GEOTRACES SCIENTIFIC STEERING COMMITTEE
ANNUAL REPORT TO SCOR 2010/2011
June 2011

SCOR Scientific Steering Committee for GEOTRACES

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Rotating off members (end 2010)
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William Jenkins, USA
Pere Masqué, Spain
Kristin Orians, Canada
Carol Robinson, UK

The SSC membership (listed above) contains representatives of 15 different countries with diverse expertise including: Marine biogeochemistry of carbon and nutrients; Trace elements and isotopes as proxies for past climate conditions; Land-sea fluxes of trace elements/sediment-water interactions; Trace element effects on organisms; Hydrothermal fluxes of trace elements; Tracers of ocean circulation; Tracers of contaminant transport; Controls on distribution and speciation of trace elements; and Ocean Modelling.

1. SSC meeting

The fifth meeting of the GEOTRACES SSC was held for three days (22nd-24th September 2010) at the Laboratoire d'Etudes en Géophyisque et Océanographie Spatiales (LEGOS) in Toulouse, France. Logistics were organized by the GEOTRACES International Project Office (Catherine Jeandel and Elena Masferrer).

The meeting was attended by 19 member of the 2009/2010 SSC. Other attendees included: Chris Measures (Co-chair of the Data Management Committee); Ed Urban (SCOR); Ed Mawji (GEOTRACES Data Assembly Centre) and Elena Masferrer (GEOTRACES International Project Office).

The morning of the first day, following introductions and welcome, was spent in national reports detailing GEOTRACES activities of the last year in 15 countries. The afternoon of the first day was dedicated to present the International Project Office activities and specially, to discuss the first draft of the "new" GEOTRACES web site. The day was ended by a review of the National Investments.

The second day of the SSC meeting started with discussion of BioGEOTRACES and Organic GEOTRACES – two initiatives related to GEOTRACES. After this presentation the meeting focused on two issues that will be reported on elsewhere in this report: Data Management and Intercalibration. Subsequent discussion addressed cross-national activities.

The third and final day of the SSC meeting started with discussion on applications from two studies to become GEOTRACES process studies: KEOPS-II (France) and KH-10-02 cruise (Japan). After this, a review of the Section Plan was done. Subsequent discussion addressed forthcoming workshops and conferences; capacity building; international partnership issues; programme budget; and SSC rotation.

The next SSC meeting is scheduled for 6th-8th September in Xiamen, China.

2. GEOTRACES Intercalibration

During the last year, two major (unique) intercalibration activities occurred, the final Intercalibration Cruises Workshop and the creation of the GEOTRACES Cruise Protocols (cookbook). The "Final" GEOTRACES Intercalibration Workshop was held at Old Dominion University in Norfolk, Virginia USA from 8th-10th March 2010. Of the 48 attendees, most of the International GEOTRACES Standards and Intercalibration Committee (Cutter – Chair, Andersson, Codispoti, Croot, Geibert (for van der Loeff), and Lohan) were present to evaluate results of the intercalibration initiative. One of the principal findings of the meeting is that the US GEOTRACES Sampling System (carousel with sensors and GO Flo bottles, winch, and clean lab van) takes uncontaminated samples for all the trace elements and isotopes of interest in the GEOTRACES programme. Furthermore, hydrographic smearing of the water samples (i.e., the bottles are tripped while the carousel is moving upwards at ca. 3 m/min, thus potentially combining waters from a depth interval rather at a discrete point) is usually minimal (ca. 2 m), but more importantly quantifiable using GO Flo bottle salinity, CTD sensor salinity, and nutrient concentrations. For the radiogenic and radioactive isotopes, sampled using the ship's rosette and Niskin bottles, sampling and handling did not have any effect on sample integrity (although the ship's seawater system dramatically affected radium concentrations and therefore is not an acceptable means of collecting surface samples for this element). Nevertheless, intercalibration problems with the radionuclides were present, but largely due to lab/instrument calibrations. In this respect, further laboratory intercalibrations will be conducted with common radioisotope standards.

Particulate sampling showed surprisingly good agreement between the in situ systems (MULVFS and McLane pumps) and GO Flos on the carousel. It is not perfect, but consensus was reached on filter holders (MULVFS or "mini MULVFS") and filter types (QMA and polysulfone such as Supor). The Supor filters had some heterogeneity problems at depth (pressure-related distortion?) for the in situ pumps, so other manufacturers of filters of this material will be investigated; whole filter processing rather than slices or plugs can also circumvent this problem. GO Flos showed evidence of large particle sinking and loss during filtration, but in spite of this (and keeping the bottles mixed/shaken during filtration) GO Flo filters had very good agreement for depth distributions and concentrations for 90% of the GEOTRACES trace elements when compared to MULVFS samples during Cruise 2 in the Pacific. On the last day of the workshop, the International GEOTRACES Standards and Intercalibration Committee gave a strong endorsement for the results of the workshop – GEOTRACES is ready to go to sea (although some lab calibration problems still need to be resolved).

An intercalibration special session was held at the February 2010 Ocean Sciences Meeting in Portland Oregon ("Getting the Right Number"; G. Cutter and R. Sherrell, conveners), and 16 talks and posters on the GEOTRACES Intercalibration were presented.

The most significant activity in 2010-2011 was the completion of "Sampling and Sample-handling Protocols for GEOTRACES Cruises" cookbook for the international GEOTRACES Program. These are posted on the international GEOTRACES web site (http://www.obs-vlfr.fr/GEOTRACES/libraries/documents/Intercalibration/Cookbook.pdf). The International GEOTRACES Standards and Intercalibration Committee will maintain and update these protocols. In addition to web-publishing the Protocols, we are coordinating publication of results from the Intercalibration in a special issue of *Limnology and Oceanography: Methods* to be entitled, "Intercalibration in Chemical Oceanography." Papers will be due on 15 July 2011 and we hope to have all of them published by early 2012. The editors of this special volume are Greg Cutter (USA), Peter Croot (UK), and Per Andersson (Sweden).

Of the 3 Atlantic cruises completed in the last year (Netherlands, GA02; UK, GA06; Germany, GA11), two occupied cross over stations (GA02 and 11) that will be re-occupied by the US GA02 cruises (eastern Atlantic one sampled by US in 2010, and western Atlantic, BATS, will be done in late 2011 when the cruise is restarted). The additional benefit of the BATS reoccupation is that it is a GEOTRACES Baseline Station for which key TEI data are already available. The UK GA06 Atlantic Ocean and Japanese Indian Ocean (GI04) cruises did not have any crossover stations, but took multiple samples at multiple depths to be distributed to several labs for key TEI determinations to effect an intercalibration. All of the crossover station and replicate sampling data will be independently evaluated by the Standards and Intercalibration Committee to assess the accuracy of sampling and analyses. We anticipate that the first of these evaluations will occur in 2012.

3. Data Management for GEOTRACES

The GEOTRACES Data Assembly Centre (GDAC) is hosted by the British Oceanography Data Centre (BODC), Liverpool, UK. GDAC is responsible for all GEOTRACES data activities from start to finish, including interacting with the PSO's and national data centres, and will eventually become the central point for all GEOTRACES data. GDAC is staffed by Dr. Ed Mawji.

From the start of GDAC a high priority has been placed on meeting representatives from national data centers. Under the present data model GDAC will not contact the scientist directly (unless the PSO has grant priory permission) and all requests for data are channelled through the local/national data centers. This requires GDAC to have a good working relationship with each national office.

A funding opportunity from the COST Action ES0801 has helped fund this task, with considerable resources being used in 2009-2010 to establish relationships with the French community and the local data center (2 meetings, including French GEOTRACES scientists). After discussions with Reiner Schlitzer and Gideon Henderson, COST money for 2010-2011 was made available for meeting with representatives from the Netherlands and Germany.

The most significant meetings of 2010-2011 will be summarised.

Meetings

17 -19 January 2011, Royal NIOZ

In the last year the laboratory of Hein de Baar, Netherlands have completed three GEOTRACES cruises (line GA02) collecting >70 data sets. This increased the importance of developing relationships with the data management office based at NIOZ. Hein de Baar and Micha Rijkenberg invited Mawji to attend the post cruise meeting of GEOTRACES cruise GA02 leg 1 & 2 on 17 & 18 January 2011 at Royal NIOZ, Den Burg (Texel), Netherlands. This gave Mawji the opportunity to meet some of the senior scientists at NIOZ and to introduce the principle of the GEOTRACES data management.

More importantly, two days were spent with Taco de Bruin (Head of NIOZ data management) and Ira van den Broek (NIOZ/international IPY Data Manager). Before the meeting Taco had highlighted his main concerns, which had European wide implications- mainly concerning SeaDataNet, and CDI record submissions. Concerns were also raised about the 14 IPY cruises associated with GEOTRACES and how GDAC plans to manage this data which technically speaking are all pre- GEOTRACES.

Progress was made on the following topics:

- Preparing CDI records for SeaDataNet: This topic was of particular importance as BODC and NIOZ are both partners in SeaDataNet and data would not normally be stored at both sites. Technical protocols and assurances from BODC were made to insure no international GEOTRACES data will be submitted to SeaDataNet.
- A robust data version control mechanism needed to be established; principles of how this will happen were discussed in great detail and proposed protocols put forward. A model of how errors relating to data sets will be related back to the originator was decided upon.
- How to credit the data originator for submitting data to GDAC; an issue that is constantly raised by PI's from the international community partly driven by funding bodies. This topic needs to be discussed in greater detail at the next DMC. But as far as GDAC/BODC are concerned this is not a problem as all data is tagged with the originators name and institution.
- The IPY data manager was also satisfied with how GDAC plans to handle the IPY cruises; i.e., GDAC will only manage and collect GEOTRACES parameters and provide a link to other datasets collected on each cruise.

Since the meeting Ed Mawji has kept in regular communication with Micha Rijkenberg and Ira van den Broek, who updates Mawji when he receives IPY data.

14-December 2010

Reiner Schlitzer –BODC, Liverpool.–This meeting was used to discuss data submission and problems Mawji is encountering. Data products and how to credit PIs in future GEOTRACES data products were also discussed.

Future meetings 2011

November BODC Liverpool- Cyndy Chandler (US; BCO-DMO) is meeting with Roy Lowry (BODC) to discuss mapping data to BODC's Ontology (which is been adopted by BCO-DMO) which is good news for GEOTRACES in the long term.

Mawji and Chandler have also put aside time to discuss progress of the US GEOTRACES data.

European funding from COST is still available to fund a further meeting with the German data managers.

Overall this year has been successful in establishing and keeping links between GDAC and national data centers but it has become apparent a greater effort needs to be made to build links with the Asian community. In 2011-2012, GDAC should concentrate time and effort to build and develop links with the Asia countries.

Working with the IPO

Since the last SSC meeting in Toulouse a good working mechanism has been established between GDAC and Elena Masferrer-Dodas at the IPO office. Information is freely exchanged between the two sites. The IPO office has helped GDAC keep up to date with new developments and upcoming cruises, which in the past has proved a difficult task.

Cruises

October 2010 – November 2010

The SSC and DMC have pushed for data management on cruises and in late 2010 Mawji was given the opportunity to participate in the first UK GEOTRACES cruise (GA10 40° south). This was a success in regards to his time.

-It gave him valuable firsthand experience in GEOTRACES sampling protocols

-Allowed him to ask question about analytical techniques with which he is less familiar (this is important when tagging data with BODC parameters /ontology).

-Useful mechanism in assessing how information is passed from the ship to GDAC and what information is lost.

-Test of pre cruise sampling metadata forms developed by Gideon Henderson and Mawji and CTD cast specific log sheets. This proved a success and was adopted by Eric Achterberg in February 2011 for the second UK GEOTRACES cruise.

Website progress and data delivery mechanisms

At present the GDAC website has no delivery mechanism in place. Progress in this area is controlled by BODC and ultimately Roy Lowry. For the last 2 years this has been a high priority task for the BODC IT team. Implementation of this project finally started in January this year and a mechanism is expected to be in place by early September. Due to BODC's large back catalogue of data all new IT projects have to take into account legacy issues hence the delays. A demonstration of this mechanism should be available at the DMC and SSC in China (September 2011). The disadvantages of the slow development are outweighed by the knowledge that a functioning data porthole for GEOTRACES will be maintained after the lifespan of the project as part of the BODC archive, providing a resource for the world community. Mawji has attended the relevant development meetings and put forward how he believes data should be delivered.

After many discussions with Roy it is understood that web features will greatly improve over the next few years, but ultimately IT issues and the features are not controlled by GDAC.

Data tracking and data submission

Post cruise Metadata

To keep the GEOTRACES inventory up to date PI's have been required to submit metadata forms. If forms are not submitted or completed in full, cruises cannot be added to the database and GDAC cannot track future GEOTRACES data.

The post cruise metadata form provides three levels of data

- At the Project level
- At the Cruise level
- At Individual level

Have they been successful?

Fourteen cruises were granted IPY GEOTRACES status. All 14 cruise have completed the metadata forms.

Ten GEOTRACES section cruises – Nearly all have submitted the required metadata forms.

Good progress has been made on the GEOTRACES data inventory.

A full GEOTRACES inventory (cruise to dataset level) is available from GDAC (http://www.bodc.ac.uk/geotraces/cruises/programme/).

PI's from most nations have been happy to complete the forms, which help build the data inventory. Overall good progress has been made in the metadata collection from GEOTRACES cruises; scientists are willing to spend the time to complete the relevant forms, which is a vast improvement from past experiences. The principle scientists have also been willing to submit detailed cruise reports to GDAC. It appears the message of good metadata and the ability to communicate to the outside world via cruise reports is becoming clear.

IPY Data

2010 has been a mixed year for GDAC. Communications between GDAC and national data centres and scientists is good but there is still a reluctance to submit data. This is not just a GDAC problem but a historic issue which is slowly beginning to improve.

Note on data quality- At present GDAC has data that does not meet the high standards set by GEOTRACES. It appears submitting data to a database is always a secondary thought and as a result data is submitted with less than adequate metadata. At present GDAC has a fair amount of data that cannot be loaded into the BODC database due to inaccurate sample metadata where scientists tag data with the inaccurate collection details (station, event number, depth, bottle number etc).

Summary of the IPY cruises

- All GEOTRACES data from TAN0609 (IPY 1-Phil Boyd) have been received. Mawji helped highlight a few metadata and reporting issues, which need to be addressed. Phil Boyd has been informed of the issues.
- GEOTRACES data from the three Australian IPY cruises (IPY2, 3, 6) are expected in the next 3-4 months (Andy Bowie)
- Success in tracking down data from DynaLiFe (IPY7). Bob Anderson introduced GEOTRACES to Stan Jacobs who has now provided GDAC with a cruise report and fully processed CTD data. The IPY data manager at NIOZ has sent GDAC nutrient data and Fe ligand data.
- No data are expected from the two Russian/Japan cruises due to political reasons (IPY 9,12)
- Only 2 data sets have been collected from the two Spanish ATOS cruise which have been sent to GDAC (IPY 8, 10).
- IPY 14 - the Canadians have submitted CTD data; expect other GEOTRACES data in 2012.

During the IPY program the three cruises that had the largest GEOTRACES programmes and hence data sets are ANTXXIV3 (IPY5), ARKXXII2 (IPY11) and the French cruise Bonus Good Hope

(IPY4). Tracking data from these cruises is proving difficult. The French are not submitting data to the national data centre so no data has been submitted to GDAC. GDAC has little to no contact with PANGAEA so a new approach has now been adopted by GDAC, which is to contact the scientist directly; this has already started to produce results

GEOTRACES section cruises

The last 2 years has been a busy time for GEOTRACES especially in the Atlantic. Overall 10 full GEOTRACES cruises have taken place. With another 3 cruises planned for 2011 there is obviously a lot of data expected.

