

Geotraces: ABOUT THE EXPEDITION

About the Expedition

The ocean is a key part of the global environment. It is also a complex chemical and biological system. Its chemistry is key to supporting life as we know it. It is controlled both by *in situ* biological activity, physical circulation, and geologic and atmospheric processes. Trace metals such as iron (Fe), cobalt (Co) and molybdenum (Mo) exist in extremely tiny concentrations in the ocean, but play a crucial role in formation of life-supporting enzymes and proteins in marine organisms.

Unfortunately, our knowledge of trace elements in the marine environment is limited. This is partly because they are difficult to measure. Imagine trying to detect a billionth of a gram of iron on board a ship containing many tons of it. However, modern instrumentation coupled with very careful chemistry now allows us to make these measurements and to begin to reveal the distributions and detailed behavior of these important trace elements in the ocean.

[GEOTRACES](#) is a newly created international program aimed at making a large-scale survey of these trace elements throughout the global ocean. In addition to trace metals, GEOTRACES includes measurements of isotopes, which allow us to probe the mechanisms and rates of the biological, physical, chemical, and geological processes that control trace element distributions in the ocean.

It is a big task. The GEOTRACES program involves scientists from Asia, Europe, and North America and is expected to extend over decades. This cruise is the first U.S. contribution to the GEOTRACES program. We will be conducting a trans-Atlantic section that takes us from just north of the Straits of Gibraltar, south to the coast of Africa, west across the Atlantic to a submarine hydrothermal site ([TAG](#)), to Bermuda, and back to the northeast coast of the U.S. over the course of two months.

The First Installment

October-November, 2010

The ship (R/V KNORR) arrived in Lisbon on October 10, 2010 from a journey via Iceland. Over the course of 4 days, a team of scientists consisting of the actual cruise participants along with 5 other scientists and Eric Benway worked hard loading gear on board, securing equipment, setting up the laboratory vans (including connecting electric, water, and compressed air supplies), and assembling the trace metal clean areas (bubbles)* using plastic sheeting and HEPA filters. Liquid nitrogen tanks were topped up. Gas tank regulators were installed and tubing connected to equipment. The CTD rosettes were assembled and connected to the conducting wires, and various sampling and sample processing systems were set up.

On the morning of October 15 we left port for the first U.S. GEOTRACES cruise! The first station occurred within a few hours after departing Lisbon, and was a designated super-station, so that we had our hands full right off the bat. Prior to reaching station, the GEOTRACES carousel (GTC) was lowered to about 50 m depth in "blue water" for rinsing. When we reached the station additional test casts were deployed, alternating between the GTC and the ODF rosette (the 12 bottle 30 liter Niskin rosette) to insure mechanical integrity and to clean the bottles. A set of test samples were taken for the GTC which included both the main set of GO-FLO bottles and the backup ("B-Team") set. These samples were measured on board for Zn to diagnose for contamination. Some problems were identified and resolved. Additional "soak time" was used as a cleaning strategy for all the "A-team" GO-FLO bottles.

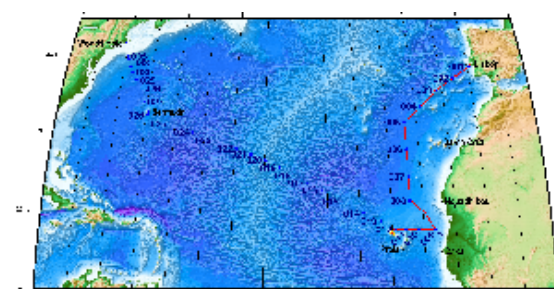
After spending more than two days testing and sampling at this first site, we continued our south-westward transect with alternating "demi" and full stations (see Cruise Map). A demi-station typically involved single shallow GTC and Niskin cast (the one exception to this was station 4, where we only completed a Niskin cast so that the GTC sampling team could catch up). Station 5 found us at the beginning of our 22°W meridional section, where we turned due southward, alternating full- and demi-stations. Station 7, a full station, coincided with the recently sampled German GEOTRACES occupation (Meteor Cruise M81/1, GEOTRACES section A11 by Martin Frank and others). We attempted to replicate most of the depths sampled during the German cruise to allow maximum opportunity for inter-comparison. Unfortunately, stringent limitations in water availability (heavy subscription by participating U.S. analysts) prevented us taking any "library samples" for distribution to non-U.S. laboratories. Following this station we continued on to Station 8, a demi-station.

Although things at first went well, the cruise was cut short by engine trouble, which developed after Station 8. We managed to complete 4 more stations along a transect extending outward from the North African coast, and we pulled into port in the Cape Verde Islands on



[Enlarge Image](#)

The KNORR can be seen through the masts of a Danish naval sailing ship in the port of Lisbon. We spent 4 days loading and setting up equipment on the ship before leaving on October 15.



GEOTRACES 2010 Cruise Track 2010-11-09 23:45

[Enlarge Image](#)

A map of the stations we occupied from October 15 - November 4, 2010. The red line shows our actual cruise track, and the other stations (13 - 35) are planned for this November (2011).

November 4.

*Imagine trying to detect natural levels of, for example iron (Fe) which occurs at less than a billionth of a gram in a liter of seawater, when you're riding on a ship weighing many, many tons and mostly made of iron! The risks are equally great for many other "trace metals". To combat the risk of even the tiniest amount of this unwanted contamination, we build "trace-metal clean" environments on the ship to process our samples.

Read All About It!

Public Interest Articles

An article about GEOTRACES appeared in Chemical and Engineering News in September, 2008. Please check out

http://pubs.acs.org/cen/email/html/cen_86_i35_8635sci4.html

In addition, our own *Jeremy Jacquot*, a graduate student at the University of Southern California has written a number of public interest articles about GEOTRACES and our expedition. Read these at

<http://discovermagazine.com/2011/apr/08-charting-earths-chemical-kissed-seas>

<http://www.earthmagazine.com/earth/article/3ac-7da-a-14>

<http://www.earthmagazine.com/earth/article/438-7db-4-19>

and in addition you can read his blog at

<http://www.earthmagazine.com/earth/article/3c4-7da-b-b>

Enjoy!

Acknowledgments

Funding Support

This work has been funded by the *National Science Foundation* through numerous research grants. The planning, logistics, and coordination of the cruise, along with ship-board hydrographic measurements, have been supported by NSF grant OCE-0926423.

Ship Support

We are grateful to the Captain and crew of the Research Vessel R/V KNORR for their support and hard work during the cruise. The Woods Hole Oceanographic Institution Port Office, in particular Eric Benway were very helpful in coordination and staging.

Leadership and Inspiration

This would not have happened without the vision, planning, and hard work of the GEOTRACES committees (both U.S. and International). These groups of scientists worked tirelessly over many years to design and assemble an ambitious global research program. We are particularly indebted to two individuals: Dr. Robert Anderson (Lamont-Doherty Earth Observatory) and Dr. Gideon Henderson (Oxford University), who led the way.

Last updated: July 11, 2011

Copyright ©2007 Woods Hole Oceanographic Institution, All Rights Reserved.

Mail: Woods Hole Oceanographic Institution, 266 Woods Hole Road, Woods Hole, MA 02543, USA.

E-Contact: info@whoi.edu; press relations: media@whoi.edu, tel. (508) 457-2000

Problems or questions about the site, please contact webdev@whoi.edu



[Enlarge Image](#)

(National Science Foundation)