled depth	meters
DEPTH_MAX	maximum sampled depth	meters
Po_SP_CONC_PUMP	Particulate Po-210; Particulate: = 0.45 um; units: disintegration per minute (dpm) / 100 L of water from pump sample	210Po dpm 100L-1
Po_SP_CONC_PUMP_STDEV	Error as standard deviation	210Po dpm 100L-1
Po_SP_CONC_PUMP_QF	quality flag: 0 = good; 4 = questionable; 8 = bad	unitless
Pb_SP_CONC_PUMP	Particulate Pb-210; Particulate: = 0.45 um; units: disintegration per minute (dpm) / 100 L of water from pump sample	210Pb dpm 100L-1
Pb_SP_CONC_PUMP_STDEV	Error as standard deviation	210Pb dpm 100L-1
Pb_SP_CONC_PUMP_QF	quality flag: 0 = good; 4 = questionable; 8 = bad	unitless
Po_LP_CONC_PUMP	Particulate Po-210; Particulate: = 0.45 um; units: disintegration per minute (dpm) / 100 L of water from pump sample	210Po dpm 100L-1
Po_LP_CONC_PUMP_STDEV	Error as standard deviation	210Po dpm 100L-1
Po_LP_CONC_PUMP_QF	quality flag: 0 = good; 4 = questionable; 8 = bad	unitless
Pb_LP_CONC_PUMP	Particulate Pb-210; Particulate: = 0.45 um; units: disintegration per minute (dpm) / 100 L of water from pump sample	210Pb dpm 100L-1
Pb_LP_CONC_PUMP_STDEV	Error as standard deviation	210Pb dpm 100L-1
Pb_LP_CONC_PUMP_QF	quality flag: 0 = good; 4 = questionable; 8 = bad	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Dataset-specific Description	Used to verify target depths during deployment.
Generic Instrument Description	The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

Dataset-specific Instrument Name	
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	Used to measure stable lead concentrations.
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.

Dataset-specific Instrument Name	Alpha Analyst Integrated Alpha Spectrometer (Canberra Inc.)
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Used to measure 209Po and 210Po activity
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	
Generic Instrument Name	McLane Pump
Dataset-specific Description	Used to collect samples
Generic Instrument Description	McLane pumps sample large volumes of seawater at depth. They are attached to a wire and lowered to different depths in the ocean. As the water is pumped through the filter, particles suspended in the ocean are collected on the filters. The pumps are then retrieved and the contents of the filters are analyzed in a lab.

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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)