GEOTRACES sections- 10 cruises

Pacific Ocean	GP13	2 cruise Australia and new Zealand	No data expected until 2013
Indian Ocean	GI04	1 cruise Japanese	No data expected until 2012
Atlantic Ocean	GA02	3 cruise -Netherlands	No data expected until 2013
Atlantic Ocean	GA10	1 cruise-UK	No data expected until 2013
Atlantic Ocean	GA06	1 cruise -UK	No data expected until 2013
Atlantic Ocean	GA11	1 cruise-Germany	No data expected until 2012
Atlantic Ocean	GA03	1 cruise-USA	No data expected until 2013

With the vast quantity of data expected in 2013 it becomes apparent that data is submitted by the time specified. As ever it is vitally important that scientists submit data following the GEOTRACES / BODC submission guidelines to ensure smooth processing and archiving.

In summary GDAC policies are proving effective with clear results; PI's are following guidelines and metadata is being submitted, CTD data and event logs have been submitted from 2 GEOTRACES sections already (1.5 years ahead of time), with another 1-2 sets of CTD data expected in the next few months.

Cruise /country	Metadata
PE319_NetherlandsA02- end date 26/5/2010	GDAC post cruise metadata form, full cruise report. CTD data expected in the next few months
PE321_NetherlandsA02 –end date8/7/2010	GDAC post cruise metadata form, full cruise report. CTD data expected in the next few months
KH09-05_Japan I04 –end date 10/1/2011	Metadata form no cruise report no data
M81-1_Germany A11 -end date 8/3/2010	Metadata form and intermediate cruise report. CTD data submitted
Cruise /country	Metadata
D357_UK A10-start date 17/10/2010	CTD +nutrient+oxygen data submitted to GDAC
KN199-4_America A03 -start date 15/10/2010	PI been in contact for full list of requirements-provided cruise name start and end dates
SK279_India I02 -start date 28/11/2011	Pre cruise metadata form
D361_UK A06-start data 02/07/2011	CSR, Cruise report CTD data expected in the next month
Pandora_France P12 -start date 02/07/2012	Planning document and proposed cruise track

4. Status of GEOTRACES Section Cruises

As noted in the preceding section, GEOTRACES has had an active year of cruises. The anticipated decadal field program is now well underway. Although several of the cruises have experienced substantial difficulties at sea (see reports from individual nations), overall the field program has enjoyed a successful and substantial implementation (Figure 1).

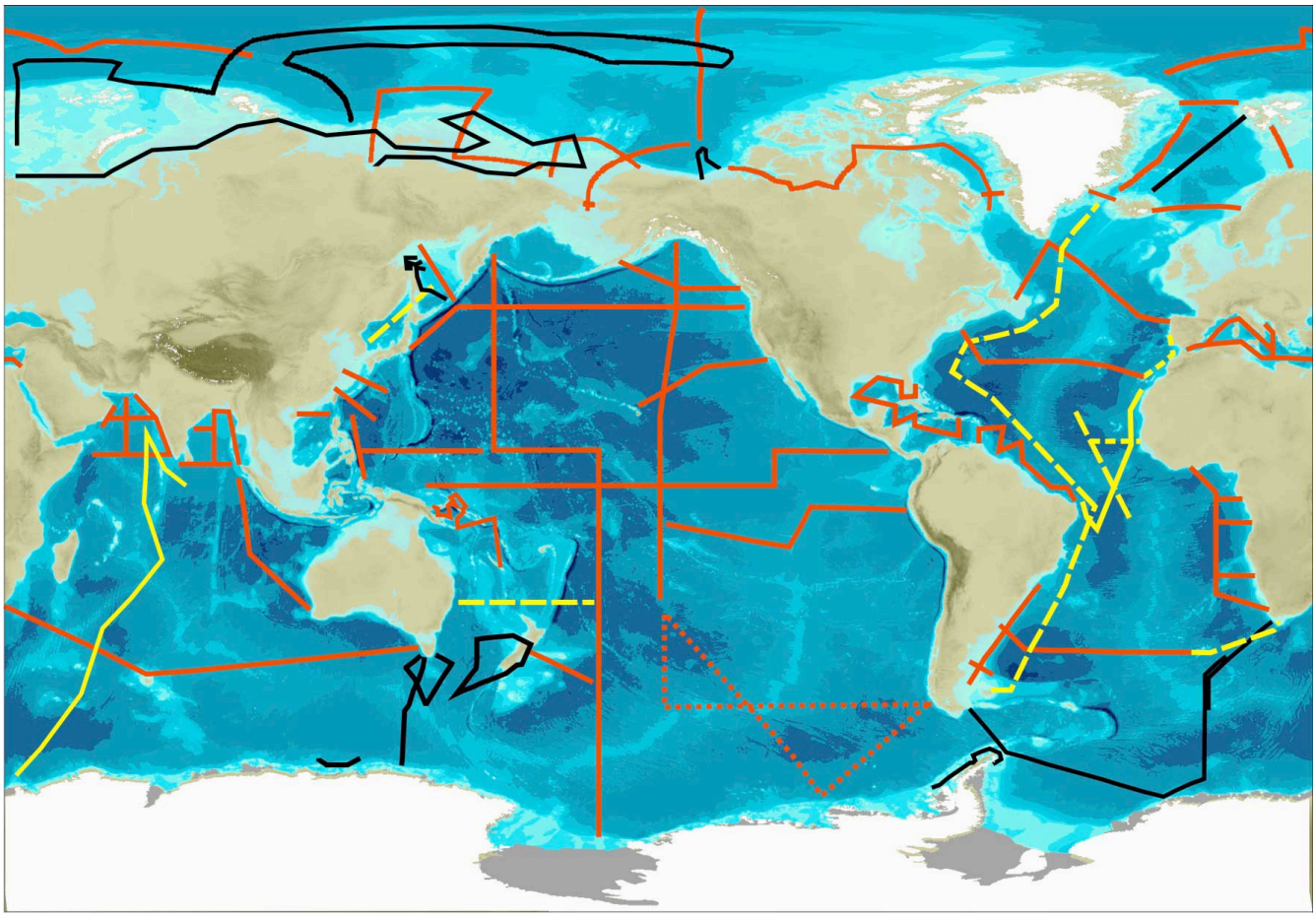


Figure 1. Status of GEOTRACES global survey of trace elements and their isotopes. In black: Sections completed as GEOTRACES contribution to the International Polar Year. In yellow: Sections completed to date as part of the primary GEOTRACES global survey (dotted yellow, completed during the past year). In red: Planned Sections. An updated version of this map can be found on the GEOTRACES home page <http://www.geotraces.org>.

5. GEOTRACES International Project Office

The GEOTRACES International Project Office (IPO) is based at the Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS) in Toulouse, France. The IPO is responsible for assisting the Scientific Steering Committee (SSC) in implementing the GEOTRACES Science Plan and implementation plans of the programme, organising and staffing meetings of the SSC, working groups and task teams, liaising with the sponsors and other relevant organisations, seeking and managing programme finances, representing the project at international meetings, maintaining the project website

assisting the GDAC in securing information about upcoming cruises and interacting with GEOTRACES national committees and groups, as well as other international projects.

The office is presented staffed by a single person: the IPO Executive Officer, Elena Masferrer. She has set up a new programme website <http://www.geotraces.org> which provides up-to-date information about all GEOTRACES activities. Main features and services provided by the web site are detailed below:

Cruise information: The homepage of the web site includes an up-to-date GEOTRACES Cruises Section Map that shows the current status of the GEOTRACES sections in different colours (Figure 1). Also a ticker with the number of stations completed is maintained (currently 372) and is visible on the homepage.

In addition, under the menu "Cruises" the information on the GEOTRACES forthcoming (scheduled) cruises is available. For detailed cruise information and data the web site is linked to the GDAC site (Note that the IPO is working closely to the GDAC and helps it to secure up to date information about new developments and upcoming cruises).

A list of GEOTRACES endorsed Process Studies is also provided on the site.

Calendar of meetings: This feature serves as a repository for all the information about any (past, present and future) GEOTRACES or GEOTRACES relevant meetings. This includes GEOTRACES meetings and workshops, GEOTRACES relevant Special Sessions in Conferences and other conferences of interest for the GEOTRACES Community. The IPO is responsible to keep it up-to-date. Note that for past meetings the information archived includes the meeting presentations and reports.
Future GEOTRACES workshops may benefit from this feature since any GEOTRACES workshop website could be easily set up using this feature which includes as well an on-line registration form.

Library: It contains all GEOTRACES publications. This includes Scientific Publications (Peer-reviewed Papers, Cruise Reports, Workshop Reports and PhD Dissertations), Planning Documents, Policy Documents and Annual Activities Reports. Currently, the IPO is developing a database of GEOTRACES publications. As soon as completed, this database will be available under the Library web page.

Science: Information about the GEOTRACES Intercalibration effort is posted under the menu "Science". It includes, for example, the GEOTRACES Cookbook and the Standard and Reference Materials. A webpage for the BIOGEOTRACES initiative has also been set-up. Other items posted under this menu include the National and Regional Activities webpage.

Outreach: A menu for GEOTRACES outreach activities has been included on the web site. The GP13 Cruise Blog is the most recent addition to this menu.

News: Latest GEOTRACES news items are posted on the web-site homepage and under a dedicated menu "News". This includes job, funding and student opportunities; cruise updates; forthcoming workshops and meetings, and any other "new" issue of interest for the GEOTRACES Community.
An RSS feed has been created to inform subscribers about the latest news.

General Information: The web site includes as well a menu "About us" that presents an overview of the GEOTRACES programme and introduces the Scientific Committee Members. Other items listed

under this menu are the funding and an introduction to other GEOTRACES relevant international programmes.

Mailing list: Starting in autumn 2010 a new GEOTRACES mailing list has been set-up. This list is maintained via the GEOTRACES web site. A module to subscribe is available on the site.

Other main tasks for the IPO this year have included: to create a "GEOTRACES Researchers Expertise Database" based on the analytical expertise of researchers (this database will facilitate the search when a specific analytical expertise is required and it will be available on the GEOTRACES website in autumn 2011); to seek funding for the management aspects of the programme (especially, at the European Level); to help organize the GEOTRACES Mediterranean Planning Workshop, the GEOTRACES Data-Model Synergy Workshop (see below) and the 2011 SSC meeting in Xiamen; and to develop a database of GEOTRACES publications.

6. Workshops and events

GEOTRACES Asia Planning Workshop:

The 2010 GEOTRACES Asia Planning Workshop was held at Academia Sinica, Taipei, Taiwan during October 3-7. The major objectives were first to identify the key processes that regulate the biogeochemical cycles of TEIs and then to generate a future action plan for TEIs research. The participants included 25 Asian scientists from China, India, Japan, Korea, and Taiwan, 10 American and European scientists, and about 30 local graduate students. Detailed workshop information is shown in the website: http://proj3.sinica.edu.tw/~geotrace/index.htm.

Following plenary talks presented in the first two days, three breakout groups were formed for further topical discussion, including water column, sinking particles, and submarine groundwater discharge (SGD) groups. The suggestions proposed by the groups were further discussed in the final plenary session. Some of the major conclusions achieved are highlighted here. First, capacity building is essential for most Asian countries prior to initiating a complete GEOTRACES program. Currently, only Japan and Taiwan own clean sampling facilities and only Japan is capable of doing shipboard analysis for contamination prone trace metals. It is thus important to select crossover stations at deep-water sites to maintain an intercalibration effort for the key TEIs as Asian countries develop their capacity for TEIs analysis. The SGD group recommended selecting SGD sampling sites in the waters along Chinese coasts where the population is huge to evaluate the relative importance of SGD for nutrient and trace metal inputs in comparison to riverine and aeolian sources. The sinking particle group emphasized that the East Asia oceanic waters are regions with exceptionally high external particle inputs from both atmospheric and riverine sources and also with high gradients of external inputs over the broad continental shelves. Evaluating the fate of aerosol deposition is a high priority for TEIs study in the regions. Some of the research topics proposed during the workshop match closely with the core study of SOLAS and provide opportunities for future collaboration.

Overall, the workshop was successful and productive. The organizers acknowledged the candid suggestions and insights provided by the American and European scientists that facilitated the regional planning and organization of cruises and scientific objectives, all of which requires substantial cooperation among participating Asian nations and research institutions. A tentative cruise plan developed by the Asian representatives is shown in Figure 2. Deliberations from the GEOTRACES Asia Planning Workshop will be recorded in a Workshop Report, which is currently in the draft form.

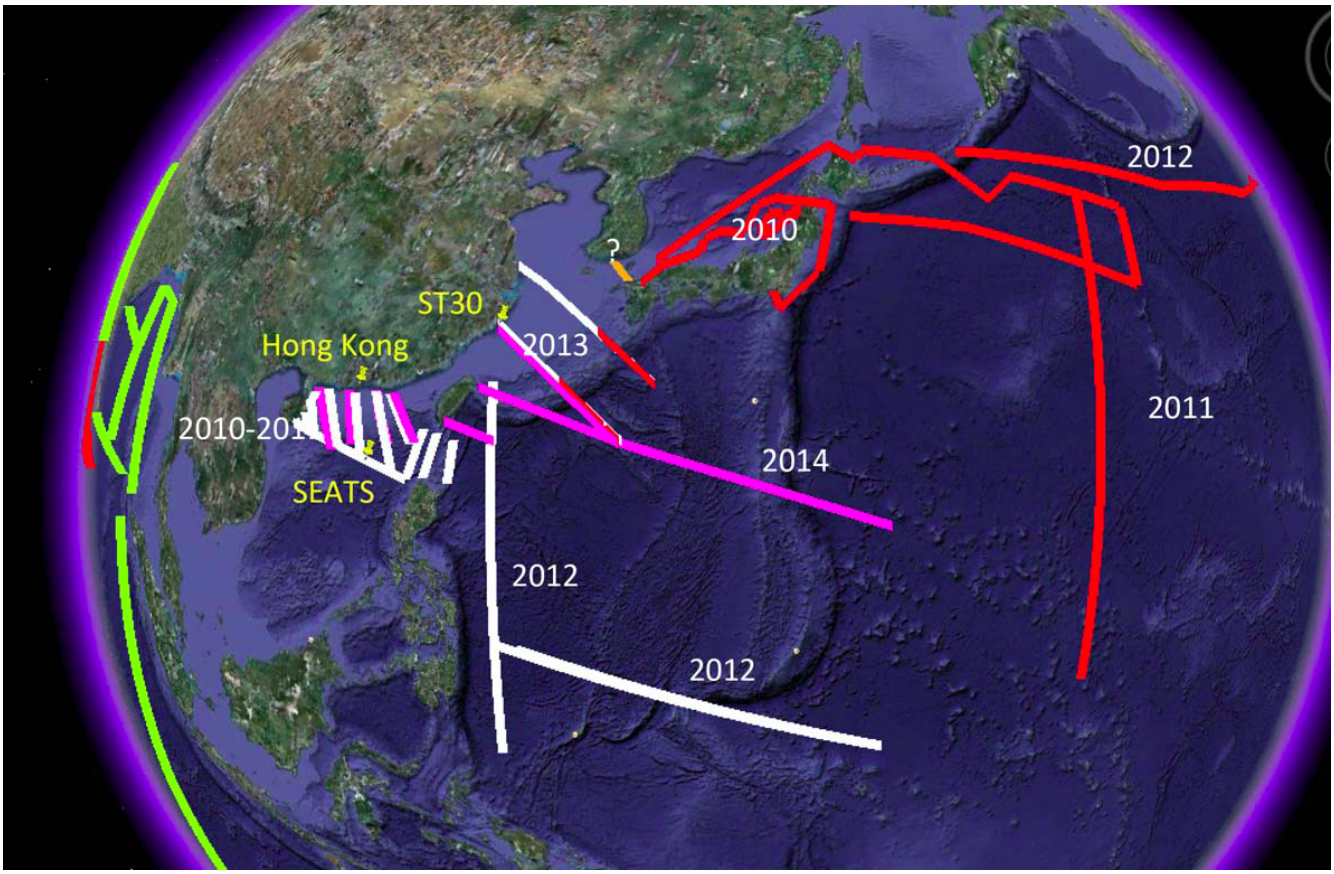


Figure 2. Ongoing and proposed Asian GEOTRACES cruises shown on the map of Google Earth. The red line cruises are or will be carried out by Japan; the white lines by China, the pink lines by Taiwan; the green lines by India. The yellow pins labeled as 'ST30' and 'Hong Kong' indicate SGD stations. The 'SEATS' site would be a crossover deep-water station. The numbers next to the lines stand for the possible years to carry out the cruises.

