

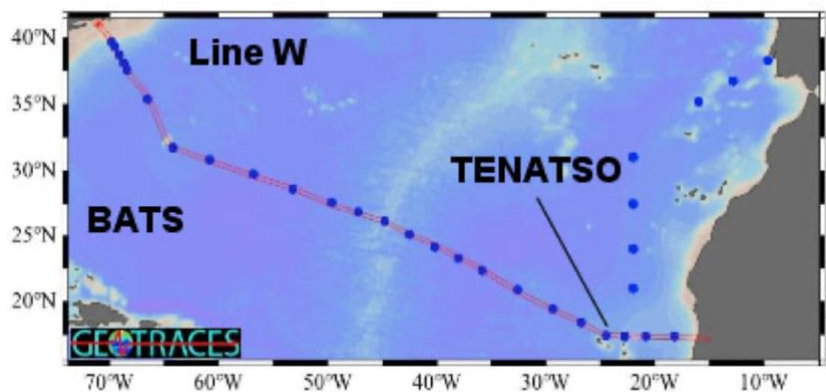
## Annual Report on GEOTRACES Activities in the U.S.

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

1. Data synthesis 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

### Activities

*North Atlantic:* A highlight of U.S. GEOTRACES activity during the past year was a data workshop to examine results from the North Atlantic section GA03 (Figure 1).



**Figure 1.** Locations of stations occupied during the U.S. North Atlantic zonal section GA03. 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.

More than 60 scientists (including students and post docs) representing 30 TEI groups (trace elements, isotopes and supporting variables) assembled 11-15 March 2013 at Old Dominion University (Norfolk, Virginia) to examine the results from the US GEOTRACES North Atlantic section (GA03). Members of the U.S. GEOTRACES Scientific Steering Committee met concurrently with the data workshop to assess the overall performance of the expedition and to make recommendations for future U.S. GEOTRACES cruises.

The first two days of the workshop were devoted to presentation of results by each group, after which participants broke into working groups to compare results pertaining to specific processes (e.g., particle transport and mineral aerosols, boundary exchange, benthic nepheloid layer processes, sources and sinks associated with the hydrothermal plume, transformations across the chlorophyll maximum, oxygen minimum zone processes). Workshop participants repeatedly returned to questions about hydrography and ocean circulation in the context of interpreting TEI distributions, and developed a plan for optimal multiparameter analysis to characterize contributions of various end-member water masses and their respective supply of TEIs along the section.

An important aspect of the workshop was attention to the ongoing intercalibration process. In addition to crossover stations with other cruises, multiple US labs measured certain TEIs, especially at “superstations” (e.g., as many as 5 labs measured dissolved Fe at selected stations). Careful examination of the results indicated that whereas agreement was generally good, thanks to previous

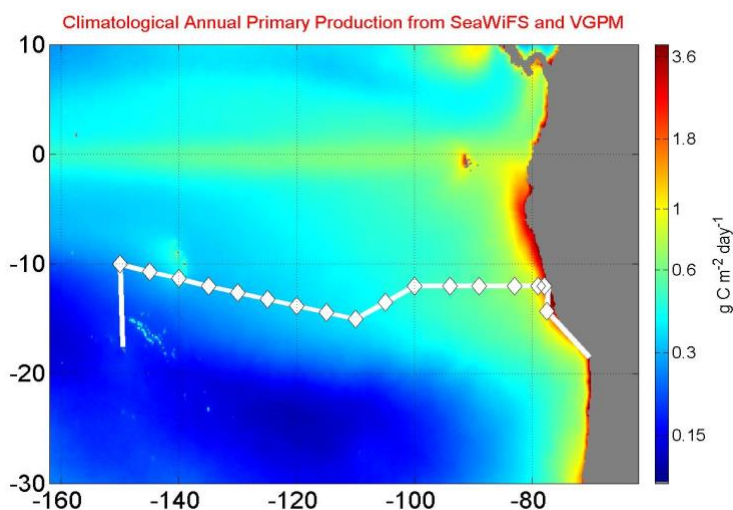
intercalibration work, some analytical issues remain unresolved. These findings emphasize the critical importance of sustaining intercalibration efforts on all GEOTRACES cruises.

