Dissolved Ga and Ba from GEOTRACES Rosette bottles R/V Knorr cruises KN199-04 and KN204-01 (GA03) in the Subtropical northern Atlantic Ocean from 2010-2011 (U.S. GEOTRACES NAT project)

Website: https://www.bco-dmo.org/dataset/3827
Data Type: Cruise Results
Version: 2
Version Date: 2016-08-30

Project
» U.S. GEOTRACES North Atlantic Transect (GA03) (U.S. GEOTRACES NAT)

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

Contributors	Affiliation	Role
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Abstract
Dissolved Ga and Ba from GEOTRACES rosette bottles on R/V Knorr cruises KN199-04 and KN204-01 (GEOTRACES cruise GA03) in the Subtropical northern Atlantic Ocean from 2010-2011.

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Coverage

Spatial Extent: **N**:39.7007 **E**:-9.6601 **S**:17.3502 **W**:-69.813
Temporal Extent: 2010-10-16 - 2011-12-10

Dataset Description

Lab-based measurements of dissolved Gallium (Ga) and Barium (Ba) from GEOTRACES Rosette bottles from the 2010 and 2011 US GEOTRACES cruises (GT10 and GT11).

STATUS NOTE: These data were significantly updated on 30 August 2016. A volume correction had not been applied to the previous version, and thus all of the original values needed to be multiplied by 0.9805. This correction has been applied in the 30 August version, now available online. There were also some samples that were re-analyzed for Ba with the values revised accordingly. Additionally, the PIs withdrew the Pb data (in the original version) because higher quality Pb data are already available from these cruises.

Please note that some US GEOTRACES data may not be final, pending intercalibration results and further

analysis. If you are interested in following changes to US GEOTRACES NAT data, there is an RSS feed available via the BCO-DMO US GEOTRACES project page (scroll down and expand the "Datasets" section).

Methods & Sampling

The samples were collected for trace metal determinations at various stations from the RV Knorr using a custom-built US GEOTRACES trace metal clean rosette consisting of an epoxy painted Al rosette frame containing 24x12 L GO-FLO bottles (Cutter and Bruland, 2012). Immediately after the rosette was recovered, the tops of the GO-FLO bottles were covered with plastic bags and the bottles were removed from the frame and carried into the US GEOTRACES clean van for sub-sampling. The GO-FLO bottles were pressurized to 10 psi using 0.2 um-filtered compressed air and samples were filtered through 0.2 um Acropak or membrane filters. All sub-sampling was undertaken in the clean van using rigorous trace metal protocols. Additional surface water samples were collected from a clean underway sampling system and similarly filtered. **This dataset contains the bottle samples.** To see the surface data, refer to the GT10-11 - GaBa_surface dataset (see Related Datasets).

Ga and Ba were determined by isotope dilution ICP-MS using a ThermoFisher Element 2 operated in low resolution. For Ga, samples were concentrated using $Mg(OH)_2$ co-precipitation (Shiller & Bairamadgi, 2006; Zurbrick et al., 2012) while Ba was determined following 20-fold dilution in dilute nitric acid (Shim et al., 2012).

Data Processing Description

Quality flag: Assignment of quality flag is based on analytical and methodological considerations in conjunction with examination of profiles and replicate analyses. Scheme is based on WOCE bottle flags: good (2), questionable (3), bad (4), not reported (5), and sample not drawn from this bottle (9).

Reporting units are pico- or nano-moles per kg-seawater. Missing data were identified by 'nd'.

Precision: Ga = 6.5% at 30 pmol/kg; Ba = 3% at 37 nmol/kg
Limit of detection: Ga = 2 pmol/kg; Ba = 0.7 nmol/kg

BCO-DMO made the following modifications:
- values of '-999' were replaced with 'nd'.
- blanks (missing data) were replaced with 'nd'.
- parameter names were modified to conform with BCO-DMO and GEOTRACES naming conventions.
- added ISO_DateTime_UTC from the original date and time field provided by PI.

STATUS NOTE: These data were significantly updated on 30 August 2016. A volume correction had not been applied to the previous version, and thus all of the original values needed to be multiplied by 0.9805. This correction has been applied in the 30 August version, now available online. There were also some samples that were re-analyzed for Ba with the values revised accordingly. Additionally, the PIs withdrew the Pb data (in the original version) because higher quality Pb data are already available from these cruises.