GEOTRACES Mediterranean Planning Workshop:

Since the inception of the international GEOTRACES Programme, a strong interest developed in carrying out GEOTRACES-related activities on trace elements and their isotopes (TEI) in the Mediterranean Sea, due to the proximity and importance of the ocean- land-atmosphere domains, as well as the variety and intensity of exchanges between these domains. A funding opportunity from COST Action ES0801 culminated in a GEOTRACES Mediterranean Planning Workshop, which was held in Nice, France, during the 4-6 October 2010. More than 50 participants from 15 countries met and discussed various aspects of implementing GEOTRACES in the Mediterranean. On day-1, keynote speeches demonstrated the large variety of themes that could be handle under the umbrella of GEOTRACES in the Mediterranean Sea. Among other things, the SOLAS-GEOTRACES cooperation in the Mediterranean was enhanced. Advocacy speeches were focusing on key parameters, tracers, processes, and sites of interest for Mediterranean GEOTRACES. Several parallel break-out sessions took place on day 2 with the goal of defining key questions and how a GEOTRACES section in the Mediterranean Sea (and Black Sea) could bring new insights regarding TEI fluxes and processes at

ocean interfaces, particle cycles, Western and Eastern Mediterranean process study/studies, TEI as proxies for past change and TEI and models. The ideal Mediterranean GEOTRACES section(s) was/were discussed: (1) one central (W-E) section by the R/V Pelagia (Netherlands) will likely occur in 2013 and (2) other sections dedicated to focused process studies in key area such as the Gulf of Lions, Adratic Sea, Black Sea, off the Egypt/Israel coasts etc. will have to be organized concomitantly to the central section, with other research vessels. Complementary to the work during GEOTRACES sections, processes studies at key sites (such as time series coupling atmospheric deposition and sediment traps) were also discussed and will be considered in the implementation. Deliberations from the GEOTRACES Mediterranean Planning Workshop will be recorded in a Workshop Report, which is currently in the draft form.

3rd GEOTRACES Data Model Synergy Workshop:

The next GEOTRACES Data-Model Synergy Workshop will be held at the "Universitat Autònoma de Barcelona", Spain, in November 14-17, 2011. A committee for the preparation of this meeting has been set up in Fall 2010. It is composed of the following members:

- **Robert Anderson** (Lamont Doherty Earth Observatory, Columbia U., USA)
- **Christoph Heinze** (Geophysical Institute, U. Bergen, Norway)
- **Gideon Henderson** (Department of Earth Sciences, U. Oxford, UK)
- **Catherine Jeandel** (Laboratoire d'Etudes en Géophysique et Océanographie Spatiales, U. Paul Sabatier, Toulouse, France)
- **Phoebe Lam** (Department of Marine Chemistry and Geochemistry, Woods Hole Oceanographic Institution, USA)
- **Olivier Marchal, Chair** (Department of Geology and Geophysics, Woods Hole Oceanographic Institution, USA)
- **Pere Masqué** (Department of Physics, U. Autònoma de Barcelona)
- **Ben Twining** (Bigelow Laboratory for Ocean Sciences, USA)

Pere Masqué and **Elena Masferrer** (GEOTRACES International Project Office, Toulouse) have taken care of the preliminary organizational aspects of the workshop.

The planning committee has now completed the following tasks:

1) **Define the theme and goal of the workshop**. The workshop will focus on ocean particles, with emphasis on their role in the biogeochemical cycle of trace elements and isotopes (TEIs). The exchange with particulate phases is recognized as an essential process in the oceanic budget of a large number of substances present in trace amount in seawater, including that of key substances of GEOTRACES. However, various aspects of ocean particles remain poorly understood, such as the spatial variations in their concentration, chemical composition, and size distribution. Likewise, our knowledge of the processes affecting particles in the ocean water column, such as aggregation, disaggregation, precipitation, dissolution, sinking, and transport by currents, is incomplete. The goal of the workshop is to bring together analysts and modelers in an effort to answer to two specific questions:

    a. What measurements of particles should GEOTRACES make?

b. How should models of ocean biogeochemistry represent particles?

2) **Define the format and content of the workshop**. The format and content of the workshop have been established after a significant amount of exchange (by email) between members of the planning committee. It was decided to hold the workshop for a period of four days. The first three days will consist of three sessions, each composed of keynotes, topical talks, and a round-table discussion. The three sessions are entitled (i) "Observing particles in the ocean: Methods, results, and lacunae", (ii) "Role of particles in the cycle of TEIs in the ocean", and (iii) "Transport and transformation of particles in the ocean". The keynotes will be reviews summarizing present observational knowledge and should culminate with a statement of emerging hypotheses. The shorter talks following the keynotes will be topical studies illustrating some of the specific aspects discussed in the keynotes. Finally, the round-table discussions, composed of both analysts and modelers, should agree on a list of explicit hypotheses regarding the interactions of TEIs with particles in the ocean, which have been formulated during the corresponding session. These hypotheses will provide the necessary context for the last day of the meeting.

   The last day of the meeting will be an essential component of the workshop, as it will rely on the material presented and discussed during the three sessions to provide a set of specific recommendations regarding the nature of future studies that would further our understanding of ocean particles. More specifically, the expected outcome of the workshop is a statement of future research directions – observational, experimental, technological, and/or theoretical – which are the most likely to advance our understanding of ocean particles, both in the context of GEOTRACES and beyond. The actions items to be identified during the workshop will be posted on the GEOTRACES website and reported in a journal publication in order to provide higher visibility to the output of the workshop.

3) **Define the material to be covered in the keynotes and identify keynote speakers**. A list of keynotes and of keynote speakers has been established by the planning committee. Each session will be composed of 6-7 keynotes by experts in their field, so the total number of keynotes during the workshop will amount to nineteen. The keynote speakers have been contacted by the committee and have committed to present a keynote and attend the workshop.

4) **Writing up the agenda of the workshop**. The detailed agenda of the workshop is reported in a word document (about 5 pages). It has been finalized by mid-April after a significant amount of exchange between members of the planning committee (about ten different versions of the agenda have been discussed). The final agenda is now available on the GEOTRACES website created by E. Masferrer (see http://www.geotraces.org).

5) **Advertise the workshop**: A preliminary advertisement of the workshop has been sent to a large number of members of the scientific community using an exhaustive email list maintained at the GEOTRACES International Project Office. The agenda of the workshop and a flyer designed by E. Masferrer have been attached to the email in an effort to widen the span of the advertisement. The flyer of the workshop can be downloaded from the GEOTRACES web site (http://www.geotraces.org). Details about the workshop have been posted on the same site. A second advertisement will be sent this coming summer. Deadline for abstract submission (topical talks) has been fixed to August 30, and deadline for registration has been fixed to September 30.

6) **Submission of proposals to support the workshop**. The workshop will be supported by various sources, such as the U.S. NSF, SCOR, and COST (http://costaction.earth.ox.ac.uk). Several proposals have been submitted to both the Spanish and Catalan governments, and at the time of writing this report the GEOTRACES International Project Office is negotiating the conclusion of an agreement with a commercial sponsor.

7. Special sessions at international conferences featuring GEOTRACES findings

ASLO 2011, Aquatic Sciences Meeting, 13-18 February 2011, San Juan Puerto Rico

Relevant sessions:
*GSO2: Chemical Oceanography/GEOTRACES
Presentations available at:
https://www.sgmeet.com/aslo/sanjuan2011/sessionschedule.asp?SessionID=GS02
Conveners: Greg Cutter, Old Dominion University and Pere Masqué, Universitat Autònoma de Barcelona

*S87: Trace Metals and their Nutritional Importance to Marine Phytoplankton and Bacteria
Presentations available at:
http://www.sgmeet.com/aslo/sanjuan2011/sessionschedule.asp?SessionID=S87
Conveners: Mak Saito, Woods Hole Oceanographic Institution; Pete Sedwick, Old Dominion University.

43th International Liège Colloquium on Ocean Dynamics, 2 - 6th May 2011, Liège - Belgium

For further information: http://modb.oce.ulg.ac.be/colloquium/

The theme of the 43rd Liege Colloquium was "Tracers of physical and biogeochemical processes, past changes and ongoing anthropogenic impacts."

Tracers such as Trace Elements and Isotopes (TEI) play an important role in oceanography as tools to (1) describe physical processes, (2) quantify production and carbon export, energy transfer, and trophic pathways, (3) understand the role of limiting micronutrients regulating ecosystem production and structure, (4) reconstruct past ocean conditions, (5) study transport and fate of anthropogenic inputs and pollutants. These themes were investigated in the framework of several international projects: GEOTRACES, SOLAS, IMBER, among others. Section cruises and process studies have taken place in polar oceans during the International Polar Year (2007-2008) and are now underway in other oceans.
Speakers at the 43rd International Liege Colloquium on Ocean Dynamics reported on new developments and insights related to tracers and proxies (from temperature and salinity to gases and isotopes) with a particular attention on the use of TEI as tracers. Although one session of the colloquium explicitly emphasized GEOTRACES activities, presentations containing GEOTRACES results were distributed throughout the week-long colloquium.

ICAS 2011, IUPAC International Congress for Analytical Sciences, 22-26 May 2011, Kyoto, Japan

Co-organized by The Japan Society for Analytical Chemistry (JSAC) and International Union of Pure and Applied Chemistry (IUPAC)

For further information: http://www.icas2011.com/index.html

Relevant session:
S17) Geochemical Analysis
Trace Elements and Isotopes in Marine Geochemistry
Co-chairs: Yoshiki Sohrin (Kyoto Univ.)
Kenneth W. Bruland (Univ. of California, USA)
Derek Vance (Univ. of Bristol, UK)

Goldschmidt 2011, 14-19 August 2011, Prague, Czech Republic
http://www.goldschmidt2011.org/index

Relevant sessions:
15a: The GEOTRACES Program
http://www.goldschmidt2011.org/themes?theme=15
Convenor: Ed Boyle, Massachusetts Institute of Technology

15b: Deep Ocean Circulation in the Past
http://www.goldschmidt2011.org/themes?theme=15
Convenors: Bob Anderson, Lamont-Doherty Earth Observatory
Jeanne Gherardi, Laboratoire des Sciences du Climat et de l'Environnement

11g: The Rare Earth Elements: Their Deposits, Geochemistry, and Environmental Impact
http://www.goldschmidt2011.org/themes?theme=11&showDescriptions=true - session_11g
Convenors: Michael Bau, Jacobs University
Ulrich Schwarz-Schampera, BGR
James R. Hein, USGS.

2011 Chemical Oceanography Gordon Research Conference, 14-18 August 2011, Andover, NH, USA
http://www.grc.org/programs.aspx?year=2011&program=chemocean

Relevant Session:
Trace Element Cycling in the Ocean: Biotic Influences and Responses
Discussion Leader: Peter Sedwick (Old Dominion University)

8. Outreach

Cruise Blogs Where possible, GEOTRACES endeavours to maintain an active blog with regular reports from sea. The IPO readily cooperates with willing scientists to post cruise information on the GEOTRACES web site. The Australian cruise GP13 maintained an active and engaging blog presence throughout the expedition. Leaders of future cruises are encouraged to adopt a similar policy.

International Year of Planet Earth An overview of the GEOTRACES programme at the transition from planning to implementation of the main field activity was drafted in 2009 for publication in the Ocean volume of the International Year of Planet Earth compendium. Subsequent to the completion of the GEOTRACES overview the project was placed on hold. In early June 2011, the editors revived the project and GEOTRACES staff are updating the overview to incorporate relevant recent information.

9. Capacity building

At-Sea Training GEOTRACES gratefully acknowledges support from SCOR to enable one scientist per year from a developing nation to participate in a GEOTRACES cruise. These opportunities are vital to the development of technical expertise in sampling and sample handling for contamination prone elements aboard "dirty" (rusty) ships.

During the past year, Dr. Thato Mtshali from South Africa was able to participate in the Australian cruise covering section GP13 in the SW Pacific ocean, thanks to this program. The participation of a South African scientist is particularly timely in light of the expansion of GEOTRACES and related oceanographic activities in South Africa (see South Africa's national report). In addition, SCOR supported José Marcus Godoy from Brazil to participate in a Netherlands cruise.

Latin American Planning Workshop During its 2010 meeting in Toulouse the SSC asked several of its members to initiate planning for a workshop in South America. Dr. Angela Wagener, SSC member representing Brazil, agreed to lead the effort and will serve as a local host. The workshop will serve multiple purposes:

- Define pressing research questions pertaining to waters offshore of Latin American nations,
- Identify opportunities for international collaboration, especially in working toward solutions to problems that exceed the technical and scientific capabilities of any single nation, and
- Related to the second item above, orchestrate a training program that will serve to build the capacity of Latin American nations for oceanographic research on trace elements and their isotopes.

The Latin American initiative is a joint effort of GEOTRACES and SOLAS, both operating under the SCOR umbrella. As planning moves forward the organizers will benefit from the collective knowledge and experience of SCOR.

Sampling Systems It is a goal of GEOTRACES that every nation carrying out oceanographic research should have access to a trace metal-clean sampling system. GEOTRACES offers guidance based on past experience in the design and construction of sampling systems as well as advice in operating these systems as shared facilities. A complementary goal to establish a program whereby scientists who have accrued experience in operating these systems can share that knowledge with scientists from nations that either are now in the process of acquiring clean sampling systems or are looking forward to acquiring such systems in the near future.

An updated status of trace metal-clean sampling systems to support GEOTRACES research is provided in the table below. Scientists interested in developing one of these systems for their own use are encouraged to contact the GEOTRACES IPO or any member of the SSC, who will arrange for contact with an appropriate person to provide technical information about the design, construction and cost of a system.

Nation	Status	System/ Carousel	Bottles	Depth
Australia	Complete	Powder coated aluminum	10-L Teflon-lined Niskin-X	4000 m; 8 mm Kevlar rope
Canada	Complete	Powder coated aluminum with titanium pressure housing for CTD	12 X 12-L GO-FLO	3000 m; conducting Vectran
China	Complete	Towed fish	NA	Surface
France	Funded, Under construction	Powder coated aluminum with titanium pressure housing for CTD	24 X 12-L GO-FLO	8000 m; conducting Kevlar
Germany	Planned	Powder coated aluminum with titanium pressure housings and fittings	12-L GO-FLO	8000 m; conducting Kevlar
India	Planned	Powder coated aluminum with titanium pressure housings and fittings	24 × 12-L GO-FLO	8000m, 18.5 mm Aramide armoured cable,
Japan	Complete	Powder coated aluminum	12-L Niskin-X	10000 m; titanium armored cable
Netherlands	Complete	Titanium frame	24 X 27-liter ultraclean PVDF	10000 m; conducting Kevlar
Netherlands	Complete	Titanium frame	24 X 12-liter GO-FLO	10000 m; conducting Kevlar
New Zealand	Complete	Powder coated aluminum	5-L Teflon-lined Niskin-X	2000 m; 8 mm Kevlar rope
Taiwan	Complete	Teflon coated rosette	24 X 12-L Teflon GO-FLO	3000 m; Kevlar
Taiwan	Complete	Teflon coated rosette	Multi- size GO-FLO	3000 m; Kevlar
UK	In testing phase	Titanium frame, Ti pressure housings	24 10-L OTE	8000m conducting Kevlar
USA - CLIVAR	Complete	Powder coated aluminum	12 X 12-L GO-FLO	1500 m; conducting Kevlar
USA - GEOTRACES	Complete	Powder coated aluminum with titanium pressure housings and fittings	24 X 12-L GO-FLO	8000 m; conducting Kevlar

Acknowledgements
We offer our special thanks to Ed Urban, who continues to provide tremendous support and valuable advice to the planning of the GEOTRACES programme.

