

## Annual Report on GEOTRACES Activities in the U.S.

Principal activities of the U.S. GEOTRACES program include:

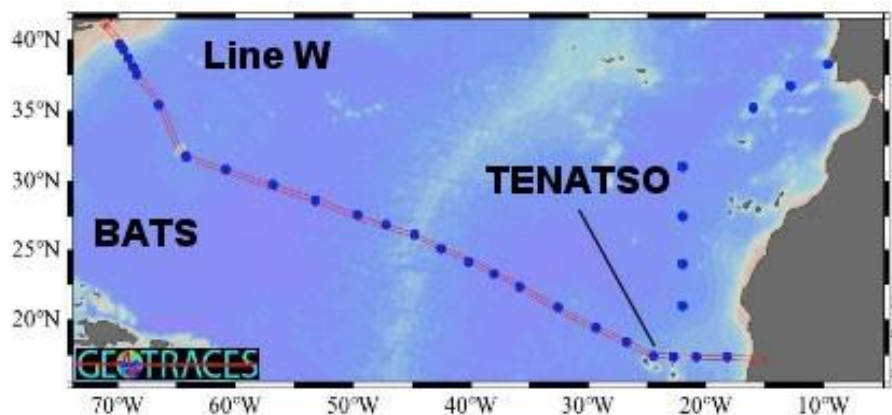
1. Completion of a North Atlantic zonal section,
2. Preparation for a Pacific section between Peru and Tahiti, and
3. Sustained planning for work in the Arctic Ocean

### Cruises

- North Atlantic: As noted in the U.S. report last year, the initial effort to complete GEOTRACES North Atlantic section GA03 was terminated prematurely in November, 2010, due to mechanical problems with the ship. U.S. GEOTRACES investigators organized a second cruise that completed the section in December 2011 (Figure 1).

Scientific objectives of the section include:

1. Characterize the trace element and isotope (TEI) distribution in Mediterranean Outflow waters,
2. Provide a measure of interannual variability in the upper water column by reoccupying a portion of the CLIVAR A16 section (20°W) that had been sampled previously for selected TEIS,
3. Define the distributions of micronutrients in the highly-productive eastern boundary current upwelling system,
4. Quantify sources of TEIs from Saharan aerosols,
5. Identify TEI sources and sinks associated with the oxygen minimum zone,
6. Compare and contrast TEI distributions in the well ventilated western basin vs. the less well ventilated eastern basin of the North Atlantic,
7. Compare and contrast TEI distributions, sources and sinks on the western (wide continental shelves) and eastern (narrow continental shelves) margins, and
8. Evaluate fluxes of TEIs carried by western boundary currents.



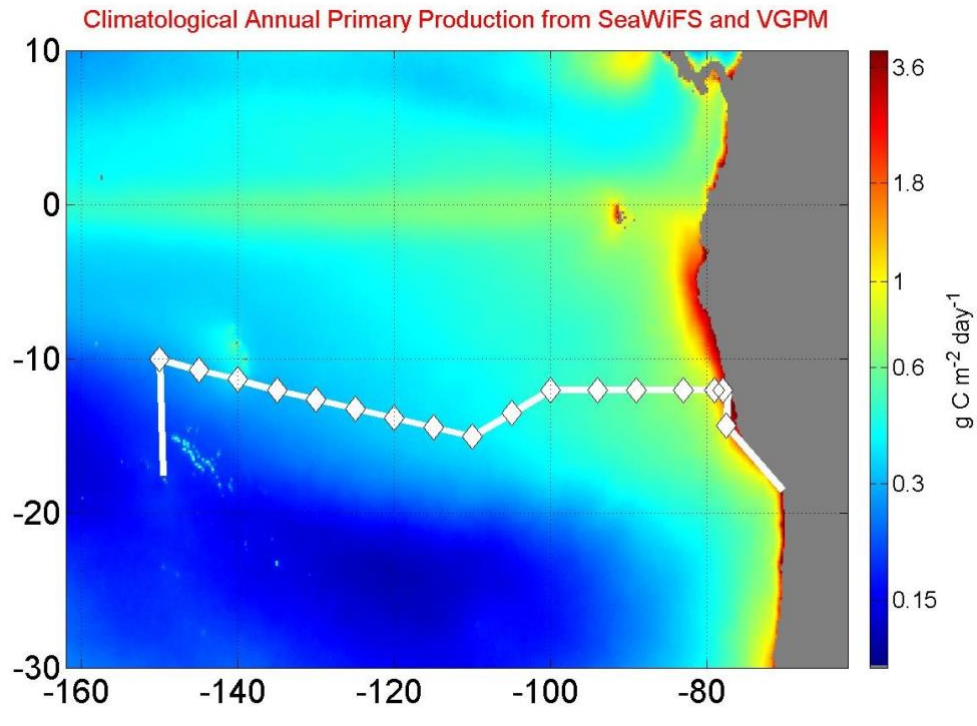
**Figure 1:** Locations of stations occupied during the U.S. North Atlantic zonal section. Stations from Portugal to TENATSO were occupied during R/V Knorr cruise KN199-4 in October-November 2010. Stations from Woods Hole (upper left) to TENATSO were occupied during KN204-1 in November-December, 2011.