Additional GEOTRACES Processing:
After the data were submitted to the International Data Management Office, BODC, the office noticed that important identifying information was missing in many datasets. With the agreement of BODC and the US GEOTRACES lead PIs, 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: station_GEOTRC, cast_GEOTRC (bottle and pump data only), event_GEOTRC, sample_GEOTRC, sample_bottle_GEOTRC (bottle data only), bottle_GEOTRC (bottle data only), depth_GEOTRC_CTD (bottle data only), depth_GEOTRC_CTD_rounded (bottle data only), BTL_ISO_DateTime_UTC (bottle data only), and GeoFish_id (GeoFish data only). 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_GT10, GT-C_Bottle_GT11, ODF_Bottle_GT10, and ODF_Bottle_GT11 datasets. Non-bottle parameters, including those from GeoFish tows, Aerosol sampling, and McLane Pumps, were taken from the Event_Log_GT10 and Event_Log_GT11 datasets. McLane pump cast numbers missing in event logs were taken from the Particulate Th-234 dataset submitted by Ken Buesseler.

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
GaBa_bottles_joined.csv (Comma Separated Values (.csv), 176.93 KB) MD5:2ffb35ab1c3352fd47176700f6af8845 Primary data file for dataset ID 3827

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Related Publications

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

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

Shim, M.-J., Swarzenski, P. W., & Shiller, A. M. (2012). Dissolved and colloidal trace elements in the Mississippi River delta outflow after Hurricanes Katrina and Rita. Continental Shelf Research, 42, 1–9. doi:10.1016/j.csr.2012.03.007
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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Related Datasets

IsRelatedTo

Shiller, A. M. (2021) **Dissolved Ga and Ba from surface tows from R/V Knorr cruises KN199-04, KN199-05, and KN204-01 in the Subtropical northern Atlantic Ocean from 2010-2011 (U.S. GEOTRACES NAT project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2) Version Date 2016-08-30 doi:10.26008/1912/bco-dmo.3831.2 [view at BCO-DMO]
Relationship Description: The Ga and Ba data from surface samples are in a separate dataset from the bottle samples.

Parameters

Parameter	Description	Units
cruise_id	Official cruise identifier e.g. KN199-04 = R/V Knorr cruise number 199-04.	text
cruise_name	GEOTRACES cruise identifier.	text
station_GEOTRC	GEOTRACES station number; ranges from 1 through 12 for KN199-04 and 1 through 24 for KN204-01. Stations 7 and 9 were skipped on KN204-01. PI-supplied values were identical to those in the intermediate US GEOTRACES master file. Originally submitted as 'STNNBR', this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions.	unitless
cast_GEOTRC	Cast identifier, numbered consecutively within a station. PI-supplied values were identical to those in the intermediate US GEOTRACES master file. Originally submitted as 'CASTNO', this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions.	unitless
date	Date (UTC).	YYYYmmdd
month	2-digit month of year (UTC).	mm (01 to 12)
day	2-digit day of month (UTC).	dd (01 to 31)
year	4-digit year (UTC).	YYYY
time	Time in HHMM format; 24-hour clock (UTC).	HHMM
lat	Latitude. North = Positive.	decimal degrees
lon	Longitude. West = Negative.	decimal degrees