National Reports

Australia

Meetings

- GEOTRACES presentations at the Australian-UK joint Royal Society-Australian Academy of Science 'Frontier of Science' meeting in Perth (Australia), October 2010
- GEOTRACES process study 'PINTS' (voyage ss2010_v01) workshop held in Hobart (Australia), February 2011 (Principal Investigator: Hassler)

Cruises

- GEOTRACES section GP13 leg (voyage ss2011_v02) in Southwest Pacific Ocean completed by Australian scientists, 13 May – 5 June 2011, along approximately 30oS (see report below; Chief Scientist: Bowie). Leg 2 further east to be undertaken by NZ colleagues on RV *Tangaroa* from June 6 to 30 (Chief Scientist: Boyd)
- Australian participation in GEOTRACES approved process study around the Kerguelen Plateau in Oct/Nov 2011 (project: KEOPS-2; PI: Blain). Dissolved and particulate trace element studies in naturally iron-fertilised region of the Southern Ocean region in the Indian Ocean sector
- Preliminary discussion on submission of an Expression of Interest for shiptime for the next Australia GEOTRACES section study in the Pacific (N-S along 170oW GP19) or Indian (Hobart to South Africa GI05 or Fremantle to India GI03) Oceans on the new research vessel *Investigator* in 2014-2015 (feedback from SSC as to which line to focus on; joint study with another nation; which countries have already committed to these sections?)
- In addition, a process study of the Tasman Sea aiming to study TEI, macronutrient and carbon cycling and budgets is under discussion. This project is a follow up of the PINTS voyage (ss2010_v01, GEOTRACES Process study) At this stage, the Australian GEOTRACES participants, researchers from CSIRO, as well as international researchers (e.g. from NIWA, NIOZ, CNRS, NOC Southampton) have shown interest in this project.

New funding

- Funding for GEOTRACES activities in Australia continues to be tight, with most projects carried out using small research grants from the institutions of the major GEOTRACES researchers (University of Tasmania, Australian National University, University Technology Sydney) and some national funding from the Australian Research Council

New results

- Data published from sea ice iron biogeochemistry time-series study undertaken at Casey Station (Antarctica) in November/December 2010 (PI: Lannuzel)
- Participation and sample analyses of GEOTRACES intercalibration exercises for dissolved (Bruland), particulate (Sherrell) and aerosols (Landing) trace elements (Bowie lab)

Publications

- Several manuscripts published with results from GEOTRACES activities, including during the International Polar Year; publication of *Deep-Sea Research* special issue on 'Subantarctic Biogeochemistry' in 2011 (detailed below; pdfs available on request)

Other activities

- Exchange of personnel and international training activities under EU-Cost Action ES0801 between laboratories in the UK (University of Plymouth) and Australia (University of Tasmania)
- Design specifications for GEOTRACES sampling requirements continue to be implemented for new Australian oceanographic research vessel, RV *Investigator* (to be commissioned in 2013)

Brief report on GEOTRACES GP13 section study in the Southwest Pacific

This project undertook an integrated oceanographic transect and dust monitoring program for iron, other trace elements, and their isotopes (TEIs) along the western end of the GP13 zonal section (~30°S) east of Australia.

Deployment of all equipment required for the GEOTRACES GP13 voyage was successful. The trace metal rosette (TMR), the McLane pumps, CTD and aerosol sampler all performed well. Three types of stations were used to achieve our aims: (i) 29 normal stations (every 1° of longitude), (ii) 3 super stations (every 5°), and (iii) 4 mega stations (every 10°). Deployments at normal stations were typically down to 1500 m, with deployments at super- and mega- stations to the full water column. We also collected samples and data from the TMR and CTD down to 6000 m at station 31 (32.5°S, 177°W) to characterise for the first time trace elements and isotopes in the deep waters passing through the Kermadec Trench.

Over 3000 dissolved water samples were collected from the TMR, over 400 particulate filter samples from the McLane pumps, over 2000 water samples from the CTD, and 7 filter samples from the aerosol sampler. Samples will be analysed in the 6-18 month period following the voyage in the laboratories of the respective Principal Investigator for the following parameters:

- Dissolved trace elements (Fe, Al, Cd, Zn, Co, Mn, Pb, etc, using FIA and ICP-MS techniques).
- Abundance and isotopic composition of trace elements in suspended marine particles
- Particulate organic carbon (POC) and nitrate (PON)
- Iron chemical speciation using an electrochemical approach
- Iron bioavailability
- Large sample volumes (1-2 L) for iron, zinc, cadmium and copper isotopes
- Large sample volumes (5-10 L) for radiogenic isotopes of Pa, Th, Nd
- Trace elements in atmospheric dusts collected on filters from an aerosol sampler
- Nutrients at the nanomolar levels
- Phytoplankton characterisation using microscopy, high-performance liquid chromatography and flow cytommetry

A number of analyses were carried out on-board including dissolved Fe by flow injection analyses, iron chemical speciation by competitive ligand equilibration – cathodic stripping voltammetry, phytoplankton photophysiology and hydrography (major nutrients, salinity, oxygen) by standard techniques. Shipboard data indicate that the TMR was non-contaminating for dissolved Fe, one of the most contamination prone elements. At station #3, a typical micronutrient-type and oceanographically-consistent profile for dissolved Fe was observed (Figure 3). Surface subsamples for nanonutrients were collected from the TMR at all stations, and these will be analysed on the next leg of the GP13 section by New Zealand colleagues. Ocean colour satellite data (8 day MODIS image, 4 km resolution) and aerosol dust data and forecasts (NAAPS, hysplit forward trajectories) was relayed to the ship by

colleagues at University of Technology Sydney (Dr Mark Baird) and Griffith University (Prof. Grant McTainsh and the Australian dustwatch network), respectively, in order to help with sampling strategies during the voyage.

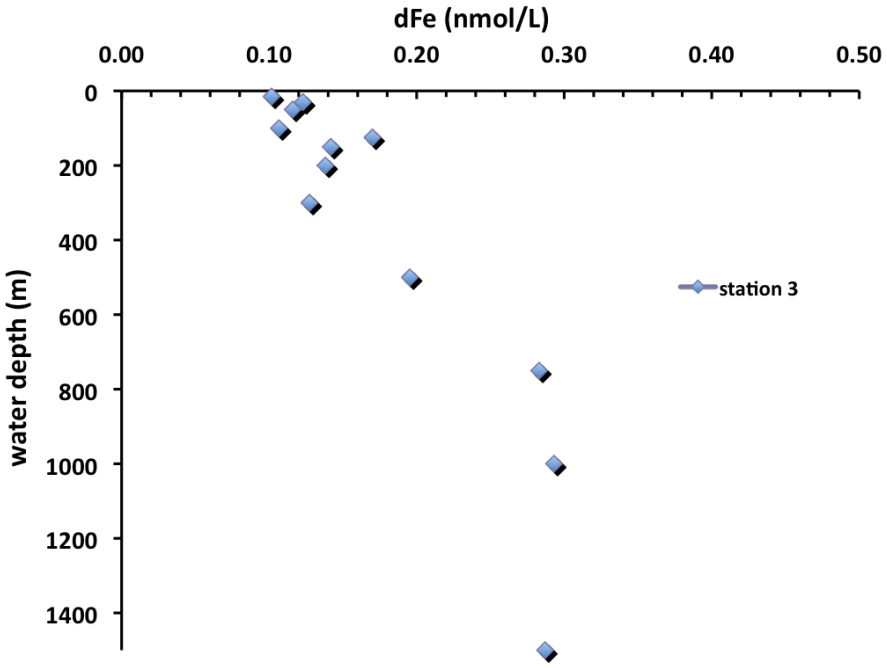


Figure 3. Dissolved iron (dFe) distribution in the upper 1500 m of the water column at mega-station #3 (30°S, 155°E).

Two stations were not carried out due to inclement weather (stations 09, and 25 CTD only deployed). Two deployments (station 03 cast 2, and station 04 cast 1) of the TMR were unsuccessful due to a software problem. This was resolved by reverting to an earlier version of the software, which was successfully tested at station 04 cast 2. An intermittent problem was identified with the one of the McLane pumps. This was believed to be due to a faulty communications cable between the electronics housing and the pump head, and the CI is in consultation with the pump manufacturer to resolve this problem.

Operations were carried out in an efficient manner, which resulted in many deployments taking less time than that allocated. This allowed us to add an extra 2 normal stations at the end of the Australian leg of the GP13 section and finish our science at 32.5°S 170°W.

This project is the first time that data on the distribution of many trace elements and their isotopes along the GP13 section in the Tasman Sea and southwest Pacific has been collected, and the 8 deep water deployments (including a 6000 m deployment of the TMR in the Kermadec Trench at 32.5°S 177°W) represent some of the few deep profiles that presently exist in any ocean worldwide. Preliminary results from shipboard analysis of dissolved Fe indicate that the western end of the transect was extremely low concentrations of dissolved Fe, despite the proximity of sampling to the continental shelf and possible dust deposition sources. Upper mixed layer nutrient concentrations were below macromolar detection limit at all stations along section GP13, with typical increases below the mixed layer. These preliminary hydrography results demonstrate low NOx concentrations in the top 100 m. Based on the maximum quantum yield (Fv/Fm), phytoplankton east of 170 oE were nutrient limited. Complementary studies on the voyage will indicate the degree of iron and nitrogen co-limitation ion

these waters. In addition, new EM300 swath bathymetric data was collected along the ocean section from 153.5°E to 170°W along 30°S (diverting to 32.5°S at 177°E), an area of significant topography including ocean ridges and trenches, submerged reefs and seamounts. This data is archived and can be processed and quality controlled after the voyage.

In summary, voyage ss2011_v02 successfully achieved the following objectives:
(1) We carried out an integrated zonal oceanographic transect east of Australia studying the marine biogeochemical cycles of TEIs, as part of Australasia's contribution to the international GEOTRACES program;
(2) Samples were collected to establish the full water column, basin-scale distribution of trace elements and isotopes along GP13 for the first time;
(3) Data from subsequent laboratory analyses will determine the sources, sinks and fluxes of TEIs (focussing on atmospheric dust delivery and biomass burning), as well as their transport, solubility and chemical form in the ocean;
(4) A number of subsamples were collected for later analysis of other GEOTRACES (such as stable, radioactive and radiogenic isotopes) and bioGEOTRACES (marine microbial biogeography and biogeochemistry; i.e., 'omics') key parameters by international colleagues who are not able to participate in the field program.

We were unable to carry-out all our planned analytical tasks on board due to contaminated Milli-Q pure water supply (flow injection analyser) and unstable power supply (cathodic stripping voltammeter) in the ANU 20' clean container. These samples will now be analysed in the home laboratories after the voyage.

Voyage Plan and Summary can be found online at www.marine.csiro.au/nationalfacility/voyagedocs/index.htm. A blog of the cruise is posted at http://www.obs-vlfr.fr/GEOTRACES/index.php/outreach/cruise-blogs/gp13-blog, as part of

GEOTRACES Outreach activities. SCOR-sponsored participation of Dr Thato Mtshali from South Africa under GEOTRACES Training and Education activities.

Outputs from GEOTRACES activities involving Australian researchers (2010-2011):

Journal articles:

Lannuzel D., van der Merwe P.C., Townsend A.T., Bowie A.R., 2011. Size fractionation of particulate metals during a time series in East Antarctic fast ice. Geochimica et Cosmochimica Acta, in review (submitted 10 May 2011)

Wake B.D., Hassler C.S., Bowie A.R., Haddad P.R., Butler E.C.V., 2011. Phytoplankton selenium requirements: the case for species isolated from temperate and polar regions of the Southern Hemisphere. Journal of Phycology, in review (submitted 25 January 2011)

Baeyens W., Bowie A.R., Buesseler K., Elskens M., Gao Y., Lamborg C., Leermakers M., Remenyi T.A., Zhang H., 2011. Size-fractionated labile trace elements in the Northwest Pacific and Southern Oceans. Marine Chemistry, doi: 10.1016/j.marchem.2011.04.004, in press (accepted 11 April 2011)

Cossa D., Heimbürger L.-E., Lannuzel D., Rintoul S.R., Butler E.C.V, Bowie A.R., Averty B., Watson R., Remenyi T., 2011. Mercury in the Southern Ocean. Geochimica et Cosmochimica Acta, doi: 10.1016/j.gca.2011.05.001, in press (accepted 24 March 2011)

van der Merwe P., Lannuzel D., Bowie A.R., Meiners K.M., 2011. High temporal resolution observations of spring fast-ice melt and seawater iron enrichment in East Antarctica. Journal of Geophysical Research – Biogeosciences, in press (accepted 15 March 2011)

Lannuzel D., Schoemann V., Pasquer B., van der Merwe P., Bowie A.R., 2011. What controls the distribution of dissolved iron in Antarctic sea ice? Spatial, seasonal and inter-annual variability. Journal of Geophysical Research - Biogeosciences, doi:10.1029/2009JG001031, in press (accepted 14 April 2010)

Bowie A.R., Griffiths F.B, Dehairs F., Trull T.W., 2011. Oceanography of the subantarctic and polar frontal zones south of Australia during summer: setting for the SAZ-Sense study. Deep-Sea Research II, in press (accepted 10 March 2011)

Petrou K.L., Hassler C.S., Doblin M.A., Shelly K., Schoemann V., Ralph P.J., 2011. .Interaction of iron and light on Southern Ocean phytoplankton. Deep-Sea Research II, in press (accepted 07 September 2010)

Lannuzel D., Remenyi T., Lam P., Townsend A., Ibisanmi E., Butler E., Wagener T., Schoemann V., Bowie A.R., 2011. Distributions of dissolved and particulate iron in the sub-Antarctic and polar frontal Southern Ocean (Australian sector). Deep-Sea Research II, in press (accepted 17 December 2009)

Ibisanmi E.B., Hunter K.A., Sander S., Boyd P.W., Bowie A.R., 2011. Vertical distributions of iron-(III) complexing ligands in the Southern Ocean, Deep-Sea Research II, in press (accepted 26 August 2009)

Hassler C.S., Schoemann V., Nichols C.A.M., Butler E.C.V., Boyd P.W., 2011. Saccharides enhance iron bioavailability to Southern Ocean phytoplankton. PNAS, 108: 1076-1081

van der Merwe P., Lannuzel D., Mancuso Nichols C.A., Meiners K., Bowie A.R., 2011. Iron partitioning in pack and fast ice in East Antarctica: temporal decoupling between the release of dissolved and particulate iron during spring melt. Deep-Sea Research II, 58, 1222–1236, doi: 10.1016/j.dsr2.2010.10.036

Lannuzel D., Bowie A.R., van der Merwe P., Townsend A., Schoemann V., 2011. Particulate and dissolved metals distribution in Antarctic sea ice and their role in tracing iron sources. Marine Chemistry, 124 (2011) 134-146, doi:10.1016/j.marchem.2011.01.004

Hassler C.S., Alasonati E., Mancuso-Nichols C.A., Slaveykova V.I., 2011. Exopolysaccharides produced by bacteria isolated from the pelagic Southern Ocean: role in iron binding, chemical reactivity and bioavailability. Marine Chemistry, 123, 88-98

Cassar N., DiFiore P., Barnett B.A., Bender M.L., Bowie A.R., Tilbrook B., Petrou K., Westwood K., Wright S., Wagener T., 2011. The influence of iron and light on net community production in the Subantarctic and Polar Frontal Zones. Biogeosciences, 8, 227-237, doi:10.5194/bg-8-227-2011

Chever F., Sarthou G., Bucciarelli E., Blain S., Bowie A.R., 2010. An iron budget during the natural iron fertilization experiment KEOPS (Kerguelen Island, Southern Ocean). Biogeosciences, 7, 455–468

Book chapter

Hassler C.S., Schoemann V., Boye M., Tagliabue A., Rozmarynowycz M., McKay R.M.L., 2011. Iron Bioavailability in the Southern Ocean. In: Southern Ocean: Oceanography, Climatic Impact. Nova Publishers, in review (submitted 10 April 2011).

