Total dissolved Cobalt and labile Cobalt concentrations from R/V Knorr cruises KN199-04 and KN204-01 in the Subtropical northern Atlantic Ocean from 2010-2011 (U.S. GEOTRACES NAT project)

Website: https://www.bco-dmo.org/dataset/3868
Data Type: Cruise Results
Version: 4
Version Date: 2013-04-26

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
Total dissolved Cobalt and labile Cobalt concentrations from R/V Knorr cruises KN199-04 and KN204-01 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

Concentrations of total dissolved cobalt and labile dissolved cobalt (0.2 um filtered).

Methods & Sampling

Samples were collected using the ODU GEOTRACES Carousel (GT-C), and were filtered through 0.2 um Acropak filters in the GEOTRACES clean van and immediately refrigerated. Samples were kept in acid-washed 60 mL LDPE bottles, and either stored for a short time (<7 days) at 4°C and double-bagged prior to analysis, or for a longer time (up to 40 days) at 4°C and in a heat-sealed bag with gas absorbing satchels. Both labile and total dissolved cobalt were analyzed from this sample bottle, and the sample identifier is the allocated GEOTRACES number.

The carousel was used to collect samples from surface to near bottom waters, and an additional sample was collected from a surface towfish at each station. Pre-conditioned, teflon-coated Go-Flo sampling bottles (General Oceanics, Miami, FL) of 12 L capacity were deployed on a polyurethane powder-coated aluminum rosette with titanium pilings and pressure housings (Sea-Bird Electronics, Inc., Bellevue, WA) attached to a Kevlar, non-metallic conducting cable. For more information regarding carousel deployment, please refer to the GEOTRACES Cookbook (www.geotraces.org/science/intercalibration/222-sampling-and-sample-handling-protocols-for-geotraces-cruises), located on the GEOTRACES Program website (www.geotraces.org/). Following the retrieval of the carousel, Go-Flo bottles were moved to the GEOTRACES Program class-100 trace metal clean van, and pressurized with HEPA filtered air for sampling in accordance with published methods (Cutter and Bruland 2012). Surface towfish samples were collected by suspending the towfish off the starboard side with a boom, and sampled water at approximately 2 m depth using a Teflon diaphragm pump following the GEOTRACES Program Cookbook sampling recommendations, and in accordance with previous collection protocols (Bruland et al. 2004).

Sample storage bottles were soaked overnight in the acidic detergent, Citranox, rinsed thoroughly with Milli-Q water (Millipore), filled with 10% HCl to soak for 10 days, rinsed thoroughly with Milli-Q water adjusted to pH 2, and double-bagged, empty.

Concentrations of total dissolved and labile cobalt during the KN199-04 cruise were determined ship-board using a previously described cathodic stripping voltammetry (CSV) method (Saito and Moffett 2001, Saito et al. 2004). Measurements were made using the Eco-Chemie µAutolabIII systems connected to Metrohm 663 VA Stands equipped with hanging mercury drop electrodes and Teflon sampling cups within 7 days of sampling. Standard additions were carried out with Metrohm 765 Dosimats using a programmed dosing procedure (Noble and Saito et al. 2008).

Concentrations of total dissolved and labile cobalt from the KN204-01 cruise were measured on land between 1 and 6 weeks after the sampling date, using the same protocol as that of the KN199-04 cruise.

For total dissolved cobalt analyses, samples were UV-irradiated for 1 h prior to analysis using a Metrohm 705 UV digester to degrade the organic ligands that bind cobalt and allow binding by the added electroactive cobalt ligand, dimethylglyoxime. Samples were analyzed in 8.5 mL aliquots with the addition of 30 µL recrystalized dimethylglyoxime (DMG, 0.1 mol L-1 in methanol), 1.5 mL purified sodium nitrite (1.5 mol L-1 in Milli-Q water), and 50 µL purified N-(2-hydroxyethyl)piperazine-N-(3-propanesulfonic acid) (EPPS) buffer (0.5 mol L-1 in Milli-Q water). Reagent purification protocols were identical to those previously published (Saito and Moffett 2001). Cobalt concentrations were determined by the standard additions technique, with initial concentrations measured in triplicate followed by four 25 pmol L-1 cobalt additions.

The analytical blank was determined by analyzing seawater that had been UV-irradiated for 1 h, equilibrated overnight with prepared Chelex 100 resin beads (Bio-Rad), and UV-irradiated a second time to degrade any leached synthetic ligands. Blanks for each reagents batch (nitrite, DMG, EPPS) were subtracted from the initial sample concentration. Blank analyses for each reagent batch were made at the beginning and end of use to confirm that the blank remained constant during analyses. The averaged blank for all reagent batches for the entire dataset was 4pM +/- 1.2 with a range of 1.7 - 6.3pM (n = 38 for individual blank analyses). For a given reagent batch, the standard deviation was smaller, and we report a detection limit (3 times the standard deviation of the blank) of 1.8pM, representing the average of the detection limits estimates for reagent batches with at least 3 blank analyses (n = 6).

