Dissolved 210Po and 210Pb along US GEOTRACES North Atlantic Transect from R/V Knorr KN199-04, KN204-01 cruises in the Subtropical northern Atlantic from 2010-2011 (U.S. GEOTRACES NAT project)

Website: https://www.bco-dmo.org/dataset/3914
Data Type: Cruise Results
Version: 2013-11-5
Version Date: 2013-11-05

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

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

Contributors	Affiliation	Role
Church, Thomas M.	University of Delaware	Principal Investigator
Baskaran, Mark	Wayne State University (WSU)	Co-Principal Investigator
Rigaud, Sylvain	EPOC (Environnements et Paleoenvironnements Oceaniques et Continentaux), UMR Universite Bordeaux - CNRS (EPOC UMR CNRS)	Co-Principal Investigator
Stewart, Gillian	Queens College (CUNY QC)	Co-Principal Investigator
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager
Kinkade, Danie	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Table of Contents

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

Dataset Description

Free access for all member of the US GEOTRACES program, only for the first two years, then open access.

DMO Note: the November 5, 2013 version replaces previous data file dated April 17, 2013.

Methods & Sampling

Sampling and Analytical Methodology for Dissolved NAST 210Po and 210Po Sample

Currently, the recommended assay of both dissolved and particulate sea water samples are outlined in the GEOTRACES procedures manual at:
http://www.obs-vlfr.fr/GEOTRACES/science/intercalibration/222-sampling-and-sample-handling-protocols-for-geotraces-cruises

Specific methods based on this cruise follow.

The dissolved samples were drawn onboard from 30 liter Niskin bottles deployed on the rosette and at the designated depths. The samples were filtered (0.45 micron) seawater using Acropac capsules with Supor membranes, and acidified (pH2 with Optima HCl). The twenty liter cubitainers were rinsed, filled and sealed dark at sea and transferred to cold storage after shipping and before analysis ashore. The samples were spiked with a well-calibrated 209Po tracer solution (T1/2 =102 y), together with a stable lead carrier added to monitor the losses of Po and Pb during sample processing. For the dissolved samples, Po and Pb were pre-concentrated from large volumes of seawater via co-precipitation with Fe(OH)3 (Thomson and Turekian 1976; Nozaki 1986). The Po nuclides are then plated by spontaneous deposition onto a silver disc (Flynn 1968). Silver discs, 1-2 cm in diameter, were be obtained with greater than 99.99% purity from A.F. Murphy Die and Machine Co, Inc. USA. They were first cleaned with a commercial silver polish and then using water and ethanol. One side of the disc was covered by rubber cement, so that Po was plated on only one side. The Po activities were measured after deposition by alpha spectrometry (Ortec Inc, Alpha Quad; Canberra Inc., Alpha Analyst). Any remaining 209Po and 210Po in solution was removed by using anion exchange resin AG-1X8 (Sarin et al. 1992). After separation, the final eluate containing the 210Pb was re-spiked with 209Po and stored for greater than 6 months to allow in-growth of 210Po from 210Pb. At that time, the 210Pb activity of the sample was determined by replating the eluate on a new silver disc and measuring the in-growth of 210Po. The determination of the initial activities of 210Po and 210Pb in the sample at the time of collection accounted for decay and ingrowth between the time of collection and processing, with corrections for chemical recoveries (Rigaud, et al., in revision). The error analysis accounts for the relative uncertainty for each parameter considered in the calculation of final 210Po and 210Pb activities. For the cruise, the method allows estimating 210Pb activity with a relative uncertainty of about 7%. However for 210Po activities, the final relative uncertainty is more variable and depends on the 210Po/210Pb activity ratio in the initial sample and the time elapsed between sampling and sample processing. For samples from this cruise, the 210Po uncertainty is not better than 6%.

References

Fleer, A. P., and M. P. Bacon. 1984. Determination of 210Pb and 210Po in seawater and marine particulate matter. Nucl. Instrum. Methods Phys. Res. 223: 243-249.

Flynn, W. W. 1968. The determination of low levels of polonium-210 in environmental materials. Anal. Chim. Acta 43: 221-227.

Nozaki, Y. 1986. 226Ra-222Rn-210Pb systematics in seawater near the bottom of the ocean. Earth Planet. . Earth Planet. Sci. Lett. 32: 304-312.

Sarin, M. M., R. Bhushan, R. Rengarajan, and D. N. Yadav. 1992. The simultaneous determination of 238U series nuclides in seawater: results from the Arabian Sea and Bay of Bengal. Indian J. Mar. Sci. 21: 121-127.

Thomson, J., and K. K. Turekian. 1976. 210Po and 210Pb distributions in ocean water profiles from the Eastern South Pacific. Earth Planet. Sci. Lett. 32: 297-303.

Data Processing Description

Also see section above.

Raw data were corrected for ingrowth, decay, isotope recoveries, detector background and blanks.

Quality Code	Definition	How to Use it
1	Sampled but not yet received.	A sample for this measurement has been drawn but the results have not yet been received. This is an internal sample inventory code. It should not be reported. See code 5 for samples that are lost.
2	No problems noted.	Not necessary (default).
3	Questionable measurement.	Does not fit cast profile, adjacent casts or other criteria. No problems were noted by the analyst.
4	Bad measurement.	Does not fit cast profile, adjacent casts or other criteria. Analytical or sampling problems are likely.
5	Sample not reported.	The sample (or analysis) was lost. A value could not be reported.
6	Mean of replicate measurements.	The value reported is a mean of replicate measurements.
7	Manual (chromatographic) peak measurement.	A normally machine-generated peak measurement was derived manually.
8	Irregular digital chromatographic peak integration.	A machine-generated peak measurement was found to be abnormal.
9	Sample not drawn from this bottle.	No sample was drawn

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.