Prepared by:
Andrew Bowie (Antarctic Climate & Ecosystems CRC, University of Tasmania, Australia)

Brazil

Although a lot of progress has been made elsewhere, for instance in China and India, in the direction of contributing to GEOTRACES, the same does not apply to Brazil. Last year the National Research Council opened a call for large oceanographic projects with the goal to create National Institutes and promote integration. Twelve projects were submitted and to this date there is no result on the groups, which will be financed although the deadline to report results was due in December 2010. All proposing groups had to aggregate at least one institution housing an oceanographic ship so many groups requested funds to modernize their ships. I know three of the 12 groups: one is centered in Rio de Janeiro and was nucleated by the Navy Research Institute (they have a new ship) and includes PUC and other universities; one was nucleated by the University of São Paulo and the third group grew around FURG, the university where Felipe Niencheski is affiliated to. Any substantial change in our capability to perform oceanographic cruises at the quality level required by GEOTRACES will only occur within the next two or three years.

The actions of Petrobras has generated oceanographic data of quality but their goals are not coincidental with those of GEOTRACES. Ships and sampling is performed by hired companies and a good quality control is made. As for organics, stable isotopes, black carbon and metals in sediments I can ensure that we have for the Campos Basin a very good collection of data covering in detail a large area (isobaths 50 to 3000m). Metals were also determined in surface waters (Al, As, Ba, B, Cd, Cu, Cr, Mn, Hg, Ni, V, Zn) but detection limits were not appropriate for iron and could be better for zinc. Nutrients, pigments and other oceanographic properties were also obtained for several depths in the water column. A second large project will be implemented in the Santos Basin but I do not yet have information on the detailed program.

Angela Wagener made a presentation last March in Monaco (the IAEA Symposium) showing results on lipids and stable isotopes in sediments for the Campos Basin and the audience was really amazed with the large number of stations as well as with the data quality and the value of information. A short manuscript was submitted for publication in the proceedings since the goal is to publish in a journal reaching a wider audience.

Figures illustrating the spatial distribution of concentrations (organics and metals) can certainly be provided but permission must be obtained from Petrobras and this cannot be made so fast as to be available by June 15. It can possibly be available by the end of June.

The most recent contribution of Brazil to GEOTRACES was the active participation of Jose Marcus Godoy last March in the cruise organized by Hein de Baar in the South Atlantic. It is hoped that other opportunities will come for Brazilians to participate of such cruises and learn more about the GEOTRACES methods as well as to contribute in data acquisition.

Canada

Most PIs are still working up their data from the Beaufort Sea cruise in 2009 (IPY).

PIs have made a number of presentations at meetings, but no publications have appeared as of yet.

Canadian GEOTRACES has funding to organize a workshop on the Canadian GEOTRACES IPY cruise. However, the cruise leaders do not want to hold the meeting before most of the data are in hand (i.e. later this year or early next year).

Prospects for new cruises/research program we are still at a very early stage.

China

Activities

1) A part of China-GEOTRACES was accommodated in the "973" Carbon project– CHOICE-C. There have been four cruises to the Chinese Marginal Seas. Measurements include ^{234}Th, ^{228}Th, ^{228}Ra, ^{226}Ra, ^{224}Ra, ^{223}Ra, Cu, Mn, Cd, Pb in seawater samples.

2) Another part of China-GEOTRACES was accommodated in a newly founded China "973" project. There will be a cruise in the Yangtze estuary this summer. Measurements for ^{7}Be, ^{210}Pb, ^{228}Ra, ^{226}Ra, ^{224}Ra, ^{223}Ra, ^{232}Th, ^{230}Th, ^{234}Th, ^{228}Th will be conducted in the sediment samples to understand the processes of early diagenesis.

3) Field observations were carried out in the Changjiang drainage basin (main stream and major tributaries) during April 2011 to understand the impacts of Three Gorges Dam's construction on the weathering characteristics of the drainage basin and also the variations of terrestrial flux on the marginal seas of China.

France

Meetings

- GEOTRACES-France organized the GEOTRACES SSC meeting (C. Jeandel and E. Masferrer, Toulouse, 22-24 September 2010).
- GEOTRACES-France organized the Med Sea workshop, Nice, 4-6 Oct 2010 (L. Coppola, http://www.cybaes.org/gtmed/).
- Participation to the GEOTRACES Asia Planning Workshop, 4-6 oct 2010 (F. Lacan invited as representative).
- KEOPS II kick off meeting (Banyuls, 17-18 march 2011).
- Participation to the Scientific Committee and large participation to the "Traces and Tracers" oceanographic meeting (Liège, 2-6 may 2011).
- Participation to the COST-GEOTRACES-GMOS International Workshop on Mercury in the marine environment: a global metrology challenge (9-12 May 2011).
- Participation to the French National meeting in the framework of the Joint Programming Initiative "Healthy and Productive Seas and Oceans" (G. Sarthou, Roscoff 30-31 may 2011).
- Meeting for the GA01 cruise proposal preparation (G. Sarthou/C. Jeandel, Brest, 5 july 2011).

Cruises

- Dates of KEOPSII: 6 October-28 November .

New funding

- KEOPS II (G. process study) fully funded, both for the cruise and for the science.
- Funds for the acquisition of the French clean sampling system are (finally) completed this year.

New results

The most recent results of the GEOMAR group in Toulouse on Nd and Fe isotopes and in Brest along the BGH section are confirming that dissolved elements are released by the dissolution of a fraction of the sediments that are deposited on the oceanic margins. Due to the large amount of these sediments, the resulting net flux to the ocean is very large, as discussed in a recent publication to EOS (Jeandel et al, in press).

Other activities

Participation to the Scientific Committee (with O. Marchal) for the organization of the 3rd GEOTRACES Data-Model Synergy Workshop (Barcelona).

Publications

Bourquin et al., Determination of 226Ra concentrations in seawater and suspended particles (NW Pacific) using MC-ICP-MS

Bown J., Boye M., Baker A., Duvieilbourg E., Lacan F., Le Moigne F., Planchon F., Speich S. and Nelson D.M., 2011. The biogeochemical cycle of dissolved cobalt in the Atlantic and the Southern Ocean south off the coast of South Africa. Marine Chemistry, in press. doi:10.1016/j.marchem.2011.03.008

Boye M., Achterberg E., Bown J., Bucciarelli E., Cardinal D., Cassar N., Cavagna A.-J., Chever F., Dehairs F., Fine R.A., Happell J., Joubert W., Le Moigne F., Masqué P., Monteiro P., Planchon F., Sarthou G., Verdeny E., Wake B., Waldron H., 2009. A First look at GEOTRACES issues from the IPY BONUS GOODHOPE cruise in the Southern Ocean. Geochim. Cosmochim. Acta, 73 (13): A152.

Heimbürger L.H., H. Lavigne, C. Migon, L. Coppola, F. D'Ortenzio and J-C. Miquel Physical control on the interannual variability of the mass flux at the DYFAMED time-series station (Ligurian Sea). Submitted to Deep Sea Research II 2011

Jeandel C., Peucker-Ehrenbrink B., Jones M., Pearce C.R., Oelkers E., Godderis Y., Lacan, F., Aumont O. and Arsouze T. Ocean margins: the missing term for oceanic element budgets? Eos, in press

Lacan, F., A. Radic, C. Jeandel, F. Poitrasson, G. Sarthou, C. Pradoux, R. Freydier and J. Chmeleff. High precision determination of the isotopic composition of dissolved iron in iron depleted seawater by double spike MC-ICPMS., Anal. Chem. 2010, 82, 7103–7111

Oelkers, E, Gislason, S.R, Eiriksdottir, E.S, Jones, M., Pearce, C.R. and Jeandel, C. The role of riverine particulate material on the global cycles of the elements, Applied Geochemistry. 26, Suppl. 1, June 2011, Pages S365-S369

Radic, A., F. Lacan, et J. Murray (2011), Isotopic composition of dissolved iron in the equatorial Pacific Ocean: new constraints for the oceanic iron cycle, Earth And Planetary Science Letters, in press, doi:10.1016/j.epsl.2011.03.015.

Ussher, S.J., Achterberg, E.P., Sarthou, G, Laan, P., de Hein Baar J.W., Worsfold, P.J., 2010, Distribution of size fractionated dissolved iron in the Canary Basin, Marine Environmental Research, doi: 10.1016/j.marenvres.2010.03.001

Submitted by Catherine Jeandel.

Germany

The German GEOTRACES activities of the past year were dominated by preparations for work on the material recovered from RV Meteor cruise M81/1 (GEOTRACES cruise GA11, chief scientist M. Frank, IFM-GEOMAR, Kiel) to the tropical Atlantic Ocean (Las Palmas, Canary Islands - Port of Spain, Trinidad and Tobago, 4th February until 8th March 2010), which was funded by the German Science Foundation. The most important activity directly related to the cruise was the writing of a bundle proposal to the German science foundation to fund two Ph.D. and a post doc position for work on the GEOTRACES core parameters on samples from this cruise. At the beginning of May 2011 we were informed that this proposal was successful and we can now start to work on the samples at IFM-GEOMAR (Martin Frank), Jacobs University Bremen (Andrea Koschinsky) and AWI-Bremerhaven (Sven Kretschmer).

In January 2011, Torben Stichel from GEOMAR, Kiel successfully defended his PhD thesis on Hf and Nd isotope distributions, which he obtained on samples from the German/Dutch IPY cruise ANTXXIV/3 in the Southern Ocean. In February 2011 he took up a GEOTRACES postdoctoral position in the laboratory of Katharina Pahnke in Hawaii to work on radiogenic isotope compositions of samples from the U.S. GEOTRACES cruise GA03 in the Atlantic Ocean. In June Oliver Baars will defend his thesis on trace metal distributions on the same samples. There are several manuscripts on the data of this IPY cruise already published (such as in the upcoming Deep-Sea Research special volume on the IPY cruise in the Southern Ocean (ANTXXIV/3) with papers of Celia Venchiarutti, Peter Croot, Oliver Baars, Katrin Bluhm, Michiel Rutgers van der Loeff) or in submission.

The main planning activities of the German GEOTRACES community in 2011 have been focused on a 12 days GEOTRACES cruise to the Baltic Sea made possible by the Polish GEOTRACES community in November 2011.

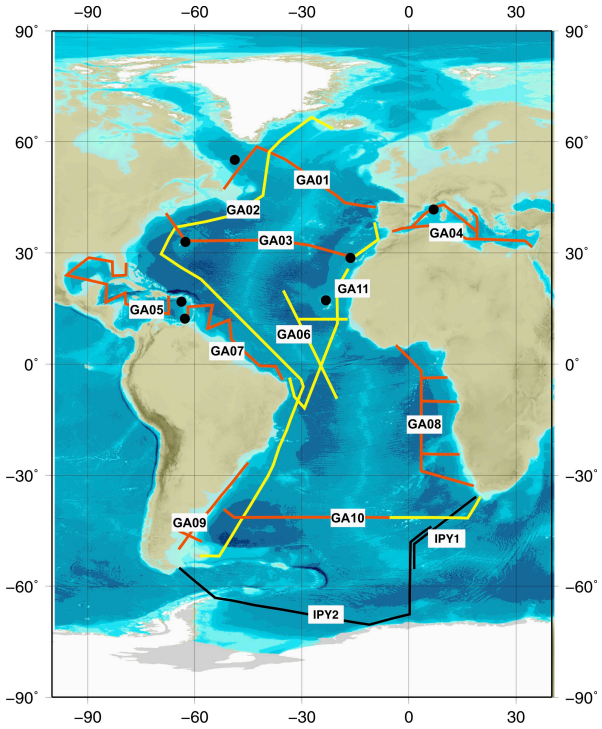


Figure 4. Completed GEOTRACES Sections in the Atlantic (in yellow)

India

Nine groups from India initiated working on trace elements and isotope studies in the Arabian Sea, the Bay of Bengal and associated estuaries. Funding from Ministry of Earth Sciences (MoES) India has been released to some of the groups working on Indian GEOTRACES. Indian GEOTRACES contributed INR one million towards the GEOTRACES International Data Centre from the funding obtained from MoES. We are in process of acquiring clean sampling system for Indian GEOTRACES programme. The system should be operational by the end of this year.

Our studies on some of the less contamination prone trace elements and isotopes were continued on the samples collected using conventional techniques. Nd isotope compositions in water columns of the Bay of Bengal along 87° E transect (Figure 5) are analysed, results of two profiles are given in Figure 5. Results display significant contribution of non-radiogenic Nd from the Ganga and the Brahmaputra river system to the Bay of Bengal water.

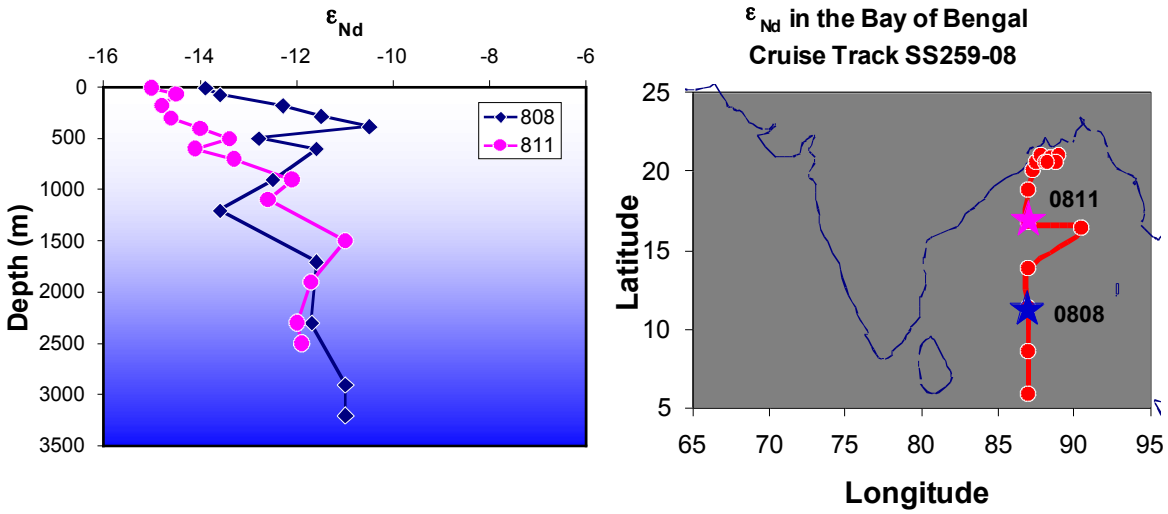


Figure 5: ε_{Nd} in the water columns of Bay of Bengal

Conference/meeting/ Session arranged

Organised a session, "OS08: Trace Elements and Isotopes in Oceans" in Asia Oceania Geosciences Society conference 2010, Hyderabad, July 5-9, 2010

Publications

1. Rahaman W., and Singh S. K. and Raghav S. (2010) Dissolved Mo and U in rivers and estuaries of India: Implication to geochemistry of redox sensitive elements and their marine budgets, Chemical Geology 278, 160–172, doi:10.1016/j.chemgeo.2010.09.009
2. Singh S. P., Singh S. K., Bhushan R. (2011) Behavior of dissolved redox sensitive elements (U, Mo and Re) in the water column of the Bay of Bengal, Marine Chemistry, doi:10.1016/j.marchem.2011.04.001

Planned Cruise

1. Arabian Sea: November to December 2011, onboard Sagar Kanya
2. Indian ocean: Chennai-Australia-Chennai: January to March 2013, onboard Sagar Kanya

**Submitted by Sunil Kumar Singh.

Japan

Summary

Japan GEOTRACES has been quite active this last year. The first ASIAN GEOTRACES cruise by R/V Hakuho Maru was completed and several international meetings were attended by Japanese scientists. Although Japan is in a very difficult situation now after the 11 March earthquake and tsunami, Japanese marine biogeochemists in the whole country are working hard together to reconstruct after the disaster, not only for the life, the economy, and the environment, but also for the ocean sciences. The next Hakuho Maru cruise to the Western North Pacific will sail within a month, and the zonal GEOTRACES cruise along 47N in the North Pacific has started preparations already. A new grant was awarded for international investigation and research for the next four years; broader international collaborations for our future expeditions/cruises are welcome.