For labile cobalt analyses, 8.5 mL of sample were pipetted into acid washed Teflon vials that were preconditioned with a small aliquot of sample water. 30 uL of DMG were added to each vial and allowed to equilibrate overnight in the dark prior to analysis (Saito et al. 2004). Analyses were then performed as described for total concentrations with the addition of the remaining two reagents and use of the standard addition technique. Previously, we determined that natural cobalt ligands in seawater have a conditional stability constant of >10^16.8 (Saito et al. 2005). This suggests that the cobalt is very strongly bound to ligands. Thus, we define labile cobalt as the fraction of total dissolved cobalt that is either bound to weak organic and inorganic ligands in seawater or present as free Co(II), and is then exchangeable with the complexing agent (DMG) used for analysis (Saito et al. 2004, Saito et al. 2005). The difference between the total dissolved cobalt and the labile cobalt can then be used as an estimation of the strong cobalt ligand concentration.

Two full electrochemical systems were utilized for analyses. One electrode was dedicated to total analyses and the other to labile analyses. GEOTRACES standard seawater and internal standard lab seawater were analyzed periodically to ensure that the two electrodes were intercalibrated and functioning properly. GEOTRACES standard seawater was UV irradiated and neutralized using Optima ammonium hydroxide to bring the pH up to 7.5. Standard seawater internal to our lab was UV irradiated as well, but was not previously acidified so received no further treatment prior to analysis. These results demonstrate that the methodologies employed to produce this dataset detect concentrations within the standard deviation of current consensus values for UV irradiated samples, which can be found on the International GEOTRACES Program website (www.geotraces.org/). On occasion, analyses were repeated due to obvious electrode malfunction or to confirm oceanographic consistency of measured values. If the repeated measurement was similar to the initial, the initial value is reported. If the repeated analysis was more oceanographically consistent with adjacent values in the water column, that analysis was used instead.

Our laboratory has participated in the GEOTRACES intercalibration effort using this electrochemical Co method. We report our laboratory values for the GEOTRACES and SAFe standard analyses using this electrochemical method, including those conducted during analysis of the US North Atlantic GEOTRACES Section samples to be: SAFe S1 = 5.4 +/- 2.6 (n=9), SAFe D2 = 48.3 +/- 5.5 (n=7), GEOTRACES GS = 31.4 +/- 4.1 (n=24), GEOTRACES GD = 66.9 +/- 6.2 (n=30). These results are in good agreement with those from the GEOTRACES intercalibration effort for Co using different methods all using UV-oxidation to degrade strong cobalt ligands.

Data Processing Description

For the labile cobalt analyses, the ligand concentration was often close to or in excess of the total concentration. In these situations, no measurable peak is present in the initial scan prior to standard addition. In these instances, the value is reported as '0' with a flag of 6, indicating that the labile concentration is so low that it is below our detection limit.

Data are flagged with the numbers described below (and found on the Ocean Data View website):
0 = no quality control = No quality control procedures have been applied to the data value. This is the initial status for all data values entering the working archive.
1 = good value = Good quality data value that is not part of any identified malfunction and has been verified as consistent with real phenomena during the quality control process.
2 = probably good value = Data value that is probably consistent with real phenomena but this is unconfirmed or data value forming part of a malfunction that is considered too small to affect the overall quality of the data object of which it is a part.
3 = probably bad value = Data value recognized as unusual during quality control that forms part of a feature that is probably inconsistent with real phenomena.
4 = bad value = An obviously erroneous data value.
5 = changed value = Data value adjusted during quality control. Best practice strongly recommends that the value before the change be preserved in the data or its accompanying metadata.
6 = value below detection = The level of the measured phenomenon was too small to be quantified by the technique employed to measure it. The accompanying value is the detection limit for the technique or zero if that value is unknown.

BCO-DMO made the following edits:
- Changed parameter names.
- Replaced blanks with 'nd' to indicate 'no data'.
- Added cruise_part column & separated KN204-01a and KN204-01b into cruise_id & cruise_part.