bottle_GEOTRC	Alphanumeric characters identifying bottle type (e.g., NIS representing Niskin and GF representing GOFLO) and position on a CTD rosette. PI-supplied values were identical to those in the intermediate US GEOTRACES master file. Originally submitted as 'BTLNBR', this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions.	unitless
sample_GEOTRC	Unique identification numbers given to samples taken from bottles; rangies from 1 to 24; often used synonymously with bottle number. PI-supplied values were identical to those in the intermediate US GEOTRACES master file. Originally submitted as 'GEOTRC_SAMPNO', this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions.	unitless
depth_GEOTRC_CTD	Observation/sample depth in meters, calculated from CTD pressure. PI-supplied values were identical to those in the intermediate US GEOTRACES master file. Originally submitted as 'CTDDEPTH', this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions.	meters
Ga_D_CONC_BOTTLE	Dissolved gallium (Ga) in pmol/kg seawater; determined at the University of Southern Mississippi.	pmol/kg
Ga_D_CONC_BOTTLE_FLAG_W	Quality flag for 'Ga'; based on WOCE bottle flags: 2= good; 3 = questionable; 4 = bad; 5 = not reported; 9 = sample not drawn from this bottle.	unitless
Ba_D_CONC_BOTTLE	Dissolved barium (Ba) in nmol/kg seawater; determined at the University of Southern Mississippi.	nmol/kg
Ba_D_CONC_BOTTLE_FLAG_W	Quality flag for 'Ba'; based on WOCE bottle flags: 2= good; 3 = questionable; 4 = bad; 5 = not reported; 9 = sample not drawn from this bottle.	unitless
ISO_DateTime_UTC	Cast date/time (UTC) formatted to ISO8601 standard. T indicates start of time string; Z indicates UTC. Calculated from original date and time fields.	YYYY-mm-ddTHH:MM:SS.ssZ
event_GEOTRC	Unique identifying number for US GEOTRACES sampling events; ranges from 2001 to 2225 for KN199-04 events and from 3001 to 3282 for KN204-01 events. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	unitless

sample_bottle_GEOTRC	Unique identification numbers given to samples taken from bottles; ranges from 1 to 24; often used synonymously with bottle number. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	unitless
BTL_ISO_DateTime_UTC	added from the intermediate US GEOTRACES master file (see Processing Description). This standard is based on ISO 8601:2004(E) and takes on the following form: 2009-08-30T14:05:00[.xx]Z (UTC time)	YYYY-MM-DDTHH:MM:SS[.xx][+/-TZ]

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Instruments

Dataset-specific Instrument Name	GO-FLO Bottle
Generic Instrument Name	GO-FLO Bottle
Dataset-specific Description	The samples were collected for trace metal determinations at various stations from the RV Knorr using a custom-built US GEOTRACES trace metal clean rosette consisting of an epoxy painted Al rosette frame containing 24x12 L GO-FLO bottles.
Generic Instrument Description	GO-FLO bottle cast used to collect water samples for pigment, nutrient, plankton, etc. The GO-FLO sampling bottle is specially designed 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	Inductively Coupled Plasma Mass Spectrometer
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	Ga and Ba were determined by isotope dilution ICP-MS using a ThermoFisher Element 2 operated in low resolution.
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

KN199-04

Website	https://www.bco-dmo.org/deployment/58066
Platform	R/V Knorr
Report	http://bcodata.whoi.edu/US_GEOTRACES/AtlanticSection/Cruise_Report_for_Knorr_199_Final_v3.pdf
Start Date	2010-10-15
End Date	2010-11-04
Description	This cruise constitutes the first survey section as part of the U.S. participation in an international program named GEOTRACES. Funding: NSF OCE award 0926423 Science Objectives: To obtain state of the art trace metal and isotope measurements on a suite of samples taken on a mid-latitude zonal transect of the North Atlantic. In particular, sampling targeted the oxygen minimum zone extending off the west African coast near Mauritania, the TAG hydrothermal field, and the western boundary current system along Line W. For additional information, please refer to the GEOTRACES program Web site (https://www.geotraces.org/) for overall program objectives and a summary of properties measured. Science Activities include seawater sampling via GoFLO and Niskin carousels, in situ pumping (and filtration), CTDO2 and transmissometer sensors, underway pumped sampling of surface waters, and collection of aerosols and rain. Hydrography, CTD and nutrient measurements were supported by the Ocean Data Facility (J. Swift) at Scripps Institution of Oceanography and funded through NSF Facilities. They provided an additional CTD rosette system along with nephelometer and LADCP. A trace metal clean Go-Flo Rosette and winch were provided by the group at Old Dominion University (G. Cutter) along with a towed underway pumping system. Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/KN199-04 Other Relevant Links: List of cruise participants: [PDF] Cruise track: JPEG image (from Woods Hole Oceanographic Institution, vessel operator) ADCP data are available from the Currents ADCP group at the University of Hawaii: KN199-04 ADCP