Meetings

International meetings:

- Special session: "Strengthening interdisciplinary regional ocean networks: The dynamic rapidly changing East/Japan Sea", twelve oral presentations; in the 5th PEACE (Program of the East Asian Cooperative Experiments) workshop, Korea, 11-12 September, 2010.
- Asian regional GEOTRACES workshop (2010 GEOTRACES Asia Planning Workshop) Taiwan, 4-6 October, 2010.

These meetings strengthened the cooperation of the Asian regional marine biogeochemical and ocean/environmental sciences community.

National meetings:

- National GEOTRACES symposium was planned for the Spring Meeting of Oceanography Society of Japan, 22 March 2011, but was canceled because of the disaster caused by the 11 March earthquake and tsunami. The abstracts (in Japanese) of fourteen presentations were posted on the Japanese GEOTRACES web page.
- National GEOTRACES Committee in the Science Council of Japan, was planned also for 22 March 2011 but was cancelled and postponed to autumn.

Cruises

Recent cruise:

- KH-10-2 cruise by R/V Hakuho Maru (Figure 6).

"Marine biogeochemical studies and behavior of trace elements and isotopes in the East Asian Marginal Seas (ASIAN GEOTRACES)", in the Japan/East Sea and northwestern Pacific, 11 June – 23 July 2010 (PI: J. Zhang).

The Hakuho Maru KH-10-2 cruise was successfully conducted by the Atmosphere and Ocean Research Institute (AORI) of the University of Tokyo, and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), from 11 June to 23 July 2010 (a total of 43 days) in the Japan Sea (East Sea), western North Pacific and Okhotsk Sea. This cruise was proposed five years ago, and has been internationally recognized as the first regional GEOTRACES study in Asia (ASIAN-GEOTRACES). The main study theme of this cruise was marine biogeochemical observations in the Japan Sea (East Sea), Okhotsk Sea and western North Pacific. It had many specific objectives, including studies of the oceanic circulation and deep convection system, air-sea interaction, behaviors and structures of the subducted/advected water masses, marine biogeochemical cycles and fluxes of the TEIs and gasses, and ecosystems and associated spatio-temporal changes in this cruise. Results will enable the characterization of the physical, chemical, and biological processes and associated distributions, and their sensitivity to changing environmental conditions in the East Asian

Marginal Seas and the western North Pacific region. A total of fifty-three scientists, graduate students and staff took part in the cruise to pursue international/regional collaborative studies on GEOTRACES. These scientists came from twenty-two institutions in five countries. As one of our aims of the KH-10-2 cruise was educating young scientists from Asia, we performed a water-sampling workshop for more than forty chemical analyses, and four seminars (Science Coffee in Hakuho-Maru) by Japanese, Korean and Russian scientists. This cruise and all its results will form one of the cornerstones of the GEOTRACES program as its first regional GEOTRACES study in Asia and covering the various marginal seas connecting to the North Pacific, and also serve to greatly strengthen the cooperation of the Asian regional marine biogeochemical and ocean/environmental sciences community.

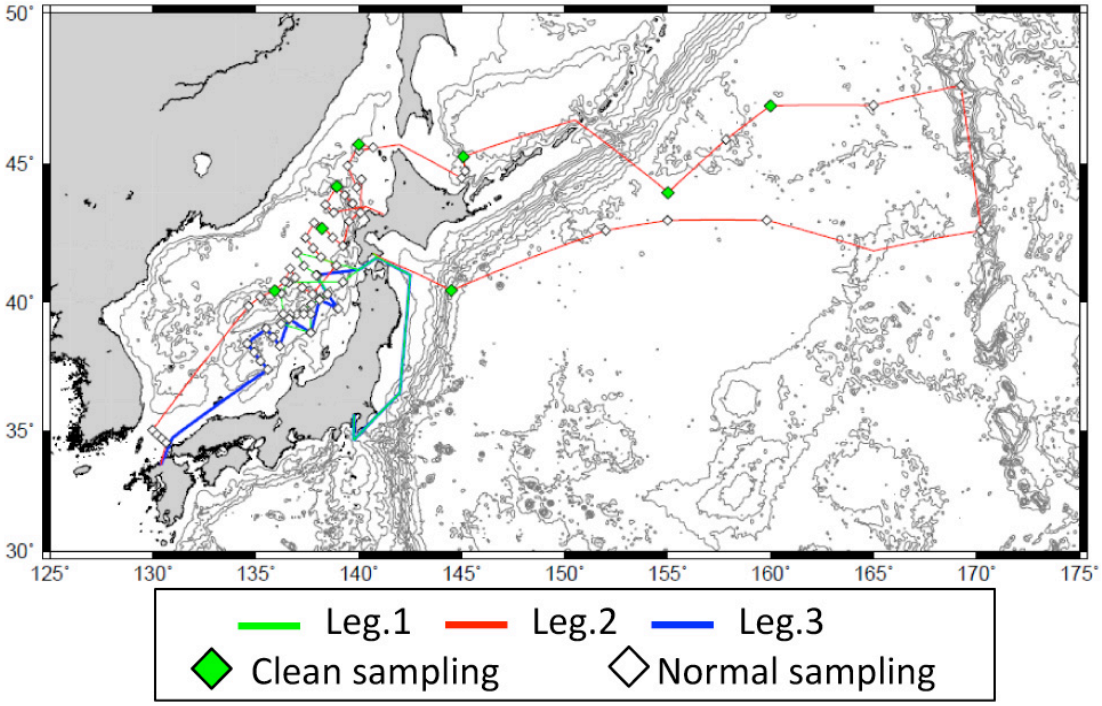


Figure 6. KH-10-02 Cruise Plan

Cruise Planning:

- KH-11-07 cruise by R/V Hakuho Maru (Figure 7).

"Marine biogeochemical studies and behavior of trace elements and isotopes in the Western North Pacific", 16 July – 4 August 2011 (PI: J. Zhang).

Part of GEOTRACES section GP18, including the process studies focusing on cold seep biogeochemistry and earthquake mechanisms/radionuclide impact studies off NE Japan and Fukushima area.

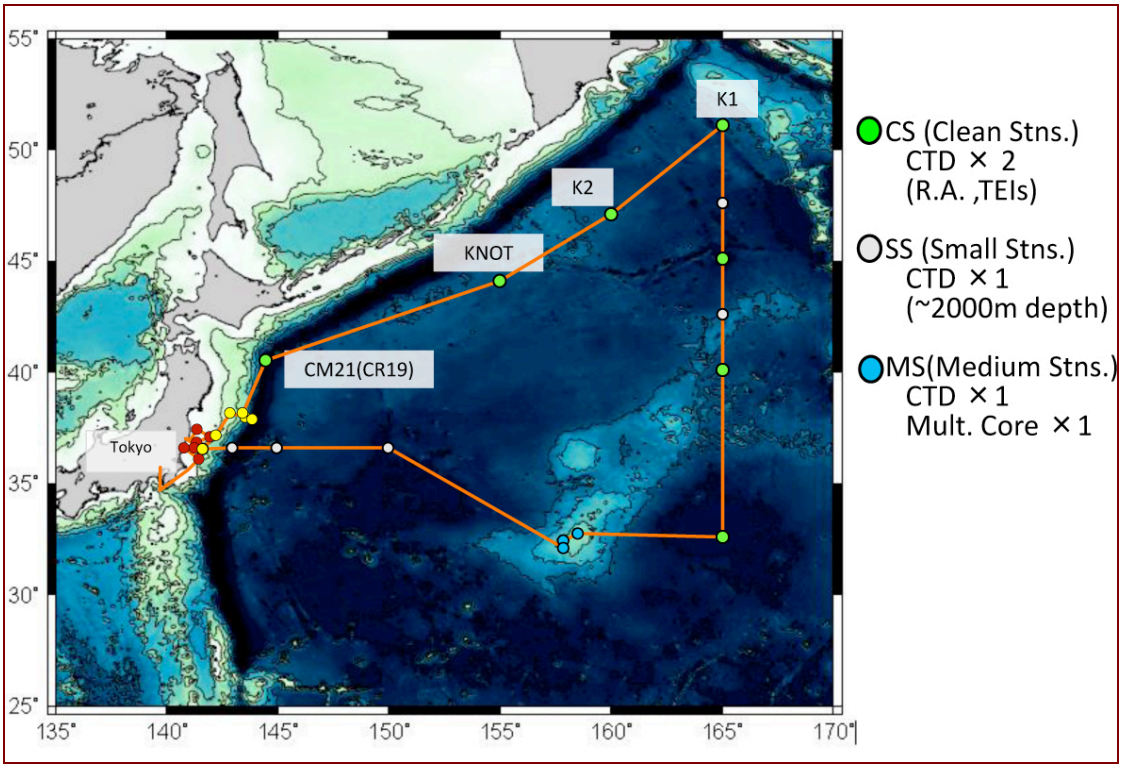


Figure 7. R/V Hakuho-Maru KH-11-07 Cruise Plan (Jul 16-Aug 04)

- Cruise by R/V Hakuho Maru.
GEOTRACES section GP02, zonal GEOTRACES cruise in the North Pacific (47N), planned for summer, 2011 (PI: T. Gamo).

New funding

- Proposal for international investigation and research was funded.
Grant in Aid for Scientific Research; US$ 0.4M, April 2011 – March 2014.

Netherlands

The Dutch GEOTRACES project aimed to map the distribution of important trace elements and isotopes and investigate the deep sea microbiology in the West Atlantic Ocean. Since the last report to SCOR of 2009/2010 two more Dutch GEOTRACES cruises have been performed together completing the Western Atlantic Transect from 65°N to 50°S, Figure 8.

PELAGIA 64PE321, 11 June through 8 July 2010, Bermuda to Fortaleza (Brazil), chief scientist Dr. Micha Rijkenberg (micha.rijkenberg@nioz.nl).

During leg 2 of the Geotraces cruise a total of 22 full depth stations were conducted with 1 test station, 14 normal stations (1 ultraclean 27 L & 1 normal 25 L hydrocast), 4 superstations (addition of deep in situ pump sampling and samples for Pa/Th) and 3 hyperstations (deep in situ pump sampling, 2 ultra clean & 3 normal hydrocasts).

Trace metal clean sampling was performed using the ultraclean Titan frame with PVDF samplers which was upon recovery immediately placed inside its clean laboratory container (Figure 9), where sub-sampling of a large variety of filtered or unfiltered seawater was done for (shipboard or afterwards) determinations of concentrations of Fe, Mn, Al, Co, Cu, Zn, Ag, Cd, Pt, Pb; physical-chemical speciation of Fe; large volumes for natural isotope systematics of Si, Fe, Zn, Cd, Pb, Nd; major nutrients; $^{14}CO_2$ and $^{13}CO_2$. Underway trace metal clean aerosol samples were collected using air filter units. Surface seawater samples for Fe speciation, Pt and Pb isotopes were sampled inside a trace metal clean container from tubing connected to a torpedo towed alongside the ship (Figure 9). The regular Niskin-type samplers and the in situ pumps provided the often required large volumes for natural or anthropogenic (radio)-isotopes systematics of ^{15}N, ^{99}Tc, ^{129}I, ^{137}Cs, ^{210}Pb, ^{210}Po, ^{226}Ra, ^{228}Ra, ^{227}Ac, ^{230}Th, ^{234}Th, ^{238}U, ^{231}Pa, ^{237}Np, $^{239,240}Pu$ and supporting parameter Dissolved Organic Matter (DOM). Complementary to GEOTRACES, many samples were collected for a transient tracers program comprising DIC, ALK, O_2, nutrients, CFC's and above mentioned $^{14}CO_2$ and $^{13}CO_2$, and for a microbial oceanography program comprising DOC, DON, bacterial and viral abundance, bacterial and archaeal and viral production, ^{3}H-FISH, ^{14}C-FISH and DNA microbial biodiversity and POC, ^{13}C plus ^{15}N by NanoSims, Nitrification, qPCR. These complementary transient tracers and deep sea microbial oceanography will play a role in unraveling the processes controlling the GEOTRACES variables, and vice-versa.

Two cross over stations were sampled with i) BATS important as a cross over station with various US GEOTRACES cruises, and ii) our hyperstation 36 (lat: 7° 45' 57"N, long -48° 52' 58"W) as a cross-over station with RV Meteor cruise M81/1 (GEOTRACES cruise A11, 4 February until 8 March 2010, chief scientist M. Frank, IFMGEOMAR, Kiel).

An interesting aspect of leg 2 was our encounter with water masses consisting of seawater mixed with Amazon and Orinoco river water, Figure 10.

RRS JAMES COOK JC057, 2 March through 6 April 2011, Punta Arenas (Chile) to Las Palmas (Spain), chief scientist Dr. Micha Rijkenberg (micha.rijkenberg@nioz.nl).

With 18 full depth stations sampled during our last leg 3 including 12 normal-, 2 super- and 4 hyperstations we now completed a transect of 54 stations from 65ºN to 50ºS, see Figure 8 for cruise track and full West Atlantic Ocean transect. In situ pumps were used in the surface 300 m of the hyperstations and two additional stations. Our hyperstation 6 at -39°58'06" N and -42°29'15" W forms the cross over station with the UK GEOTRACES cruise on the RRS Discovery (chief scientist Gideon Henderson) along 40°S to be completed in December 2011.

On board we had a diverse party of international scientists from Brazil, Germany, France, UK, USA, Austria and the Netherlands. We sampled an even more diverse set of parameters with direct on

board measurement of the trace metals Fe, Al, Mn, Co, Zn and Cd, the CO_2 system, nutrients, organic speciation and size fractionation of Fe, ^{234}Th and bacterial and archaeal production. We also sampled a large set of parameters for the international community including Ag, Pt, Cu, Zn, Hg, Ba, U, Mo, the rare earth elements, the isotopes of Cd, Cr, Ni, Nd (water column and bottom sediments), Pb, Fe, Zn, Si, ^{15}N, $^{13/14}$C, ^{230}Th, ^{231}Pa, ^{232}Th, ^{18}O, D and other parameters as CFC's and a whole range of parameters to increase our understanding of the deep sea microbiology.

Figure 11 shows as an example silicate concentrations for the full transect of the West Atlantic Ocean.

Planning of Mediterranean Geotraces, Hein de Baar and Micha Rijkenberg attended the Mediterranean Geotraces workshop on 4th to 6th October in Nice, France, to investigate the use of the Dutch Research vessel RV Pelagia for Geotraces transects in the Mediterranean and Black Sea.