- Separated original date field into day, month, and year.
- Added ISO_DateTime_UTC (from the day, month, year, and time fields)
- Corrected event number of KN199-04 station 6 cast 1 from 2026 to 2106 (due to correction in bottle file).
- Corrected event numbers for samples 5622, 6000, 7964. The original sample numbers were correct, however, the event numbers were changed to match those in the event log. (26-April-2013)

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	
Co_tot_and_labile_GT10-11_joined.csv	(Comma Separated Values (.csv), 104.66 KB) MD5:d7b0ca6f1055556391e45c79147f83b9
Primary data file for dataset ID 3868	

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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

Noble, A. E., Saito, M. A., Maiti, K., & Benitez-Nelson, C. R. (2008). Cobalt, manganese, and iron near the Hawaiian Islands: A potential concentrating mechanism for cobalt within a cyclonic eddy and implications for the hybrid-type trace metals. Deep Sea Research Part II: Topical Studies in Oceanography, 55(10-13), 1473–1490. doi:10.1016/j.dsr2.2008.02.010
General

Saito, M. A., & Moffett, J. W. (2001). Complexation of cobalt by natural organic ligands in the Sargasso Sea as determined by a new high-sensitivity electrochemical cobalt speciation method suitable for open ocean work. Marine Chemistry, 75(1-2), 49–68. doi:10.1016/s0304-4203(01)00025-1
Methods

Saito, M. A., Moffett, J. W., & DiTullio, G. R. (2004). Cobalt and nickel in the Peru upwelling region: A major flux of labile cobalt utilized as a micronutrient. Global Biogeochemical Cycles, 18(4), n/a–n/a. doi:10.1029/2003gb002216
Methods

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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
expocode	Expedition code.	unitless
station	Station number; provided by PI in original data submission.	unitless
cruise_part	Part of cruise. For KN204-01: A = 11/6/2011 to 11/18/2011 (Woods Hole to Bermuda) B = 11/19/2011 to 12/11/2011 (Bermuda to Praia, Cabo Verde)	text
depth	Sample depth in meters; provided by PI in original data submission.	meters
press	Pressure in decibars.	dbars
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
sample_GEOTRC	Unique identifying number for US GEOTRACES samples; ranges from 5033 to 6078 for KN199-04 and from 6112 to 8148 for KN204-01. 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
sample_bottle_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 'SAMPNO', this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions.	unitless
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
bot_flag	Bottle quality flag, following the WOCE protocol. See http://woce.nodc.noaa.gov/woce_v3/wocedata_1/whp/exchange/exchange_format_desc.htm.	unitless
month	2-digit month of year when the event occurred.	mm (01 to 12)
day	2-digit day of month when the event occurred.	dd (01 to 31)
year	4-digit year when the event occurred.	YYYY
time	Time in hours and minutes when the event occurred; 24-hour clock.	HHMM
lat	Latitude in decimal degrees. North = Positive.	decimal degrees

lon	Longitude in decimal degrees. West = Negative.	decimal degrees
Co_diss_tot	Total dissolved cobalt concentration, 0.2um filtered, in pM.	pM
Co_diss_tot_flag	Quality flag for Co_diss_tot. See 'Processing Description' for code definitions.	unitless
Co_labile	Labile dissolved cobalt concentrations, 0.2um filtered, in pM.	pM
Co_labile_flag	Quality flag for Co_labile. See 'Processing Description' for code definitions.	unitless
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. Some GeoFish stations are denoted as X_to_Y indicating the tow occurred between stations X and Y. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	dimensionless
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. PI-supplied values were identical to those in the intermediate US GEOTRACES master file. Originally submitted as 'GEOTRC_EVENTNO', this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions.	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).	meters
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[.xx][+/-TZ]
ISO_DateTime_UTC	Date and time of the event formatted to the ISO8601 standard; calculated from the month, day, year, and time fields. T indicates start of time string; Z indicates UTC.	YYYY-MM-DDTHH:MM:SS[.xx][+/-TZ]

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Instruments

Dataset-specific Instrument Name	GeoFish
Generic Instrument Name	GeoFish-type Near-surface Towfish Sampler
Dataset-specific Description	Surface samples were collected at each station using the GEOTRACES surface TowFish.
Generic Instrument Description	This term describes a family of custom-designed, trace-metal-clean, near-surface seawater sampling systems based on the 'GeoFish' design developed by Geoffrey Smith and Ken Bruland at the University of California, Santa Cruz (UCSC). The systems consist of a weighted towed body or torpedo, clean intake tubing, a shipboard pneumatic pump, and a sampling manifold. They are deployed alongside a moving vessel, outside the ship's wake, with the intake typically positioned approximately 1 to 3 meters below the sea surface. Seawater is continuously pumped through the clean tubing to the ship for filtered and unfiltered sampling and, in some applications, direct connection to analytical instruments. This term includes the original GeoFish sampler, Super-GeoFISH variants, and subsequent modified towfish systems used on U.S. GEOTRACES cruises. These systems share the same basic sampling principle but may differ in body construction, depressor or stabilization design, deployment hardware, tubing, pump configuration, flow rate, and sampling manifold. The systems have been used for trace-metal, nutrient, biological, and other chemical measurements in both GEOTRACES and non-GEOTRACES studies, including Bruland et al. (2005).

