

# SAFe and GEOTRACES trace element references from R/V Knorr KN199-04, KN204-01 in the Subtropical northern Atlantic Ocean from 2010-2011 (U.S. GEOTRACES NAT project)

**Website:** <https://www.bco-dmo.org/dataset/3852>

**Data Type:** Cruise Results

**Version:** 1

**Version Date:** 2013-01-11

## Project

» [U.S. GEOTRACES North Atlantic Transect \(GA03\)](#) (U.S. GEOTRACES NAT)

## Program

» [U.S. GEOTRACES](#) (U.S. GEOTRACES)

Contributors	Affiliation	Role
<a href="#">Bruland, Kenneth W.</a>	University of California-Santa Cruz (UCSC)	Principal Investigator
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## Abstract

SAFe and GEOTRACES trace element references from R/V Knorr cruises KN199-04 & KN204-01 in the Subtropical northern Atlantic Ocean from 2010-2011.

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## Methods & Sampling

### SAFe reference samples:

During the SAFe (Sampling and Analysis of Fe) program and the North Atlantic and North Pacific GEOTRACES Intercalibration cruises, we (Geoffrey Smith and Ken Bruland) collected large volumes of homogenized surface and deep seawater to provide 0.5 L SAFe reference samples to researchers investigating the marine chemistry of trace metals in both the U.S. and international trace metal communities. Surface seawater was collected using the UCSC designed "GeoFish" towed sampling system, filtered as described below and then homogenized in two 500 L SAFe tanks. Water from 1000 m was collected with multiple four-bottle casts using our Teflon coated, 30 L, GOFlo samplers deployed on Kevlar hydroline (Bruland et al. 1979), filtered and then homogenized in one of the SAFe tanks. Our GeoFish/SAFe tank system consists of PFA Teflon tubing, an all PFA Teflon diaphragm pump, sequential filtration through 0.45  $\mu\text{m}$  then 0.2  $\mu\text{m}$  pore size polycarbonate, track etched (PCTE) pleated filter cartridges and two 500 L fluorinated low density polyethylene tanks connected with all Teflon tubing, valves and fittings. All filtrations, acidifications and bottling of the SAFe samples were performed inside of Class-100 clean benches in a portable clean van. We successfully collected and continue to provide to an international trace metal community 650 SAFe S reference samples of surface water, 650 SAFe D1 reference samples of 1000 meter depth water, and 650 SAFe D2 reference samples of 1000 meter depth water. These samples have been stored in rigorously acid cleaned LDPE bottles for over four years and have proven stable for dissolved Fe and other trace metals. These SAFe reference samples are now proving to be valuable for a suite of GEOTRACES key and non-key trace metals.

### GEOTRACES reference samples:

A variety of GEOTRACES reference samples are also available. We used the SAFe tank system on the North Atlantic GEOTRACES Intercalibration cruise to collect an additional set of North Atlantic GEOTRACES reference samples from the surface and from a depth of 2000 meters. The surface reference sample (GS) was collected with the GeoFish sampling system in the same manner as for SAFe S samples, while the 2000 m deep reference sample (GD) was collected with 5 separate casts of the GEOTRACES rosette to rinse and fill a tank.

During the Pacific GEOTRACES Intercalibration cruise, we used the GeoFish/SAFe tank system to collect additional Pacific surface water from the SAFe site to be used as GEOTRACES surface Pacific (GSP) reference samples (~300 0.5 L bottles). Additionally, we collected a surface tank from the highly productive surface waters of the Santa Barbara Basin coastal site on the Pacific Intercalibration cruise and aliquoted ~600 0.5 L samples of this water as a SAFe/GEOTRACES coastal surface reference sample, "SGC".

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## Data Files

File
<b>trace_ref_Bruland.csv</b> (Comma Separated Values (.csv), 2.81 KB) MD5:63e91284f27942361438359e3c680b39
Primary data file for dataset ID 3852

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## Parameters

Parameter	Description	Units
cruise_id	cruise identification	text
sta	station number	integer
element	chemical trace element measured	text
unit	concentration units measured for each element	picomoles/kilogram or nanomoles/kilogram
blank	concentration measured for each element in the blank	picomoles/kilogram or nanomoles/kilogram
lod	limit of detection equivalent to 3 times the standard deviation of the blanks or samples at or near blank level.	picomoles/kilogram or nanomoles/kilogram
ref_SAFe_deep	concentration measured for each element from water collected at 1000 meters at the SAFe site (Pacific O.)	picomoles/kilogram or nanomoles/kilogram
ref_SAFe_surf	concentration measured for each element from water collected at the surface at the SAFe site (Pacific O.)	picomoles/kilogram or nanomoles/kilogram
ref_GT_deep	concentration measured for each element from water collected at 2000 meters at the GEOTRACES site (Atlantic O.)	picomoles/kilogram or nanomoles/kilogram
ref_GT_surf	concentration measured for each element from water collected at the surface GEOTRACES site (Atlantic O.)	picomoles/kilogram or nanomoles/kilogram