KN204-01

Website	https://www.bco-dmo.org/deployment/58786
Platform	R/V Knorr
Report	http://bcodata.whoi.edu/US_GEOTRACES/AtlanticSection/STS_Prelim_GT11_Doc.pdf
Start Date	2011-11-06
End Date	2011-12-11
Description	The US GEOTRACES North Atlantic cruise aboard the R/V Knorr completed the section between Lisbon and Woods Hole that began in October 2010 but was rescheduled for November-December 2011. The R/V Knorr made a brief stop in Bermuda to exchange samples and personnel before continuing across the basin. Scientists disembarked in Praia, Cape Verde, on 11 December. The cruise was identified as KN204-01A (first part before Bermuda) and KN204-01B (after the Bermuda stop). However, the official deployment name for this cruise is KN204-01 and includes both part A and B. Science activities included: ODF 30 liter rosette CTD casts, ODU Trace metal rosette CTD casts, McLane particulate pump casts, underway sampling with towed fish and sampling from the shipboard "uncontaminated" flow-through system. Full depth stations are shown in the accompanying figure (see below). Additional stations to sample for selected trace metals to a depth of 1000 m are not shown. Standard stations are shown in red (as are the ports) and "super" stations, with extra casts to provide large-volume samples for selected parameters, are shown in green. Station spacing is concentrated along the western margin to evaluate the transport of trace elements and isotopes by western boundary currents. Stations across the gyre will allow scientists to examine trace element supply by Saharan dust, while also contrasting trace element and isotope distributions in the oligotrophic gyre with conditions near biologically productive ocean margins, both in the west, to be sampled now, and within the eastern boundary upwelling system off Mauritania, sampled last year. Funding: The cruise was funded by NSF OCE awards 0926204, 0926433 and 0926659. Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/KN204-01 Other Relevant Links: ADCP data are available from the Currents ADCP group at the University of Hawaii at the links below: KN204-01A (part 1 of 2011 cruise; Woods Hole, MA to Bermuda) KN204-01B (part 2 of 2011 cruise; Bermuda to Cape Verde)

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Project Information

U.S. GEOTRACES North Atlantic Transect (GA03) (U.S. GEOTRACES NAT)

Website: https://www.geotraces.org/

Coverage: Subtropical western and eastern North Atlantic Ocean (GA03)

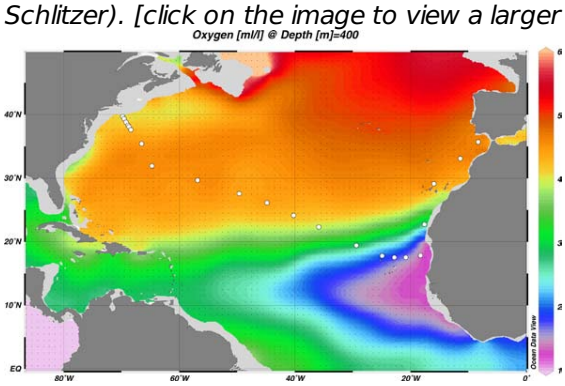
Much of this text appeared in an article published in OCB News, October 2008, by the OCB Project Office.

The first U.S. GEOTRACES Atlantic Section will be specifically centered around a sampling cruise to be carried out in the North Atlantic in 2010. Ed Boyle (MIT) and Bill Jenkins (WHOI) organized a three-day planning workshop that was held September 22-24, 2008 at the Woods Hole Oceanographic Institution. The main goal of the workshop, sponsored by the National Science Foundation and the U.S. GEOTRACES Scientific Steering Committee, was to design the implementation plan for the first U.S. GEOTRACES Atlantic Section. The primary cruise design motivation was to improve knowledge of the sources, sinks and internal cycling of Trace Elements and their Isotopes (TEIs) by studying their distributions along a section in the North Atlantic (Figure 1). The North Atlantic has the full suite of processes that affect TEIs, including strong meridional advection, boundary scavenging and source effects, aeolian deposition, and the salty Mediterranean Outflow. The North Atlantic is particularly important as it lies at the "origin" of the global Meridional Overturning Circulation.

