PO4, NO3, NO2 surface concentrations along the US GEOTRACES North Atlantic Transect from the R/V Knorr KN199-04, KN199-05 cruises in the subtropical N. Atlantic during 2010 (U.S. GEOTRACES NAT project)

Website: https://www.bco-dmo.org/dataset/3470
Data Type: Cruise Results
Version: 2
Version Date: 2013-02-27

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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Gegg, Stephen R.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
PO4, NO3, NO2 surface concentrations along the US GEOTRACES North Atlantic Transect from the R/V Knorr KN199-04, KN199-05 cruises in the subtropical N. Atlantic during 2010.

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Coverage

Spatial Extent: **N**:38.34679 **E**:-9.60547 **S**:16.8546 **W**:-78.9949
Temporal Extent: 2010-10-17 - 2010-11-25

Dataset Description

Nanomolar concentrations of PO4, NO3, NO2 - Surface Transects.

Methods & Sampling

Filtered (0.4 µm) water samples from the Geotraces surface tow-fish and water from the upper 200 m water column (GEOTRACES Carousel/GoFlo system) were analyzed on an Astoria Pacific 300 series gas-segmented continuous flow nutrient auto-analyzer modified with 200 cm liquid waveguide capillary cells (LWCC; World Precision Instruments). Nitrate was reduced to nitrite using a Cd-column, then determined

spectrophotometrically following formation of a highly colored dye, but slightly modified for use with a liquid core waveguide (see references below). Nitrite is measured separately without the Cd column and then subtracted from the combined nitrate+nitrite sample. The molybdenum blue method modified for use with liquid core wave guide was used for phosphate (references below).

Recovery for phosphate measurements for LWCC relative to the MAGIC method is 100 ± 15 % for concentrations below 100 nmol/L. The relative standard deviation for nine measurements of 5 nmol/L phosphate was 1.6 %. The relative standard deviation for nine measurements of 60 nM phosphate was 0.9 %. LWCC detection limit (3 x σ of blank) for phosphate was 0.5 nmol/L, 1.5 nmol/L for nitrate and 0.6 nmol/L for nitrite.

Upper working limit for LWCC:
Phosphate 100 nmol/L
Nitrate 200 nmol/L
Nitrite 200 nmol/L

Data Processing Description

Data Processing:
Nitrate = (Nitrate+nitrite) – nitrite

Samples were measured in triplicate (flag =6)

Samples out of linear calibration range for LWCC (flag = 10)

BCO-DMO Processing Notes:
- Generated from original spreadsheet file "GEOTRACES Knorr199-4 and -5 nanomolar nutrients.xls", sheet: "surface" contributed by Greg Cutter
- Parameter names modified to conform to BCO-DMO convention
- cruise_id added
- date/time reformatted to date as YYYYMMDD
- date/time reformatted to time as HHMM
- longitude values converted to negative (West)
- "nd" (no data flag) inserted into blank cell
- added ISO_DateTime_UTC based on the original date and time fields

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
Nutrients_Surface_joined.csv (Comma Separated Values (.csv), 11.42 KB) MD5:7fa3bd6aa3ce8128e6a3978b92a6e660
Primary data file for dataset ID 3470

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Related Publications

Karl, D. M., & Tien, G. (1992). MAGIC: A sensitive and precise method for measuring dissolved phosphorus in aquatic environments. Limnology and Oceanography, 37(1), 105–116. doi:10.4319/lo.1992.37.1.0105
Methods

Li, Q. P., & Hansell, D. A. (2008). Intercomparison and coupling of magnesium-induced co-precipitation and long-path liquid-waveguide capillary cell techniques for trace analysis of phosphate in seawater. Analytica Chimica Acta, 611(1), 68–72. doi:10.1016/j.aca.2008.01.074
Methods

Li, Q. P., Hansell, D. A., & Zhang, J.-Z. (2008). Underway monitoring of nanomolar nitrate plus nitrite and phosphate in oligotrophic seawater. Limnology and Oceanography: Methods, 6(7), 319–326. doi:10.4319/lom.2008.6.319
Methods

Murphy, J., & Riley, J. P. (1962). A modified single solution method for the determination of phosphate in natural waters. Analytica Chimica Acta, 27, 31–36. doi:10.1016/s0003-2670(00)88444-5
Methods

Patey, M. D., Rijkenberg, M. J. A., Statham, P. J., Stinchcombe, M. C., Achterberg, E. P., & Mowlem, M. (2008). Determination of nitrate and phosphate in seawater at nanomolar concentrations. TrAC Trends in Analytical Chemistry, 27(2), 169–182. doi:10.1016/j.trac.2007.12.006
Methods

Zhang, J.-Z. (2000). Shipboard automated determination of trace concentrations of nitrite and nitrate in oligotrophic water by gas-segmented continuous flow analysis with a liquid waveguide capillary flow cell. Deep Sea Research Part I: Oceanographic Research Papers, 47(6), 1157–1171. doi:10.1016/s0967-0637(99)00085-0 https://doi.org/10.1016/S0967-0637(99)00085-0
Methods

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Related Datasets

IsRelatedTo

Cutter, G. A. (2021) **Surface nanomolar Phosphate, Nitrate, and Nitrite concentrations from R/V Knorr cruise KN204-01 in the Subtropical northern Atlantic Ocean in 2011 (U.S. GEOTRACES NAT project).** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2) Version Date 2013-02-20 doi:10.26008/1912/bco-dmo.3838.2 [view at BCO-DMO]