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## Instruments

<b>Dataset-specific Instrument Name</b>	GeoFish
<b>Generic Instrument Name</b>	GeoFish Towed near-Surface Sampler
<b>Generic Instrument Description</b>	The GeoFish towed sampler is a custom designed near surface (

<b>Dataset-specific Instrument Name</b>	GO-FLO Teflon Trace Metal
<b>Generic Instrument Name</b>	GO-FLO Teflon Trace Metal Bottle
<b>Dataset-specific Description</b>	Teflon coated,30 L, GOFlo samplers were deployed on Kevlar hydroline (Bruland et al. 1979),
<b>Generic Instrument Description</b>	GO-FLO Teflon-lined Trace Metal free sampling bottles are used for collecting water samples for trace metal, nutrient and pigment analysis. The GO-FLO sampling bottle is designed specifically to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

<b>Dataset-specific Instrument Name</b>	Mass Spectrometer
<b>Generic Instrument Name</b>	Mass Spectrometer
<b>Generic Instrument Description</b>	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

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## Deployments

KN199-04

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/58066">https://www.bco-dmo.org/deployment/58066</a>
<b>Platform</b>	R/V Knorr
<b>Report</b>	<a href="http://bcodata.whoi.edu/US_GEOTRACES/AtlanticSection/Cruise_Report_for_Knorr_199_Final_v3.pdf">http://bcodata.whoi.edu/US_GEOTRACES/AtlanticSection/Cruise_Report_for_Knorr_199_Final_v3.pdf</a>
<b>Start Date</b>	2010-10-15
<b>End Date</b>	2010-11-04
<b>Description</b>	<p>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 (<a href="https://www.geotraces.org/">https://www.geotraces.org/</a>) 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): <a href="https://www.rvdata.us/search/cruise/KN199-04">https://www.rvdata.us/search/cruise/KN199-04</a> 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</p>

**KN204-01**

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/58786">https://www.bco-dmo.org/deployment/58786</a>
<b>Platform</b>	R/V Knorr
<b>Report</b>	<a href="http://bcodata.whoi.edu/US_GEOTRACES/AtlanticSection/STS_Prelim_GT11_Doc.pdf">http://bcodata.whoi.edu/US_GEOTRACES/AtlanticSection/STS_Prelim_GT11_Doc.pdf</a>
<b>Start Date</b>	2011-11-06
<b>End Date</b>	2011-12-11
<b>Description</b>	<p>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): <a href="https://www.rvdata.us/search/cruise/KN204-01">https://www.rvdata.us/search/cruise/KN204-01</a> 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)</p>

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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)

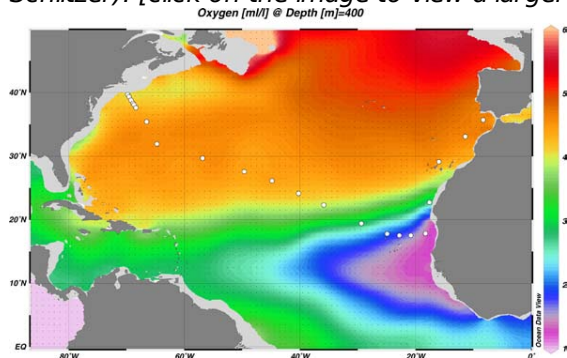
*Much of this text appeared in an article published in OCB News, October 2008, by the OCB Project Office.*

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]*

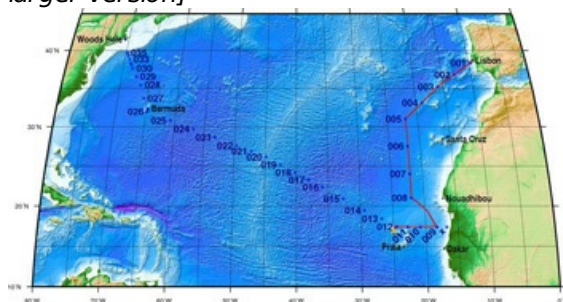


Hydrography, CTD and nutrient measurements will be supported by the Ocean Data Facility (J. Swift) at Scripps Institution of Oceanography and funded through NSF Facilities. They will be providing an additional CTD rosette system along with nephelometer and LADCP. A trace metal clean Go-Flo Rosette and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

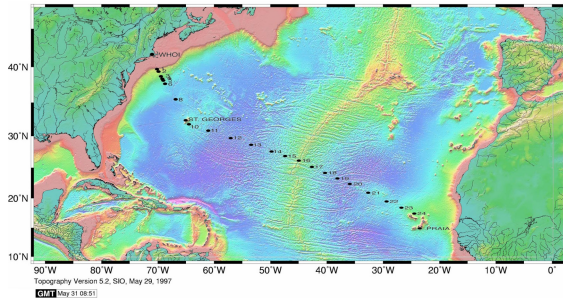
*Figure 2. The red line shows the cruise track for the first leg of the US Geotraces North Atlantic Transect on the R/V Knorr in October 2010. The rest of the stations (beginning with 13) will be completed in October-December 2011 on the R/V Knorr (courtesy of Bill Jenkins, Chief Scientist, GNAT first 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
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-0961579</a>

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