Dissolved organic carbon (DOC) from US GEOTRACES North Atlantic Transect cruise on the R/V Knorr KN199-04 in the subtropical N. Atlantic in 2010 (U.S. GEOTRACES NAT project)

Website: https://www.bco-dmo.org/dataset/3855
Data Type: Cruise Results
Version: 1
Version Date: 2013-01-14

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

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

Contributors	Affiliation	Role
Chaves, Joaquin	National Aeronautics and Space Administration (NASA)	Principal Investigator
McClain, Charles	National Aeronautics and Space Administration (NASA)	Co-Principal Investigator
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Abstract
Dissolved organic carbon (DOC) from US GEOTRACES North Atlantic Transect cruise on the R/V Knorr KN199-04 in the subtropical N. Atlantic in 2010.

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Coverage

Spatial Extent: **N**:38.3307 **E**:-9.66 **S**:17.3497 **W**:-24.4998
Temporal Extent: 2010-10-16 - 2010-11-02

Dataset Description

Dissolved organic carbon (DOC) on samples were collected during Geotraces 2010 (KN199-04).

The following metadata was extracted from the original file header:

/begin_header
/investigators=Joaquin_Chaves Charles_McClain
/affiliations=NASA
/contact=joaquin.chaves@nasa.gov
/experiment=GEOTRACES
/cruise=kn199-04

/station=NA
/data_file_name=kn199-04_DOC_BCODMO.csv
/documents=DOC_protocols.pdf
/calibration_files=kn199-04_DOC_run.pdf
/data_type=bottle
/data_status=final
/start_date=20101016
/end_date=20101103
/start_time=15:10:00[GMT]
/end_time=00:19:00[GMT]
/north_latitude=38.3307[DEG]
/south_latitude=17.3497[DEG]
/east_longitude=-9.66[DEG]
/west_longitude=-24.4998[DEG]
/water_depth=-999
/measurement_depth=-999
/secchi_depth=-999
/wind_speed=-999
/cloud_percent=-999
/wave_height=-999 !
! The field "replicates" indicates how many replicate samples were
! averaged to produce the reported value

Note: The following header line was incorrect and subsequently corrected by BCO-DMO
! sample_no==-999 were collected with NASA's surface peristaltic pump
---
! quality = 1 good; 2 = medium; 3 = suspect
!
/missing=-999
/delimiter=comma

Methods & Sampling

Methods for the Collection and Measurement of Dissolved Organic Carbon (DOC): Seawater samples for analysis of dissolved organic carbon (DOC) and chromophoric dissolved organic matter (CDOM) absorption are filtered under a gentle vacuum (<5 in Hg) through pre-combusted (6 hours at 450°C) Whatman GF/F glass fiber filters and collected directly into pre-cleaned and pre-combusted sample glass bottles and vials. Duplicate samples at the surface and single samples at depth are collected for DOC analysis and stored frozen at -20°C. Samples are measured by high temperature combustion oxidation (HTCO) on a Shimadzu TOC-L carbon analyzer. Mean of replicate runs for individual samples must maintain a standard deviation <2% for a minimum of 3 of 7 injections (Benner and Strom 1993; Sharp et al. 2002; Mannino et al. 2008). Accuracy of analyses is monitored by running DOC consensus reference material standards (CRM; Hansell Laboratory, University of Miami RSMAS); CRM measurements must maintain an analytical error to within ±5% of the consensus values.

Standard curves of the manufacturer-recommended carbon standard, potassium hydrogen phthalate (KHP), ranging from ~500 to 4000 µg C L-1 and from ~500 to 2000 µg C L-1 are conducted daily. KHP check standards are interspersed between every 6 samples for each sample batch to verify the consistency of the standard curve throughout each sample batch analyzed. To minimize salt accumulation in the instrument flow path, Milli-Q water blanks are inserted between every 3 samples for each batch of samples. Injection volumes for seawater samples, standards and blanks are typically 120µL.