The true potential of the GEOTRACES philosophy was realized as investigators compared results for different TEIs and supporting variables when interpreting the processes affecting TEI distributions along the section. For example, within the “margin section” between Mauritania and the Cape Verde Islands, iron isotopes, radium isotopes, circulation tracers, nutrients and oxygen were combined with distributions of a suite of trace elements to discriminate between dust and boundary exchange with margin sediments as a source of iron and other TEIs. Workshop participants identified a number of synthesis topics like this to be developed for publication over the next year or so.

Preparations are underway for a special issue of Deep-Sea Research Part-II featuring results from GA03. Bill Jenkins, Ed Boyle, Greg Cutter and Bob Anderson will serve as guest editors.

*Eastern Tropical Pacific:* The second major section planned by US GEOTRACES is a zonal section in the eastern tropical Pacific roughly between Peru and Tahiti (GP16, Figure 2).

Approximately 60 representatives of the U.S. GEOTRACES community met on 22-24 April 2013 at the Woods Hole Oceanographic Institution to refine station and sampling protocols for the planned section between Peru and Tahiti scheduled for October - December 2013. The objectives of the workshop were to maximize coordination of sampling and analytical efforts, develop deck utilization plans, shipping and loading logistics, and explore data management protocols. The group resolved a critical situation in which the number of berths requires to cover all of the essential science operations at sea greatly exceed available bunks. Teams of specialists were established to assure that shipboard operations would be covered and that samples would be collected and archived for all funded projects. Station plans for the cruise were refined to provide a telescoping sampling resolution in regions of greatest anticipated gradients in the concentrations of trace elements and isotopes. The research vessel (Thompson) will be loaded in Seattle 5-7 October before steaming to Manta Ecuador where the scientific party will depart on 25 October for a two-month expedition scheduled to end just before Christmas in Tahiti.



**Figure 2.** Tentative locations of full depth stations planned for the U.S. eastern tropical south Pacific zonal section (GP16). Shallow stations to 1000 m are not shown. The cruise is planned for late 2013. Map and productivity calculations courtesy of M-E Carr.

Arctic: U.S. GEOTRACES submitted a proposal to the U.S. National Science Foundation in October 2012 requesting support for management and logistics support of an Arctic cruise in 2015, contributing to the international GEOTRACES initiative. That proposal was declined. The management team met with representatives from NSF to discuss a strategy to strengthen the proposal. We plan to submit a revised proposal for a NSF deadline on 15 August 2013.

### **New Funding**

Funding for individual investigators to participate in the Peru-Tahiti section is now in place. Approximately 35 independent projects, involving more than 60 principal investigators as well as numerous students and post docs, have been funded. Completion of GP16 will generate a wealth of new data, both for TEIs and for complementary parameters that will facilitate the interpretation of TEI distributions.

### **Presentation of results**

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

- Fall 2012 AGU meeting (3 - 7 December 2012, San Francisco, California, USA).
- 93rd annual meeting of the American Meteorological Society (6 - 11 January 2013, Austin, Texas USA).

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

US GEOTRACES sponsored two large workshops during the past year. These are described above under “Activities”. In addition, members of the US GEOTRACES community participated in two international planning workshops:

- Nine members of the US GEOTRACES community participated in the International GEOTRACES Latin America workshop (12 - 15 November 2012, Rio de Janeiro, Brazil).
- Seven members of the US GEOTRACES community participated in the GEOTRACES Russia planning workshop (27 - 29 November 2012, Moscow, Russia).

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

- \* Fitzsimmons, J. N., R. Zhang, and E. A. Boyle (2013), Dissolved iron in the tropical North Atlantic Ocean, *Marine Chemistry*, 154, 87-99.