Ocean Sciences 2012 conference in Salt Lake City, Utah, USA. Micha Rijkenberg, Rob Middag, Stephanie Owens and Patricia Cámara Mor organize a session on the Ocean Sciences 2012 conference in Salt Lake City with the title: "Advances in the oceanography of Trace Elements and Isotopes in the Atlantic and Polar Oceans" inviting topics on trace elements and isotopes in the Atlantic and polar oceans, including methods, intercalibration, field data and ocean modeling. Relevant topics in other oceans are most welcome as well.

Update on outputs from GEOTRACES activities involving Dutch researchers (July 2010-June 2011):

Meetings

Post cruise meeting Dutch GEOTRACES leg 1 & 2, 17 & 18 January 2011 at the Royal NIOZ, Texel, The Netherlands

Presentations

Klunder, M.B., P. Laan, R. Middag, C-E Thuroczy, L. Gerringa, H.J.W. De Baar. Trace Metals in the Polar Oceans. IPY – Oslo Science Conference, Oslo, Juni 2010.

Middag, R. Dissolved Aluminium and Manganese in the Polar Oceans. Oral presentation at the 2010 DISCO XXII meeting (invited), 07-10-2010, Honolulu, Hawaii.

Thuroczy, C-E., Brest, IUEM, seminar at LEMAR-CNRS-UMR6539, November 2010, oral presentation.

First results of the complete West Atlantic GEOTRACES transect were presented at 43rd International Liège Colloquium on Ocean Dynamics, Belgium, May 2011, see here below:

Abouchami W., S.J.G. Galer, H. De Baar, A.C. Alderkamp, R. Middag, P. Laan, H. Feldmann, M.O. Andreae, The Southern Ocean Cadmium Isotope Divide, oral presentation

de Baar, Hein (Keynote), Southern Ocean Iron Fertilization; What do we know now, what needs to be investigated, oral presentation

de Baar H.J.W., R. Middag, P. Laan, Dissolved Aluminium and Manganese in the Arctic-Atlantic-Antarctic Oceans, oral presentation

van Heuven S.M.A.C., Salt L., De Baar H.J.W. and Meijer H.A.J., Initial results of 14C in GEOTRACES-NL, oral presentation

van Hulten M.M.P., A. Sterl, A. Tagliabue, J.-C. Dutay, M. Gehlen, H.J.W. de Baar, R. Middag and W. Hazeleger, Aluminium in a general circulation model. Optimising the model or the measurements?, oral presentation

Laan P., M.B. Klunder, D. Bauch, H.J.W. De Baar, IPY – GEOTRACES: Dissolved Fe in the Arctic Ocean, oral presentation

Rijkenberg MJA, Gerringa, LJA, Laan, P, Schoemann, V, Middag, R, van Heuven, SMAC, Salt, L, van Aken, HM, de Jong, JTM, de Baar, HJW, Dissolved Fe in the Western Atlantic Ocean: distribution, sources, sinks and cycling, oral presentation

Rutgers van der Loeff M., P. Cai, D. Bauch, T. Roeske, M. Klunder, R. Middag, K. Bakker, I. Stimac, Tracers of river inputs in the Transpolar Drift, Arctic Ocean during the Polarstern IPY expedition, 2007, oral presentation

Journal articles

Rob Middag completed his PhD thesis comprising nine research articles on Al and Mn in the Polar Oceans. Similarly several manuscripts/chapters are completed of the theses in progress of Maarten Klunder on Fe in Polar Oceans and Charles-Edouard Thuroczy on Fe Physical- Chemical Speciation in Polar Oceans. Several articles of the Antarctic Polarstern expedition ANT XXIV/3 will appear in a special issue of Deep-Sea Research II.

Abouchami, W., Galer, S.J.G., de Baar, H.J.W., Alderkamp, A.C., Middag, R., Laan, P.,Feldmann, H., Andreae, M.O., 2011. Modulation of the Southern Ocean cadmium isotope signature by ocean circulation and primary productivity. Earth and Planetary Science Letters 305, 83-91.

Gerringa, L.J.A, Alderkamp, A.-C, Laan, P, Thuróczy, C-E, de Baar, H.J.W., Mills, MM, van Dijken, G.L., van Haren,H., Arrigo, K.R. Iron from melting glacier fuels the algal bloom in Pine Island Bay (Amundsen Sea). Deep Sea Research II,special issue DynaLife, Submitted and in review.

Klunder, M.B., D. Bauch, P. Laan, H.J. W. De Baar, S. v. Heuven, S. Ober. Dissolved iron in the Arctic shelf seas and surface waters of the Central Arctic Ocean: Impact of river water and ice-melt. In review for publication in JGR---Oceans, March 2011.

Klunder, M.B., P. Laan, H.J.W. De Baar, R. Middag, Dissolved Fe in the Arctic Ocean: important role of hydrothermal sources, shelf input and scavenging removal. In review for publication in JGR-Oceans, March 2011.

Klunder, M. B., P. Laan, R. Middag, H. J. W. De Baar, and J. V. Ooijen. 2011. Dissolved iron in the Southern Ocean (Atlantic sector). Deep Sea Research Part II: Topical Studies in Oceanography in press

Middag, R., H. J. W. De Baar, P. Laan, and M. B. Klunder. 2011. Fluvial and hydrothermal input of manganese into the Arctic Ocean. Geochimica Et Cosmochimica Acta 75: 2393-2408.

Middag, R., H. J. W. De Baar, P. Laan, P. H. Cai, and J. C. Van Ooijen. 2011. Dissolved manganese in the Atlantic sector of the Southern Ocean. Deep Sea Research Part II: Topical Studies in Oceanography in press

Middag, R., C. Van Slooten, H. J. W. De Baar, and P. Laan. 2011. Dissolved aluminium in the Southern Ocean. Deep Sea Research Part II: Topical Studies in Oceanography in press

Rutgers Van Der Loeff, M., P. Cai, I. Stimac, A. Bracher, R. Middag, M. Klunder, and S. Van Heuven. 2011. 234Th in surface waters: Distribution of particle export flux across the Antarctic Circumpolar Current and in the Weddell Sea during the GEOTRACES expedition ZERO and DRAKE. Deep Sea Research Part II: Topical Studies in Oceanography in press

Thuróczy, C-E, Alderkamp, A-C. Laan, P, Gerringa, L.J.A., de Baar H.J.W., Arrigo, K.R. Key role of organic complexation of iron in sustaining phytoplankton blooms in the Pine Island and Amundsen Polynyas (Southern Ocean). Deep Sea Research II, special issue DynaLife, Submitted and in review.

Thuróczy, C-E., L.J.A. Gerringa, M. Klunder, P. Laan, M. Le Guitton, H.J.W. de Baar. Distinct trends in the speciation of iron between the shelf seas and the deep basins of the Arctic Ocean, Journal of Geophysical Research-Oceans, accepted for publication.

Thuróczy, C. E., L. J. A. Gerringa, M. B. Klunder, R. Middag, P. Laan, K. R. Timmermans, and H. J. W. De Baar. 2010. Speciation of Fe in the Eastern North Atlantic Ocean. Deep Sea Research Part I: Oceanographic Research Papers 57: 1444-1453.
Thuróczy, C. E., L. J. A. Gerringa, M. B. Klunder, P. Laan, and H. J. W. De Baar. 2011. Observation of consistent trends in the organic complexation of dissolved iron in the Atlantic sector of the Southern Ocean. Deep Sea Research Part II: Topical Studies in Oceanography in press

Submitted on behalf of all participants by Micha Rijkenberg.

For general information about Netherlands GEOTRACES contact by email to:
Hein.de.Baar@nioz.nl

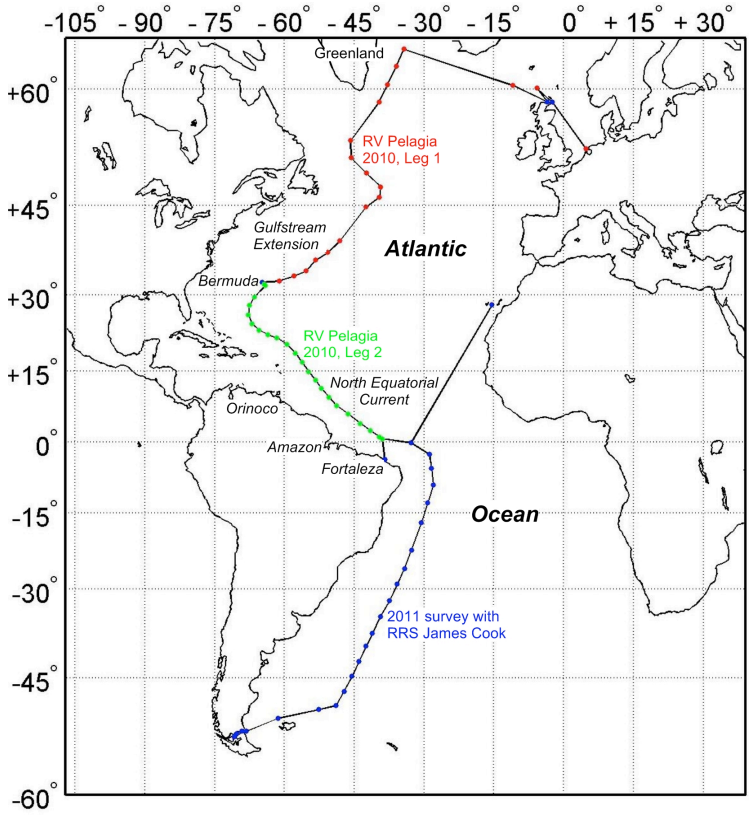


Figure 8: The completed West Atlantic Ocean transect of the Dutch GEOTRACES project.

Figure 9: Equipment used during the three Dutch GEOTRACES cruises in the West Atlantic Ocean.

Figure10: On the left clear blue surface seawater at 28°05'N and 67°30'W and on the right the green black surface seawater affected by Amazon river outflow at 05°55'N and 46°25'W.

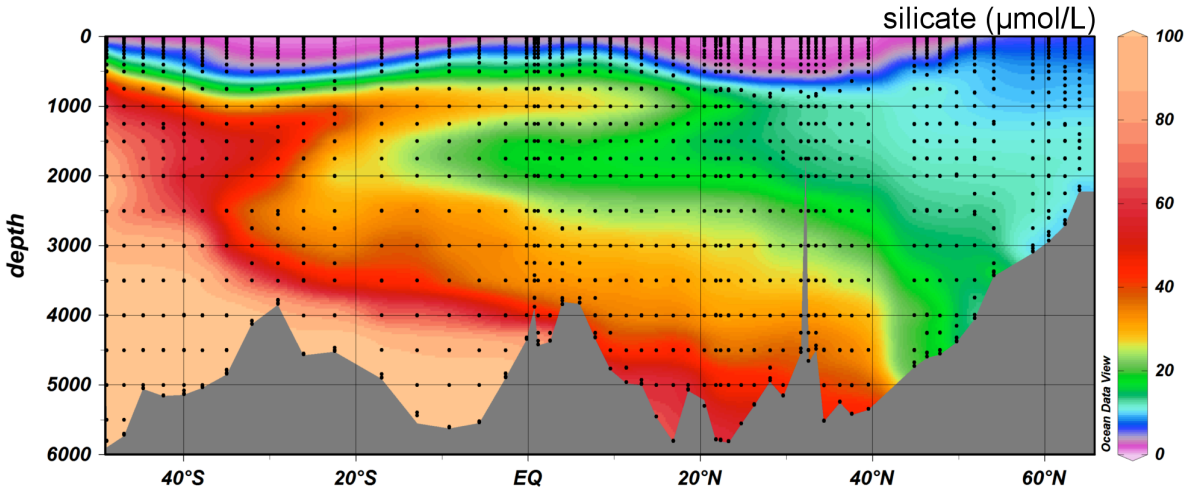


Figure 11: The silicate concentration for the whole West Atlantic Ocean transect.

New Zealand

In 2010/11 we have focussed on three main tasks: the final data analysis and write-up of papers from the GEOTRACES process voyage FeCycle II; preparations for our leg of the Brisbane to Lima GP13 zonal section; ongoing aerosol dust sampling from both ships-of-opportunity and a land-based site in the Pacific. Other broader activities have included liaising (along with Dr. Carol Robinson) with three labs involved in the fledgling bioGEOTRACES component of GEOTRACES, and participating in GEOTRACES-related workshops on nutrient limitation (IGBP) and molecular biology (OCB).

The FeCycle II process study yielded a suite of interesting insights into patterns of biological uptake and recycling of iron in high iron waters, that are now being compared with those from FeCycle I (also a quasi-lagrangian biogeochemical budgetary study but in low iron waters) in a series of manuscripts to be submitted for publication in late 2011. We have been working closely with the Australians to ensure that we have two successful legs on GP13. This has involved loaning of equipment such as TM rosettes and pumps to ensure that each voyage will have back-up equipment etc. The New Zealand voyage will set sail on June 6 for 24 days, and we will rendez-vous with the Australian vessel in Auckland on June 5th. As in previous years we have continued our aerosol dust sampling programme between Japan and New Zealand. The data from the first three years of this study are being written up in a comparative study with that of the Atlantic Meridional Transect dust sampling programme.

Relevant publications

Boyd P.W. and & M. J. Ellwood (2010) The biogeochemical cycle of iron in the ocean *Nature Geoscience,* 3, 675–682, doi:10.1038/ngeo964

Submitted by Philip Boyd.

Poland

Meetings

Cruise planning meeting (March 14-15 – SOPOT, Poland)

Participants: Jacek Beldowski, Martin Frank, Gideon Henderson, Johan Ingri, Jaromil Jakacki, Karl Kulinski, Janusz Pempkowiak (Tues only), Christa Pohl, Don Porcelli, Beata Szymczycha, Michael Staubwasser

Meeting included an outline of GEOTRACES goals and activities, and planning of Baltic GEOTRACERS cruise in November

Cruises

Planned cruise on the Polish RV Oceania in the Baltic for the period November 3-13. Three main scientific targets were discussed at the meeting as foci for the cruise:

i. Trace element and isotope (TEI) impact of the reducing conditions in the deep basins of the Baltic

ii. TEI fluxes from marginal Baltic basins (e.g. Bothnia Gulf) and chemistry on mixing

iii TEI fluxes out of the Baltic to the Atlantic

Scientists from 6 institutions from UK, Germany, Sweden and Poland will perform the research. Cruise track includes 10 major stations and a number of minor stations for the monitoring of physical parameters variability between stations. Cruise track is presented in Figure 12.

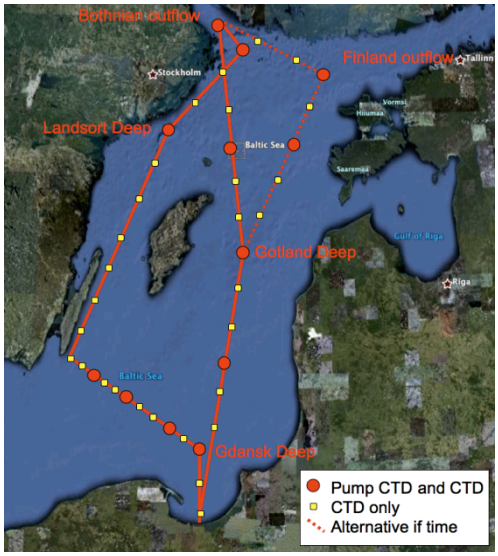


Figure 12. Cruise track and sampling stations location

New results

Pilot study was performed in Gdansk Deep and Gotland Deep area, based on samples collected in 2009-2010. Results included dissolved and particulate metals concentration, chlorophyll concentration and DOC/POC levels. Results are now being compiled into the database and will be a subject of statistical interpretation.