It is well understood that many trace metals play important roles in biogeochemical processes and the carbon cycle, yet very little is known about their large-scale distributions and the regional scale processes that affect them. Recent advances in sampling and analytical techniques, along with advances in our understanding of their

roles in enzymatic and catalytic processes in the open ocean provide a natural opportunity to make substantial advances in our understanding of these important elements. Moreover, we are motivated by the prospect of global change and the need to understand the present and future workings of the ocean's biogeochemistry. The GEOTRACES strategy is to measure a broad suite of TEIs to constrain the critical biogeochemical processes that influence their distributions. In addition to these "exotic" substances, more traditional properties, including macronutrients (at micromolar and nanomolar levels), CTD, bio-optical parameters, and carbon system characteristics will be measured. The cruise starts at Line W, a repeat hydrographic section southeast of Cape Cod, extends to Bermuda and subsequently through the North Atlantic oligotrophic subtropical gyre, then transects into the African coast in the northern limb of the coastal upwelling region. From there, the cruise goes northward into the Mediterranean outflow. The station locations shown on the map are for the "fulldepth TEI" stations, and constitute approximately half of the stations to be ultimately occupied.

Figure 1. The proposed 2010 Atlantic GEOTRACES cruise track plotted on dissolved oxygen at 400 m depth. Data from the World Ocean Atlas (Levitus et al., 2005) were plotted using Ocean Data View (courtesy Reiner Schlitzer). [click on the image to view a larger version]

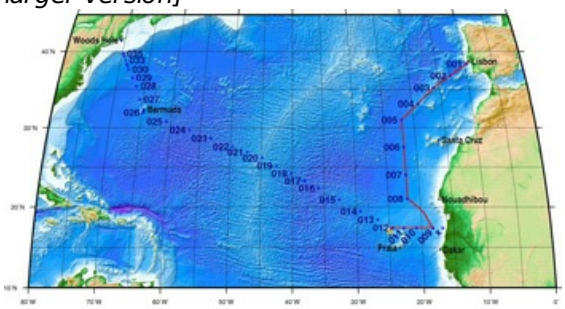


Hydrography, CTD and nutrient measurements will be supported by the Ocean Data Facility (J. Swift) at Scripps Institution of Oceanography and funded through NSF Facilities. They will be providing an additional CTD rosette system along with nephelometer and LADCP. A trace metal clean Go-Flo Rosette and winch will be provided by the group at Old Dominion University (G. Cutter) along with a towed underway pumping system.

The North Atlantic Transect cruise began in 2010 with KN199 leg 4 (station sampling) and leg 5 (underway sampling only) (Figure 2).

KN199-04 Cruise Report (PDF)

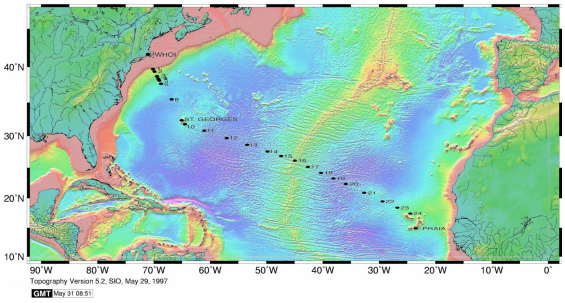
Figure 2. The red line shows the cruise track for the first leg of the US Geotraces North Atlantic Transect on the R/V Knorr in October 2010. The rest of the stations (beginning with 13) will be completed in October-December 2011 on the R/V Knorr (courtesy of Bill Jenkins, Chief Scientist, GNAT first leg). [click on the image to view a larger version]



The section completion effort resumed again in November 2011 with KN204-01A,B (Figure 3).

KN204-01A,B Cruise Report (PDF)

Figure 3. Station locations occupied on the US Geotraces North Atlantic Transect on the R/V Knorr in November 2011. [click on the image to view a larger version]



Data from the North Atlantic Transect cruises are available under the Datasets heading below, and consensus values for the SAFe and North Atlantic GEOTRACES Reference Seawater Samples are available from the GEOTRACES Program Office: Standards and Reference Materials

ADCP data are available from the Currents ADCP group at the University of Hawaii at the links below:
KN199-04 (leg 1 of 2010 cruise; Lisbon to Cape Verde)
KN199-05 (leg 2 of 2010 cruise; Cape Verde to Charleston, NC)
KN204-01A (part 1 of 2011 cruise; Woods Hole, MA to Bermuda)
KN204-01B (part 2 of 2011 cruise; Bermuda to Cape Verde)

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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-0927951

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