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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
date	date (GMT) in the format YYYYMMDD	unitless
time	time (GMT)	HHMM
lat	Station latitude (South is negative)	decimal degrees
lon	Station longitude (West is negative)	decimal degrees
GeoFish_id	Identifying number of a GeoFish tow, numbered consecutively within a cruise. PI-supplied values were identical to those in the intermediate US GEOTRACES master file. Originally submitted as 'Fish_ID', this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions.	integer
GeoTraces_ID	Unique identifiers for ALL vertical profile samples (and surface fish samples when we arrive on station, or depart).	integer
PO4	PO4: phosphate (reactive - or ortho-phosphate)	nmol/L
PO4_Flag	PO4 Data Flag: Samples were measured in triplicate (flag=6); Samples out of linear calibration range for LWCC (flag=10)	integer
NO3	NO3: Nitrate = (Nitrate+nitrite) - nitrite	nmol/L
NO3_Flag	NO3 Data Flag: Samples were measured in triplicate (flag=6); Samples out of linear calibration range for LWCC (flag=10)	integer
NO2	NO2: Nitrite	nmol/L
NO2_Flag	NO2 Data Flag: Samples were measured in triplicate (flag=6); Samples out of linear calibration range for LWCC (flag=10)	integer
Remarks	Remarks	text

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
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. Values were added from the intermediate US GEOTRACES master file (see Processing Description).	dimensionless
ISO_DateTime_UTC	Date/Time (UTC) formatted to ISO8601. T indicates start of time string; Z indicates UTC. Calculated from the original date and time fields.	YYYY-mm-ddTHH:MM:SS.ssZ

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Instruments

Dataset-specific Instrument Name	GeoFish
Generic Instrument Name	GeoFish-type Near-surface Towfish Sampler
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).

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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

KN199-05

Website	https://www.bco-dmo.org/deployment/58142
Platform	R/V Knorr
Start Date	2010-11-08
End Date	2010-11-26
Description	KN199-05 is the completion of the US GEOTRACES Zonal North Atlantic Survey Section cruise originally planned for late Fall 2010 from Lisboa, Portugal to Woods Hole, MA, USA. Due to engine failure, the science activities scheduled for the KN199-04 cruise were canceled on 2 November 2010. On 4 November the R/V Knorr put in at Porto Grande, Cape Verde (ending KN199 leg 4) and was scheduled to depart November 8, under the direction of Acting Chief Scientist Oliver Wurl of Old Dominion University. The objective of KN199 leg 5 (KN199-05) was to carry the vessel in transit to Charleston, SC while conducting abbreviated science activities originally planned for KN199-04. 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/KN199-05 Other Relevant Links: List of cruise participants: [PDF] ADCP data are available from the Currents ADCP group at the University of Hawaii: KN199-05 ADCP

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Project Information

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

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

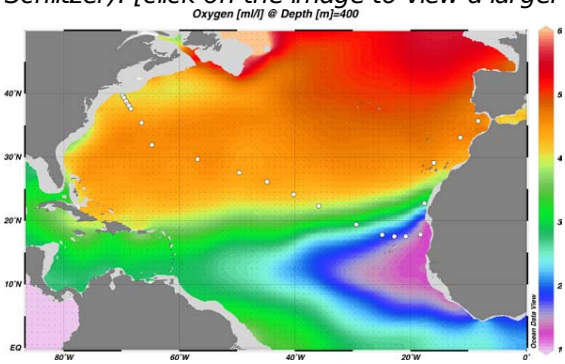
Coverage: Subtropical western and eastern North Atlantic Ocean (GA03)

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]



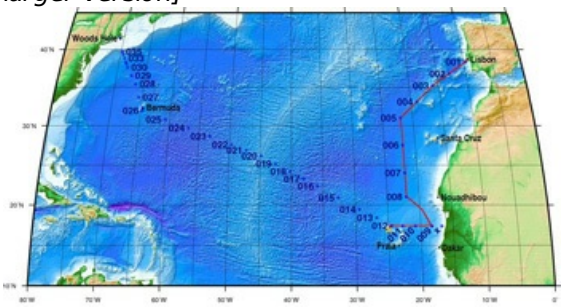
Hydrography, CTD and nutrient measurements will be supported by the Ocean Data Facility (J. Swift) at Scripps Institution of Oceanography and funded through NSF Facilities. They will be providing an additional CTD rosette system along with nephelometer and LADCP. A trace metal clean Go-Flo Rosette and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

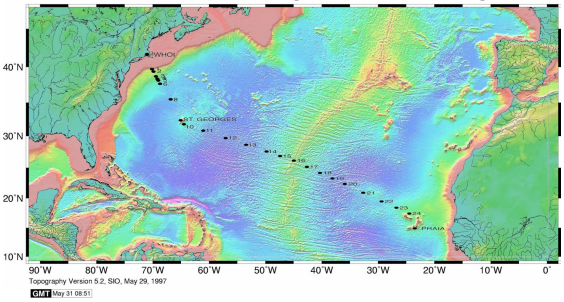
Figure 2. The red line shows the cruise track for the first leg of the US Geotraces North Atlantic Transect on the R/V Knorr in October 2010. The rest of the stations (beginning with 13) will be completed in October-December 2011 on the R/V Knorr (courtesy of Bill Jenkins, Chief Scientist, GNAT first 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-0926423
NSF Division of Ocean Sciences (NSF OCE)	OCE-0926092

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