Preliminary results from the section have been presented at international conferences (see “Presentation of Results” below). Many of the more labor-intensive analyses are still underway. A comprehensive review of the cruise results will be made during a cruise data workshop planned for 11-15 March 2013 at Old Dominion University.

- Eastern Tropical Pacific: The second major section planned by U.S. GEOTRACES is a zonal section in the eastern tropical Pacific roughly between Peru and Tahiti (Figure 2).

The principal scientific objectives of this section are:

1. Characterize the distributions of micronutrients in the highly-productive eastern boundary current upwelling system,
2. Compare and contrast TEI distributions between the biologically productive eastern end of the section and the oligotrophic western portion of the section,
3. Quantify sources and sinks of TEIs associated with hydrothermal systems of the East Pacific Rise,
4. Quantify TEI sources and sinks associated with the oxygen minimum zone.



**Figure 2:** Tentative locations of full depth stations planned for the U.S. eastern tropical south Pacific zonal section. Shallow stations to 1000 m are not shown. The cruise is planned for late 2013. Map and productivity calculations courtesy of M-E Carr.

A management proposal to secure ship time and to provide for cruise logistics was funded by the U.S. NSF in 2011. Proposals by individual investigators and collaborative proposals involving small groups were submitted to NSF in February 2012. At the time this report was written, investigators are still being informed of the fate of their proposals. It appears that a wide range of TEIs and circulation tracers will be funded, although a final list of funded proposals is not yet available.

The dates of the cruise are still being negotiated with the ship schedulers, but the cruise is expected to begin in October or November of 2013.

- South Atlantic (Not reported last year): Three individuals from U.S. institutions sailed aboard leg 3 of GEOTRACES section GA02. Stephanie Owens (Woods Hole Oceanographic Institution) sampled for 234Th

while Leo Pena and Alison Hartman (Lamont-Doherty Earth Observatory) sampled for rare earth elements and Nd isotopes.

### ***New Funding***

Two proposals were submitted to the U.S. NSF in February 2011: 1) a management proposal for the Pacific section described above, which will secure ship time and support the cost of operating the clean sampling system and other cruise logistics, and 2) a proposal for three years of continuing support of the U.S. GEOTRACES project office. Shortly after the last annual report was submitted was submitted to SCOR, U.S. GEOTRACES was notified that both proposals would be funded.

As noted above, individual investigators are being informed at this time about the fate of their proposals to participate in the Peru-Tahiti section

### ***Presentation of results***

Preliminary results from the North Atlantic cruise (Figure 1) were presented at three international conferences:

1. Ocean Sciences meeting (20-24 February 2012, Salt Lake City, Utah, USA)
2. Goldschmidt Conference (24-29 June 2012, Montréal, Canada)
3. Ocean Carbon and Biogeochemistry workshop (16-19 June 2012, Woods Hole, USA)

### ***U.S. GEOTRACES Meetings***

US GEOTRACES sponsored two large workshops and two town hall meetings during the past year. The US GEOTRACES project office also supported participation in two international GEOTRACES workshops by individuals from U.S. institutions. In chronological order, these events included:

1. A planning workshop for the Peru-Tahiti section (Figure 2) was held 12-14 September 2011 in La Jolla, California, to set priorities for the cruise and to share information that would facilitate preparation of proposals by individual investigators for submission to NSF on 15 February 2012. This workshop was attended by approximately 60 scientists, ship operators and program officers from NSF.
2. Twenty-three scientists and students from U.S. institutions participated in the 3rd GEOTRACES Data-Model Synergy workshop (14-17 November 2011, Universitat Autnoma de Barcelona, Spain).
3. A town hall meeting was held at the Fall 2011 AGU meeting (6 December 2011) to engage the oceanographic community in planning for a US GEOTRACES field program in the Arctic Ocean.
4. A town hall meeting was held at the 2012 Ocean Sciences meeting (22 February 2012) to engage the oceanographic community in planning for a U.S. GEOTRACES field program in the Arctic Ocean.
5. Four scientists from U.S. institutions participated in a GEOTRACES workshop on Arctic Climate Change (2-4 May 2012, University of British Columbia, Vancouver, Canada). This workshop served to coordinate plans for multiple research cruises in the Arctic Ocean in the time frame of 2015-2016.
6. The international implementation workshop in Vancouver was followed by a workshop at NSF (1315 June, 2012) to refine the research objectives for a U.S. GEOTRACES cruise in the western Arctic Ocean and to develop an implementation strategy to meet those objectives. Approximately 80 scientists, NSF program managers and representatives from the U.S. Coast Guard and NOAA participated in the meeting. The results of the deliberations are currently being synthesized in an implementation plan that will serve to prepare a set of priorities to guide the submission of the US

Arctic GEOTRACES management proposal (due October 18, 2012), the submission of individual PI proposals (due 15 February 2014), and the evaluation of those proposals.