Dataset-specific Instrument Name	GO-FLO Bottle
Generic Instrument Name	GO-FLO Bottle
Dataset-specific Description	Samples were collected using the ODU GEOTRACES Carousel (GT-C). Pre-conditioned, teflon-coated Go-Flo sampling bottles (General Oceanics, Miami, FL) of 12 L capacity were deployed on a polyurethane powder-coated aluminum rosette with titanium pilings and pressure housings (Sea-Bird Electronics, Inc., Bellevue, WA).
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	Metrohm 663 VA Stand mercury electrode
Generic Instrument Name	Metrohm 663 VA Stand mercury electrode
Dataset-specific Description	Measurements were made using the Eco-Chemie µAutolabIII systems connected to Metrohm 663 VA Stands equipped with hanging mercury drop electrodes and Teflon sampling cups within 7 days of sampling. See more information from the manufacturer.
Generic Instrument Description	The Metrohm 663 VA stand forms the wet chemical part of a polarographic and voltammetric analytical system. It features a mercury electrode, an Ag/AgCl reference electrode and a glassy carbon counter electrode. The size of the mercury drop and the stirrer speed are set manually on the VA Stand. The VA Stand can be operated in Dropping Mercury Electrode (DME), Hanging Mercury Drop Electrode (HMDE) and Static Mercury Drop Electrode (SMDE) modes. The VA Stand can be controlled by a potentiostat in conjunction with the Metrohm IME663 interface.

Dataset-specific Instrument Name	Automatic titrator
Generic Instrument Name	Titrator
Dataset-specific Description	Standard additions were carried out with Metrohm 765 Dosimats using a programmed dosing procedure (Noble and Saito et al. 2008).
Generic Instrument Description	Titrators are instruments that incrementally add quantified aliquots of a reagent to a sample until the end-point of a chemical reaction is reached.

Dataset-specific Instrument Name	Voltammetry Analyzers
Generic Instrument Name	Voltammetry Analyzers
Dataset-specific Description	Measurements were made using the Eco-Chemie µAutolabIII system. See more information from the manufacturer.
Generic Instrument Description	Instruments that obtain information about an analyte by applying a potential and measuring the current produced in the analyte.

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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/

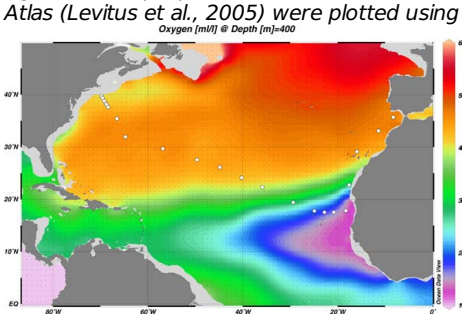
Coverage: Subtropical western and eastern North Atlantic Ocean (GA03)

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]

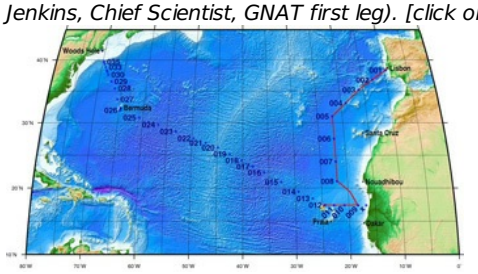


Hydrography, CTD and nutrient measurements will be supported by the Ocean Data Facility (J. Swift) at Scripps Institution of Oceanography and funded through NSF Facilities. They will be providing an additional CTD rosette system along with nephelometer and LADCP. A trace metal clean Go-Flo Rosette and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

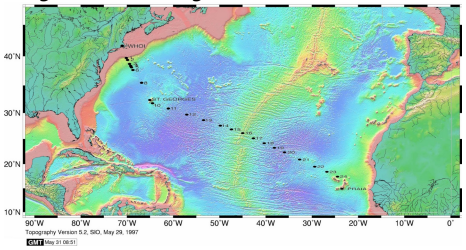
Figure 2. The red line shows the cruise track for the first leg of the US Geotraces North Atlantic Transect on the R/V Knorr in October 2010. The rest of the stations (beginning with 13) will be completed in October-December 2011 on the R/V Knorr (courtesy of Bill Jenkins, Chief Scientist, GNAT first 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-0928414

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