Data Processing Description

Data are averages of samples replicates, the number of which is indicated as a data column. Standard deviation of replicates is included as a data column as well. Data has been visually QA/QC. Accuracy of analyses is monitored by running DOC consensus reference material standards (CRM; Hansell Laboratory, University of Miami RSMAS); CRM measurements must maintain an analytical error to within ±5% of the consensus values. Results of that comparison and all QA/QC metrics plots are contained in the accompanying Supplemental

Document, "Matlab calibration report" (kn199-4_DOC_RUN.pdf).

Quality flags 'DOC_qf' are defined as: 1 = good; 2 = medium; 3 = suspect.

BCO-DMO Processing Notes:
Edits made:
- Parameter header names were renamed to BCO-DMO convention
- Blank data fields and data reported as -999 were edited to 'nd'
- Edited precision of lat/lon to four decimals.
- Edited precision of DOC and DOC_sd to one decimal.
- Removed the comment information from the file header. Where necessary the information was incorporated into BCO-DMO metadata fields and retained entirely in Dataset Description.

Note: Correspondence with the PI (2013.01.12) regarding sample numbers indicates that samples with a GEOTRACES sample number also had pigment samples taken for the WHOI Thorium group. Those samples with -999 did not have corresponding pigment samples taken. Sample numbers of -999 were subsequently edited to 'nd' and the following comment was retained in the file header as per the PI:

samples from station 1 with 0 depth were collected with WHOI's GEOTRACES pump
sample numbers for stations > 1 with depth = 0 were collected with NASA's
surface peristaltic pump

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 name 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	
DOC_GT10_joined.csv	(Comma Separated Values (.csv), 9.19 KB) MD5:8a7f210d65df61d0c67ad31b4925224e
Primary data file for dataset ID 3855	

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Supplemental Files

File
Matlab calibration report filename: kn199-4_DOC_RUN.pdf (Portable Document Format (.pdf), 110.51 KB) MD5:e31ade96cf109132f1c4459780331bad Matlab calibration report for dataset "GT10 - DOC"

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Related Publications

Benner, R., & Strom, M. (1993). A critical evaluation of the analytical blank associated with DOC measurements by high-temperature catalytic oxidation. Marine Chemistry, 41(1-3), 153–160. doi:10.1016/0304-4203(93)90113-3
Methods

Mannino, A., Russ, M. E., & Hooker, S. B. (2008). Algorithm development and validation for satellite-derived distributions of DOC and CDOM in the U.S. Middle Atlantic Bight. Journal of Geophysical Research, 113(C7). doi:10.1029/2007jc004493 https://doi.org/10.1029/2007JC004493
Methods

Sharp, J. H., Carlson, C. A., Peltzer, E. T., Castle-Ward, D. M., Savidge, K. B., & Rinker, K. R. (2002). Final dissolved organic carbon broad community intercalibration and preliminary use of DOC reference materials. Marine Chemistry, 77(4), 239–253. doi:10.1016/s0304-4203(02)00002-6 https://doi.org/10.1016/S0304-4203(02)00002-6
Methods

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Parameters

Parameter	Description	Units
lat	Latitude component of geographic position where samples were collected.	decimal degrees
lon	Longitude component of geographic position where samples were collected.	decimal degrees
time_gmt	Time of sampling, reported in GMT. in the format hhmm	unitless
yrday_gmt	Year day recorded in GMT time, where Jan 1 is day 1.	unitless
date_gmt	Date, recorded in GMT time. In the format yyyymmdd.	unitless
depth	Sample depth in meters.	meters
DOC	Dissolved organic Carbon.	micromoles/Liter

DOC_sd	Standard deviation of DOC measurement.	micromoles/Liter
replicate	A number indicating how many replicate samples were averaged to produce the reported value.	dimensionless
DOC_qf	Quality flag associated with DOC determination, where 1 = good; 2 = medium; 3 = suspect.	dimensionless
cruise_id	Official cruise identifier e.g. KN199-04 = R/V Knorr cruise number 199-04.	dimensionless
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 'station'; this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions.	dimensionless
cast_GEOTRC	Cast identifier numbered consecutively within a station. 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. 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. PI-supplied values were identical to those in the intermediate US GEOTRACES master file Originally submitted as 'sample'; this parameter name has been changed to conform to BCO-DMO's GEOTRACES naming conventions. Sample numbers from station 1 with 0 depth, were collected with WHOI's GEOTRACES pump and samples for stations > 1 from depth = 0, were collected with NASA's surface peristaltic pump. Samples with a GEOTRACES sample number also had pigment samples collected, missing sample numbers (nd) did not.	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
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) format: YYYY-MM-DDTHH:MM:SS[.xx][+/-TZ]	yyyy-MM-dd'T'HH:mm:ss.SS'Z'