US GEOTRACES publications 2012 - 2013:

- Baskaran, M., Church, T., Hong, G., Kumar, A., Qiang, M., Choi, H., Rigaud, S. and Maiti, K., 2013. Effects of flow rates and composition of the filter, and decay/ingrowth correction factors involved with the determination of in situ particulate <sup>210</sup>Po and <sup>210</sup>Pb in seawater. *Limnology and Oceanography: Methods*, 11: 126-138.
- Bishop, J.K.B., Lam, P.J. and Wood, T.J., 2012. Getting good particles: Accurate sampling of particles by large volume in-situ filtration. *Limnology and Oceanography: Methods*, 10: 681-710.
- Boyle, E.A., John, S., Abouchami, W., Adkins, J.F., Echevoyen-Sanz, Y., Ellwood, M., Flegal, A.R., Fornace, K., Gallon, C. and Galer, S., 2012. GEOTRACES IC1 (BATS) contamination-prone trace element isotopes Cd, Fe, Pb, Zn, Cu, and Mo intercalibration. *Limnology and Oceanography: Methods*, 10: 653-665.

- Buck, C.S. and Paytan, A., 2012. Evaluation of commonly used filter substrates for the measurement of aerosol trace element solubility. *Limnology and Oceanography: Methods*, 10: 790-806.
- Church, T., Rigaud, S., Baskaran, M., Kumar, A., Friedrich, J., Masque, P., Puigcorbé, V., Kim, G., Radakovitch, O. and Hong, G., 2012. Intercalibration studies of  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  in dissolved and particulate seawater samples. *Limnology and Oceanography: Methods*, 10: 776-789.
- Henderson, P.B., Morris, P.J., Moore, W.S. and Charette, M.A., 2012. Methodological advances for measuring low-level radium isotopes in seawater. *Journal of Radioanalytical and Nuclear Chemistry*, 296(1): 357-362.
- Kenna, T.C., Masqué, P., Mas, J.L., Camara-Mor, P., Chamizo, E., Scholten, J., Eriksson, M., Sanchez-Cabeza, J.-A., Gastaud, J. and Levy, I., 2012. Intercalibration of selected anthropogenic radionuclides for the GEOTRACES Program. *Limnology and Oceanography: Methods*, 10: 590-607.
- Maiti, K., Buesseler, K.O., Pike, S.M., Benitez-Nelson, C., Cai, P., Chen, W., Cochran, K., Dai, M., Dehairs, F. and Gasser, B., 2012. Intercalibration studies of short-lived thorium-234 in the water column and marine particles. *Limnology and Oceanography: Methods*, 10: 631-644.
- Morton, P.L., Landing, W.M., Hsu, S.-C., Milne, A., Aguilar-Islas, A.M., Baker, A.R., Bowie, A.R., Buck, C.S., Gao, Y. and Gichuki, S., 2013. Methods for the sampling and analysis of marine aerosols: results from the 2008 GEOTRACES aerosol intercalibration experiment. *Limnology and Oceanography: Methods*, 11: 62-78.
- Sharma, M., Chen, C. and Blazina, T., 2012. Osmium contamination of seawater samples stored in polyethylene bottles. *Limnology and Oceanography: Methods*, 10: 618-630.
- Twining, B.S. and Baines, S.B., 2013. The Trace Metal Composition of Marine Phytoplankton. *Annual Review of Marine Science*, 5(1): 191-215.
- Twining, B.S., Baines, S.B., Vogt, S. and Nelson, D.M., 2012. Role of diatoms in nickel biogeochemistry in the ocean. *Global Biogeochemical Cycles*, 26(4): GB4001 doi:10.1029/2011GB004233.
- Wozniak, A.S., Shelley, R.U., Sleighter, R.L., Abdulla, H.A.N., Morton, P.L., Landing, W.M. and Hatcher, P.G., 2013. Relationships among aerosol water soluble organic matter, iron and aluminum in European, North African, and Marine air masses from the 2010 US GEOTRACES cruise. *Marine Chemistry*, 154: 24-33.
- Wurl, O., Zimmer, L. and Cutter, G.A., 2013. Arsenic and phosphorus biogeochemistry in the ocean: Arsenic species as proxies for P-limitation. *Limnology and Oceanography*, 58(2): 729-740.
- Zimmer, L.A. and Cutter, G.A., 2012. High resolution determination of nanomolar concentrations of dissolved reactive phosphate in ocean surface waters using long path liquid waveguide capillary cells (LWCC) and spectrometric detection. *Limnology and Oceanography: Methods*, 10: 568-580.

Submitted by Bob Anderson (boba@ldeo.columbia.edu), 28 June 2013.