Additional BCO-DMO Processing Notes:

The submitted event number was 2009 for samples 5624 - 5635, while in the master file, those samples are correspond to event 2162. These values were changed to agree with master file.

Missing data were replaced wtih 'nd'.

[table of contents | back to top]

Data Files

File
PoPb_diss_joined.csv (Comma Separated Values (.csv), 17.10 KB) MD5:4bf7e95e519283d1e95ed1ba666bba00 Primary data file for dataset ID 3914

[table of contents | back to top]

Parameters

Parameter	Description	Units
cruise_id	Official cruise identifier e.g. KN199-04 = R/V Knorr cruise number 199-04	dimensionless
cruise_name	project designated cruise name	dimensionless
EXPOCODE	project cruise id code	dimensionless
station_GEOTRC	GEOTRACES station number	dimensionless
depth_GEOTRC_CTD	Observation/sample depth in meters; calculated from CTD pressure. Values were added from the intermediate US GEOTRACES master file (see Processing Description); same as depth provided by PI.	meters

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).	dimensionless
cast_GEOTRC	Cast identifier numbered consecutively within a station. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	dimensionless
sample_GEOTRC	Unique identifying number for US GEOTRACES samples	dimensionless
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).	dimensionless
bottle_GEOTRC	Alphanumeric characters identifying bottle type (e.g. NIS representing Niskin and GF representing GOFLO) and position on a CTD rosette. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	dimensionless
date	sampling date	YYYYmmDD
bottle_num_flag	quality flag	dimensionless
time	sampling time	HHMM
lat	latitude; North is positive	decimal degrees
lon	longitude; East is positive	decimal degrees
Po_210	dissolved Polonium-210 concentration	dpm/100 kilgrams
Po_210_flag	quality flag	dimensionless
Pb_210	dissolved Lead-210 concentration	dpm/100 kilgrams
Pb_210_flag	quality flag	dimensionless

BTL_ISO_DateTime_UTC	Date and time (UTC) variable recorded at the bottle sampling time in ISO compliant format. Values were 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.SSZ
Pb_210_sd	Standard deviation reported for the concentration of Lead-210.	dpm/100 kiligrams
Po_210_sd	Standard deviation reported for the concentration of Polonium-210.	dpm/100 kiligrams

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	GO-FLO Bottle
Generic Instrument Name	GO-FLO Bottle
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	Niskin bottle
Generic Instrument Name	Niskin bottle
Dataset-specific Description	30 liter bottles
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	CTD Sea-Bird SBE 911plus
Generic Instrument Name	Sea-Bird SBE 911plus CTD
Generic Instrument Description	[tethered, real-time] 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

[table of contents | back to top]

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)

[table of contents | back to top]

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)

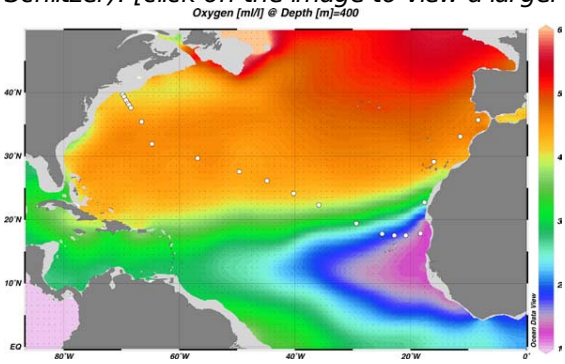
Much of this text appeared in an article published in OCB News, October 2008, by the OCB Project Office.

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]

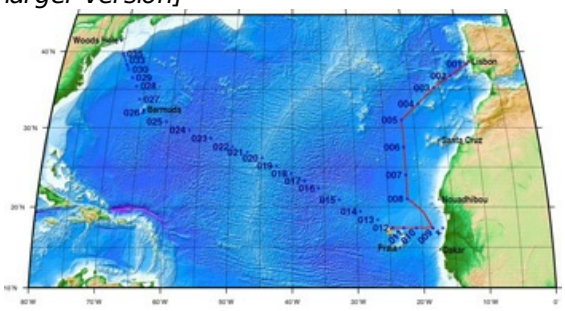


Hydrography, CTD and nutrient measurements will be supported by the Ocean Data Facility (J. Swift) at Scripps Institution of Oceanography and funded through NSF Facilities. They will be providing an additional CTD rosette system along with nephelometer and LADCP. A trace metal clean Go-Flo Rosette and 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)

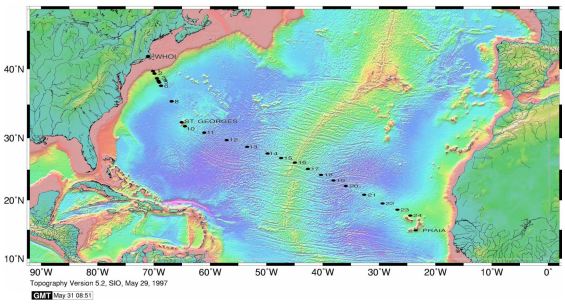
Figure 2. The red line shows the cruise track for the first leg of the US Geotraces North Atlantic Transect on the R/V Knorr in October 2010. The rest of the stations (beginning with 13) will be completed in October-December 2011 on the R/V Knorr (courtesy of Bill Jenkins, Chief Scientist, GNAT first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

[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-0961653

[table of contents | back to top]