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Instruments

Dataset-specific Instrument Name	Niskin bottle
Generic Instrument Name	Niskin bottle
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	Pump surface
Generic Instrument Name	Pump surface
Dataset-specific Description	NASA's surface peristaltic pump was used to collect surface samples from station 1. WHOI's GEOTRACES pump was used to collect surface samples from all other stations.
Generic Instrument Description	A source of uncontaminated near-surface seawater pumped onto the deck of the research vessel that can be sampled and analyzed. This pumped seawater supply is from an over-the-side pumping system, and is therefore different from the vessel underway seawater system.

Dataset-specific Instrument Name	Total Organic Carbon Analyzer
Generic Instrument Name	Total Organic Carbon Analyzer
Dataset-specific Description	Samples were measured by high temperature combustion oxidation (HTCO) on a Shimadzu TOC-L carbon analyzer.
Generic Instrument Description	A unit that accurately determines the carbon concentrations of organic compounds typically by detecting and measuring its combustion product (CO2). See description document at: http://bcodata.whoi.edu/LaurentianGreatLakes_Chemistry/bs116.pdf

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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

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Project Information

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

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

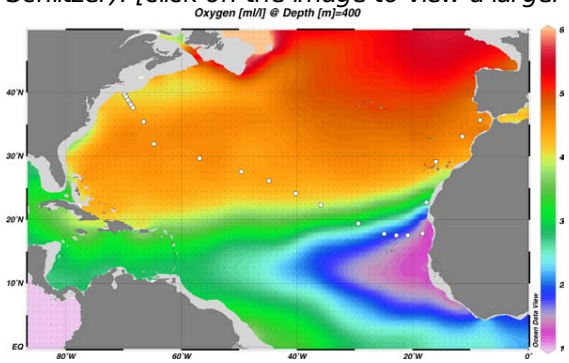
Coverage: Subtropical western and eastern North Atlantic Ocean (GA03)

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]

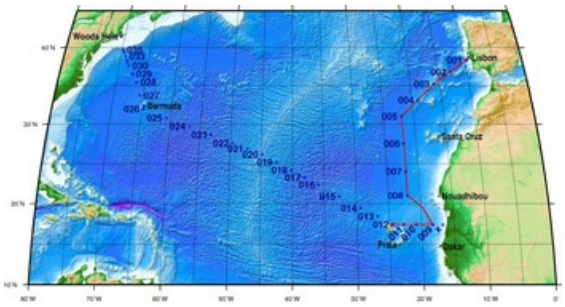


Hydrography, CTD and nutrient measurements will be supported by the Ocean Data Facility (J. Swift) at Scripps Institution of Oceanography and funded through NSF Facilities. They will be providing an additional CTD rosette system along with nephelometer and LADCP. A trace metal clean Go-Flo Rosette and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

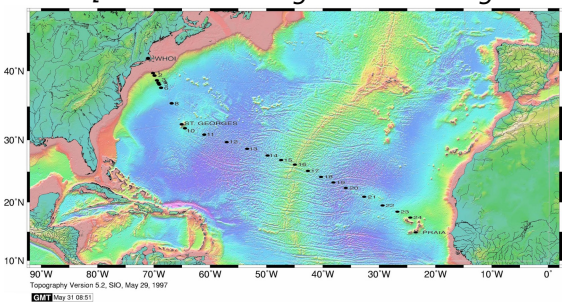
Figure 2. The red line shows the cruise track for the first leg of the US Geotraces North Atlantic Transect on the R/V Knorr in October 2010. The rest of the stations (beginning with 13) will be completed in October-December 2011 on the R/V Knorr (courtesy of Bill Jenkins, Chief Scientist, GNAT first 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
National Aeronautics & Space Administration (NASA)	NNX09AN94G

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