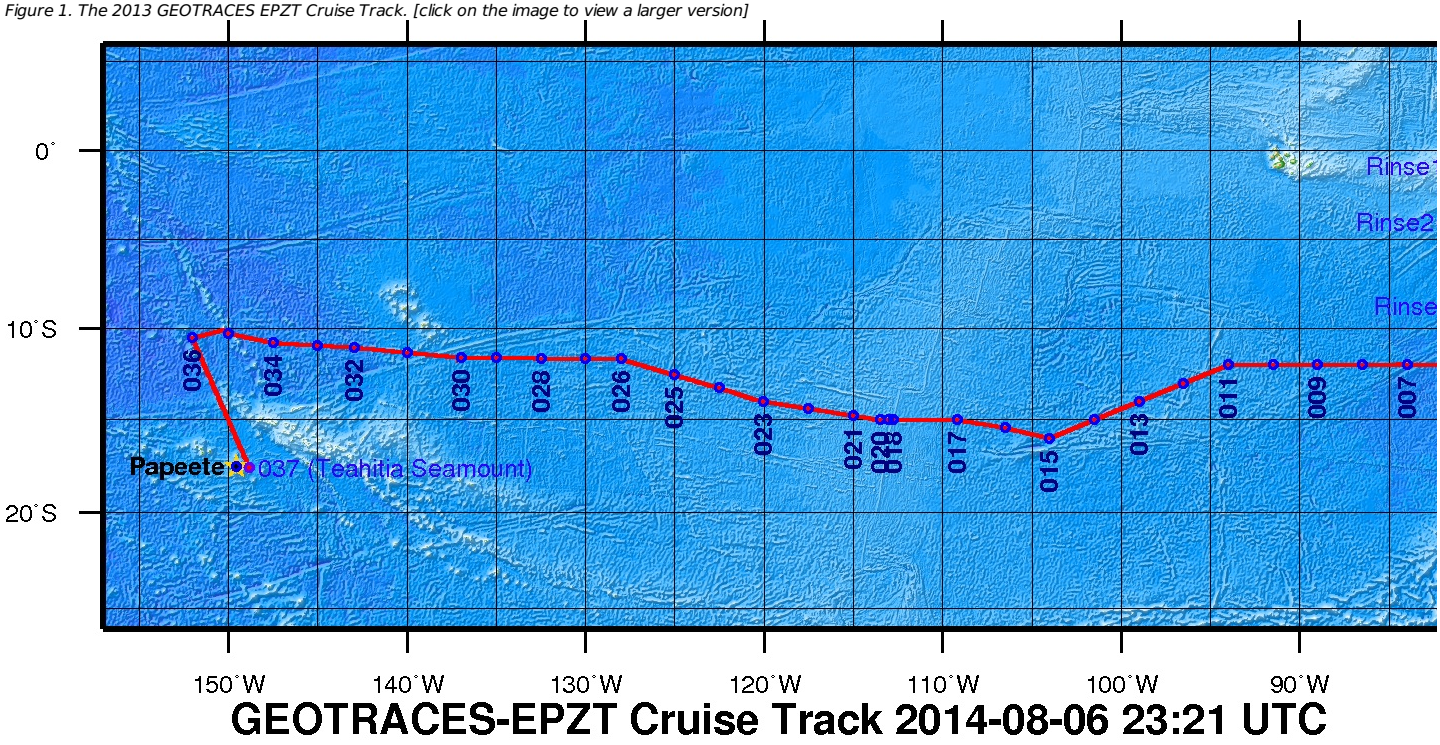
From the NSF Award Abstract
The mission of the International GEOTRACES Program (https://www.geotraces.org/), of which the U.S. chemical oceanography research community is a founding member, is "to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes 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 - 210Po and 210Pb distribution at Eastern Pacific Interface Regimes (GEOTRACES EPZT Po Pb)

Coverage: Eastern South Pacific

Extracted from the NSF award abstract

In 2013, a multi-institutional team of U.S. marine chemists and geochemists will launch a major expedition to the Pacific Ocean to map and study the distribution of trace elements and isotopes as part of the International GEOTRACES Program. Because of their proven value as natural tracers of both sedimentation dynamics and hydrodynamics in the sea, radioactive daughter isotopes in the natural U-Th radionuclide series will be of immense value to all GEOTRACES researchers. In particular the naturally-occurring Pb210/Po210 radioisotope pair would be useful for quantifying rates of particulate scavenging of other trace elements and isotopes of interest in the U.S.GEOTRACES Pacific campaign. This is because these two isotopes are themselves particle-reactive and radioactive, thus providing a natural clock for tracking the vertical transport of other particle-reactive substances.

In this project, researchers at Wayne State University and CUNY Queens College will sample and analyze several hundred dissolved and particulate (large and small) samples for 210Po and 210Pb along the U.S.GEOTRACES Eastern South Pacific section. About two thirds of the samples will be focused at six so-called "super stations" (sites chosen for intensive study), half above the main thermocline and the other half down across the benthic nepheloid layer (the zone of suspended material extending several meters above the seafloor). The depths will be chosen according to regional atmospheric input, ecosystems, and coordinated with sampling by other researchers onboard. The other third will be taken within the hydrothermal plume in the vicinity of the East Pacific Rise. The data will be synthesized according to interface scavenging models by particle types (e.g. fine/colloidal, lithogenic and biogenic). As such, the proposed work will be closely coordinated with that of other U.S.GEOTRACES PIs funded to study other particle-reactive or dissolved trace elements and radionuclide isotopes during the campaign.

BROADER IMPACTS: The broader impacts are closely linked to those of the GEOTRACES Program as a whole: to enhance (1) research infrastructure by providing a broad array of 210Po and 210Pb data useful for biogeochemical scavenging models, (2) education by mentoring graduate and undergraduate students, teaching by example from proposed research, (3) participation of under-represented students interested in careers in the geosciences, (4) research training of graduates in marine radiochemistry, and 5) public dissemination of results through publications, presentations, and on a dedicated public website at Wayne State University.

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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-1237108

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