***Publications (GEOTRACES and GEOTRACES-related\*)***

\* Noble, A.E., Lamborg, C.H., Ohnemus, D.C., Lam, P.J., Goepfert, T.J., Measures, C.I., Frame, C.H., Casciotti, K.L., DiTullio, G.R., Jennings, J. and Saito, M.A., 2012. Basin-scale inputs of cobalt, iron, and manganese from the Benguela-Angola front to the South Atlantic Ocean. *Limnology and Oceanography*, 57(4): 989-1010.

Papers led by U.S. labs appearing in the GEOTRACES Intercalibration Volume:

- Anderson, R. F., M. Q. Fleisher, L. F. Robinson, R. L. Edwards, J. A. Hoff, S. B. Moran, M. Rutgers van der Loeff, A. L. Thomas, M. Roy-Barman, and R. Francois, 2012. GEOTRACES intercalibration of <sup>230</sup>Th, <sup>232</sup>Th, <sup>231</sup>Pa, and prospects for <sup>10</sup>Be. *Limnology and Oceanography Methods*, 10: 179-213.
- Auro, M. E., L. F. Robinson, A. Burke, L. I. Bradtmiller, M. Q. Fleisher, R. F. Anderson, 2012. Improvements to <sup>232</sup>-thorium, <sup>230</sup>-thorium, and <sup>231</sup>-protactinium analysis in seawater arising from GEOTRACES intercalibration. *Limnology and Oceanography Methods*, 10: 464-474.
- Buck, K. N., J. Moffett, K. A. Barbeau, R. M. Bundy, Y. Kondo and J. Wu, 2012. The organic complexation of iron and copper: an intercomparison of competitive ligand exchange–adsorptive cathodic stripping voltammetry (CLE-ACSV) techniques. *Limnology and Oceanography Methods*, 10: 496-515.
- Charette, M. A., H. Dulaiova, M. E. Gonnea, P. B. Henderson, W. S. Moore, J. C. Scholten and M.K. Pham, 2012. GEOTRACES radium isotopes interlaboratory comparison experiment. *Limnology and Oceanography Methods*, 10: 451-463.
- Cutter G. A. and K.W. Bruland, 2012. Rapid and noncontaminating sampling system for trace elements in global ocean surveys. *Limnology and Oceanography Methods*, 10: 425-436.
- Fitzsimmons, J. N. and E. A. Boyle, 2012. An intercalibration between the GEOTRACES GO-FLO and the MITESS/Vanes sampling systems for dissolved iron concentration analyses (and a closer look at adsorption effects). *Limnology and Oceanography Methods*, 10:437-450.
- Lamborg, C. H., C. R. Hammerschmidt, G. A. Gill, R. P. Mason, S. Gichuki, 2012. An intercomparison of procedures for the determination of total mercury in seawater and recommendations regarding mercury speciation during GEOTRACES cruises. *Limnology and Oceanography Methods*, 10: 90-100.
- Pahnke, K., T. van de Flierdt, K. M. Jones, M. Lambelet, S. R. Hemming, S. L. Goldstein, 2012. GEOTRACES intercalibration of neodymium isotopes and rare earth element concentrations in seawater and suspended particles. Part 2: Systematic tests and baseline profiles. *Limnology and Oceanography Methods*, 10: 252-269.
- Planquette, H. and R. M. Sherrell, 2012. Sampling for particulate trace element determination using water sampling bottles: methodology and comparison to in situ pumps. *Limnology and Oceanography Methods*, 10: 367-388.
- van de Flierdt, T., K. Pahnke, H. Amakawa, P. Andersson, C. Basak, B. Coles, C. Colin, K. Crocket, M. Frank, N. Frank, S. L. Goldstein, V. Goswami, B. A. Haley, E. C. Hathorne, S. R. Hemming, G. M. Henderson, C. Jeandel, K. Jones, K. Kreissig, F. Lacan, M. Lambelet, E. E. Martin, D. R. Newkirk, H. Obata, L. Pena, A. M. Piotrowski, C. Pradoux, H. D. Scher, H. Schöberg, S. K. Singh, T. Stichel, H. Tazoe, D. Vance and J. Yang, 2012. GEOTRACES intercalibration of neodymium isotopes and rare earth element concentrations in seawater and suspended particles. Part 1: reproducibility of results for the international intercomparison. *Limnology and Oceanography Methods*, 10: 234-251.
- Zurbrick, C.M., P. L. Morton, C. Gallon, A. M. Shiller, W.M. Landing, A.R. Flegal, 2012. Intercalibration of Cd and Pb concentration measurements in the northwest Pacific Ocean. *Limnology and Oceanography Methods*, 10: 270-277.

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