Publications

Bełdowski J., Bełdowska M., Kuliński K., Darecki M., 2010. Vertical mercury, cadmium and lead distribution at two stratified stations in the Southern Baltic Sea, The Proceedings of 15th International Conference on Heavy Metals in the Environment, 537-540, ISBN978-83-928986-5-8

Saniewska D., Beldowska M., Beldowski J., Saniewski M., Kwaśniak J., Falkowska L. (2010), "Distribution of mercury in different environmental compartments in the aquatic ecosystem of the coastal zone of the Southern Baltic Sea" Journal of Environmental Sciences, 22, 1144-1150

M. Miotk, J. Bełdowski, J. Pempkowiak. Mercury fluxes through the sediment water interface and bioavailability of mercury in southern Baltic Sea sediments. The Proceedings of 15th International Conference on Heavy Metals in the Environment, 618, ISBN978-83-928986-5-8

SOUTH AFRICA

The new kid on the block

Report prepared by Prof AN Roychoudhury
Stellenbosch University, South Africa

Model drawing of the new South African polar research ship being built at STX Europe shipyard in Finland

South Africa has played little role in Geotraces up until now. Once a vibrant community, marine researcher in South Africa has been a dying breed for the last few decades. Main reasons being continually degrading shipboard facilities and a serious lack of capacity to undertake elaborate projects. Barring the regular environmental monitoring of coastal oceans, much of other science related activities were confined to international collaborations and science done in conjunction with logistics voyages to support South African Antarctic base.

Change is on the horizon; however, and the future looks bright. The reasons being the imminent delivery of a brand new polar ship, to be christened SA Agulhas II, in April 2012 and a promise of large financial investment by the government on global environmental change science.

Unlike its predecessor, the second-generation polar ship is made to accommodate cargo, passengers and state of the art science laboratories. Other than the typical wet and dry laboratories found on a research vessel, Geotraces related activities on SA Agulhas II would get an immense boost by the presence of multiple isotope and metal free container clean labs. Specialized Seabird titanium CTD rosette on a 6500 m Kevlar line and a "fish" for continuous underway collection of surface water samples, while the ship steams ahead, would make up the water sampling facilities for trace substances. The ship would also come equipped with a piston corer for sediment sampling.

Activities of interest

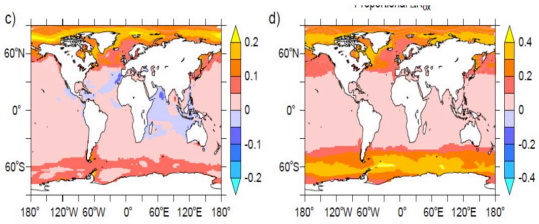
In 2010, South Africa has taken definite steps to enhance Geotraces related research. Much of the focus has been towards developing the capacity and research on iron in the Southern Ocean. The activities include modeling of iron cycling by Dr A. Tagliabue (CSIR) and set-up of FIA for measurement of nano- to picomolar iron in ocean water. Dr Thato Mtshali of CSIR and Raimund Rentel, an MSc student are being trained on FIA in Prof Roychoudhury's laboratory at Stellenbosch University. Once validated, FIA will be used to analyze water samples collected in 2010 on the Goodhope-SANAE-South Georgia line. All of this work will be conducted in a class 100 clean laboratory, equipped with class 10 Picotrace® laminar flow workstations, which is currently under construction at Stellenbosch University.

Fusing iron cycle models and observations

Global and regional ocean biogeochemistry models now routinely include iron and provide a means to test hypotheses and evaluate the importance of certain processes or parameters. Since arriving in Cape Town in November 2010, Alessandro Tagliabue is involved in employing these models in conjunction with in-situ observations and laboratory cultures to address these issues.

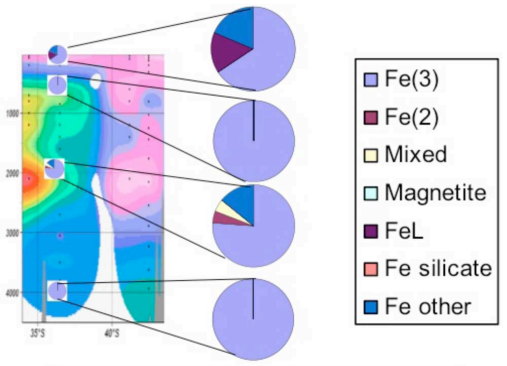
As part of a continuing collaboration with Dr. Christoph Völker of the AWI in Germany, we this year published a paper detailing a cost-effective method of modeling complex iron speciation and cycling in large scale ocean models and use this model to explore the response of iron speciation and bioavailability to future ocean climate change and acidification (Tagliabue and Völker, 2011).

Such predictions rest on experimental evidence garnered from in situ experiments and laboratory cultures. Over the next year, in collaboration with local and international colleagues, we will gain insight into the iron demand of specific Southern Ocean phytoplankton, as a function of environmental variability, as well as documenting and understanding the lability of colloidal iron species.



The proportional change in bioavailable Fe concentrations in 2100 for species that can assimilate organically complexed iron (left hand side) and those that rely solely on free uncomplexed iron (Tagliabue, A. and Völker, C.: Towards accounting for dissolved iron speciation in global ocean models, Biogeosciences Discuss., 8, 2775-2810, doi:10.5194/bgd-8-2775-2011, 2011.

Iron nano-particles in open ocean waters



Particulate iron speciation and distribution in the water column at one station (Cruise D357) Unpublished data (Von der Heyden et al.)

Bjorn von der Heyden, a PhD student of Prof Roychoudhury at Stellenbosch University is investigating the speciation of iron nano-particles in open ocean waters. In 2010, he was fortunate to be able to participate in Geotraces Cruise D357 where he was able to collect depth and surface water samples for dissolved and particulate iron in South Atlantic. In the process he was trained in shipboard clean sampling techniques.

With an in-house developed technique and using the Molecular Environmental Sciences (MES) beamline 11.0.2 at the Advanced Light Source, Lawrence Berkeley National Laboratory, Bjorn was able to identify and show a wide spatial variation in speciation of iron in the water column. These results have major implications on dissolution kinetics and bioavailability of iron.

Spain

- National committee (under SCOR-Spain)
  - P. Masqué & J. Garcia-Orellana (Barcelona-UAB)
  - A. Tovar-Sanchez (Mallorca-CSIC)
  - A. Cobelo & R. Prego (Vigo-CSIC)

- Universitat Autònoma de Barcelona (UAB) contributing 10 k€/y (2 years) to IPO

- Co-organisation and several participants at the GEOTRACES Mediterranean Workshop, Nice, October 2010

- Co-organisation and several participants at the 43rd International Liege Colloquium on Ocean Dynamics (Tracers of physical and biologichemical processes, past changes and ongoing anthropogenicc impacts), Liège (Bèlgium), May 2011

- Chairing a session and several contributions to GEOTRACES-related sessions at the ASLO Aquatic Science Meeting, Puerto Rico, February 2010

- Co-organisation of the 3rd GEOTRACES Data-Model Synergy Workshop to be held at Universitat Autònoma de Barcelona (Spain) in November 2011.

- Participation in several intercalibration activities (metals and radionuclides)

- Participation in EU funded COST Action ES0801

- Participation in GEOTRACES expeditions in the Atlantic Ocean:
  - German RV Meteor GEOTRACES M81/1 (PI: M. Frank, 2010)
  - The Netherlands RV Pelagia cruises 64PE319 and 64PE321 (PIs: H. De Baar, L. Gerringa, M. Rijkenberg, 2010)

Sweden

The Swedish GEOTRACES activities during 2010 comprise four major themes *i)* proposal and planning activities for a GEOTRACES project in the Arctic; *ii)* Participation in intercalibration efforts; *iii)* Participation in COST action ES0801; *iv)* GEOTRACES related activities in other projects/cruises.

Planning work related to GEOTRACES

Building upon the outcome of the Delmenhorst Arctic planning workshop a proposal has been submitted to the Swedish research council (VR) with the aim to use the icebreaker *Oden* as a research vessel for a GEOTRACES cruise in the Arctic Ocean (PI Per Andersson). The proposal was graded *excellent* and adopted for initial planning by Swedish Polar Research Secretariat (SPRS). The proposal includes international collaboration and the time frame for the proposed cruise is by the end of the coming 5 year period.

Participation and presentation (Per Andersson) of the Swedish Arctic GEOTRACES plans at the US GEOTRACES Arctic Workshop, 29 Sept. to 1 Oct., 2010, at NSF headquarters in Washington DC.

Robert Anderson was invited by the Royal Swedish Academy of Sciences (KVA) for a lecture in Nov. 2010. During his visit a presentation of GEOTRACES and the Swedish Arctic plans was made for the KVA geoscience class. Also a meeting between Bob A., SPRS and Per Andersson was undertaken where possible collaboration US-Swedish collaboration was discussed.

COST action ES 0801

Within the COST action *the ocean chemistry of bioactive trace elements and paleoclimate proxies* Swedish scientist are participating in the following during 2010:

- The test and training cruise organised by Dutch researcher on *R/V Pelagia* from Texel to Iceland 22 to 28 April, 2010. Unfortunately the trip was cancelled due to the Icelandic volcanic ash over European air space.
- Swedish participation (Johan Ingri) in planning workshop during 2011 for planning Baltic Sea cruises

GEOTRACES intercalibration work

Swedish laboratories participated in the intercalibration effort of Nd, Th and Si isotopes and some trace elements. Results have been reported to the coordinators for each element. Participation in the GEOTRACES intercalibration workshop at ODU Norfolk VA, 8 to 10 March 2010.

Funding

Some supporting funds for the GEOTRACES IPO have been secured and transferred to the IPO in Toulouse.

GEOTRACES promotion activities within Sweden

- Per Andersson rotated off the GEOTRACES SSC at the end of 2010 and David Turner, Gothenburgh University, is a new SSC member from 2011. Per and David met in March 2011 for a discussion about GEOTRACES.
- An e-mail list is kept and maintained by P Andersson for distribution of information about the GEOTRACES project among marine scientists in Sweden. This list is now transferred to David Turner.

- Presentations of the GEOTRACES project for the Swedish Geophysical Committee at KVA and the Swedish SCOR group meeting in March 2010.

Cruises, projects and publications

Amundsen Sea Polynya International Research Expedition (ASPIRE). A joint US-Swe expedition on icebreaker *Oden* and *R/V Palmer* during 2010/2011 with GEOTRACES related activities. Participation in TEI projects from Stockholm University (Kuria Ndungu) and Swedish Museum of Natural History (Per Andersson).

Presentations of results from the Amundsen Sea cruises at OSM in Portland Oregon, February 2010. Abstract of presentation:

Andersson P.S., Sherrell R.M., Planquette H. and Kylin H.(2010) *The Isotopic Composition of Nd in water from the Amundsen Sea: Influence of Detrital Material From the Antarctic Continent*

West Atlantic Leg3. Preparation of sampling material for collection of Th isotopes at the cruise GEOTRACES West Atlantic leg 3 Punta Arenas (Chile) 02-03-2011 to Las Palmas (Spain) 06-03-2011.

The International Siberian Shelf Study 2008 (ISSS-08) During 2010 publications from the GEOTRACES related cruise have been finalised for publication. A special volume of *Biogeosciences Discussions* for ISSS-08 results is in preparation.

Selected references from ISSS-08 includes:

Alling V., Sanchez-Garcia L., Porcelli D., Pugach S., Vonk J.E., van Dongen B. Mörth C.-M., Anderson L.G., Sokolov A., Andersson P.S., Humborg C., Semiletov I., Gustafsson ö. (2010) Non-conservative behavior of dissolved organic carbon across the Laptev and East Siberian Seas. doi:10.1029/2010GB003834 Global Biogeochemical Cycles 24, GB4033

Persson P.-O., Andersson P.S., Zhang J. and Porcelli D. (2011) Determination of Nd isotopes in water: A chemical separation technique for extracting Nd from seawater using a chelating resin. dx.doi.org/10.1021/ac102529k Analytical Chemistry 83, 1336-1341.

Climate warming in Siberian Permafrost Regions; tracing the delivery of carbon and trace metals to the Arctic Ocean. This project (PI's P Andersson and D Porcelli, Oxford) was funded by the VR as a three year project (2011-2013) and includes a field study in the Lena River Basin planned to take place during 2012. The main aim is to study a large basin dominated by permafrost and the impact of changing temperatures on the delivery of TEI to the Arctic Ocean.

Submited by Per Andersson.

Taiwan

Taiwan had an active year for GEOTRACES-related activities in 2010. We held 2010 GEOTRACES Asia Planning Workshop in October in Taipei and held 2010 Western Pacific Geophysics Meeting, including a GEOTRACES session. Three scientific cruises were carried out to study trace metal sources and distribution in the water columns of the two major marginal seas, including a July cruise in the East China Sea and a summer (July) and a winter (December) cruises on the continental shelf of the northern South China Sea (Figure 13 and 14). In addition, Taiwan has been building a 2,700 ton new R/V, which is expected to be launched in 2012 and is able to equip trace metal clean sampling facility.

Personally, Prof. C.-A. Hu at Academia Sinica has been involved in Ra inter-calibration experiment in Asian region to study submarine groundwater discharge. The laboratories of Drs. D.-C. Lee and T.-Y. Ho at Academia Sinica have established double spike techniques for trace metal isotope composition analysis (including Cd, Zn, Fe, and Ni) in seawater and phytoplankton. In 2010, there were about 15 PIs who have been funded by Taiwanese National Science Council to carry out GEOTRACES related research. We have published about 20 papers in the GEOTRACES related topics in 2010. Some of the most GEOTRACES-related papers are listed here. We have found that anthropogenic aerosols are major source for many trace metals in the water column of the marginal seas (Ho et al. 2010) and are likely to be major trace metal source in the western North Pacific Ocean as well (Figure 15).

2010 GEOTRACES related publications in Taiwan

Ho, T.-Y. *et al.* (2010) Trace metal cycling in the surface water of the South China Sea: Vertical fluxes, composition, and sources. *Limnology and Oceanography* 55: 1807-1820.

Ho, T.-Y. *et al.* (2010) Determination of trace metals in seawater by an automated flow injection ion chromatograph pretreatment system with ICPMS. *Talanta* 82: 1478-1484.

Hsu, S.-C. *et al.* (2010) Sources, solubility, and dry deposition of aerosol trace elements over the East China Sea. *Marine Chemistry* 120, 116-127.

Hsu, S.-C. *et al.* (2010) Effects of acidic processing, transport history, and dust and sea salt loadings on the dissolution of iron from Asian dust. *Journal of Geophysical Research* 115, doi:10.1029/2009JD013442.

Hung, C.-C. *et al.* (2010) POC/^{234}Th ratios in particles collected in sediment traps in the northern South China Sea. *Estuarine, Coastal and Shelf Science* 88, 303-301.

Hung, C.-C. *et al.* (2010) Comparative evaluation of sediment-trap and ^{234}Th-derived POC fluxes from the upper oligotrophic ocean in the Gulf of Mexico and the East China Sea. *Marine Chemistry* 121, 132-144.

Lin, I.-T. *et al*. (2010) Deep submarine groundwater discharge indicated by tracers of oxygen, strontium isotopes and barium content in the Pingtung coastal zone, southern Taiwan. *Marine Chemistry* 122, 51-58.

Shen, C.-C. *et al.* (2010) Sea-level rise and coral-reef development of Northwestern Luzon since 9.9 ka. *Palaeogeography, Palaeoclimatology, Palaeoecology* 292, 465-473.

Tseng, C.-M. *et al.* (2010) Development of a novel on-line flow injection mercury analyzer to determine gaseous elemental mercury over the northern South China Sea. *Journal of Analytical Atomic Spectrometry* 25, 526-533.

Wei, C.-L. *et al.* (2010) Scavenging phenomenon elucidated from ^{234}Th/^{238}U disequilibrium in the surface water of the Taiwan Strait. *Terrestrial, Atmospheric and Oceanic Sciences* 21, 713-726.

Submitted by Tung-Yuan Ho, Research Center for Environmental Changes, Academia Sinica, Taipei, Taiwan.

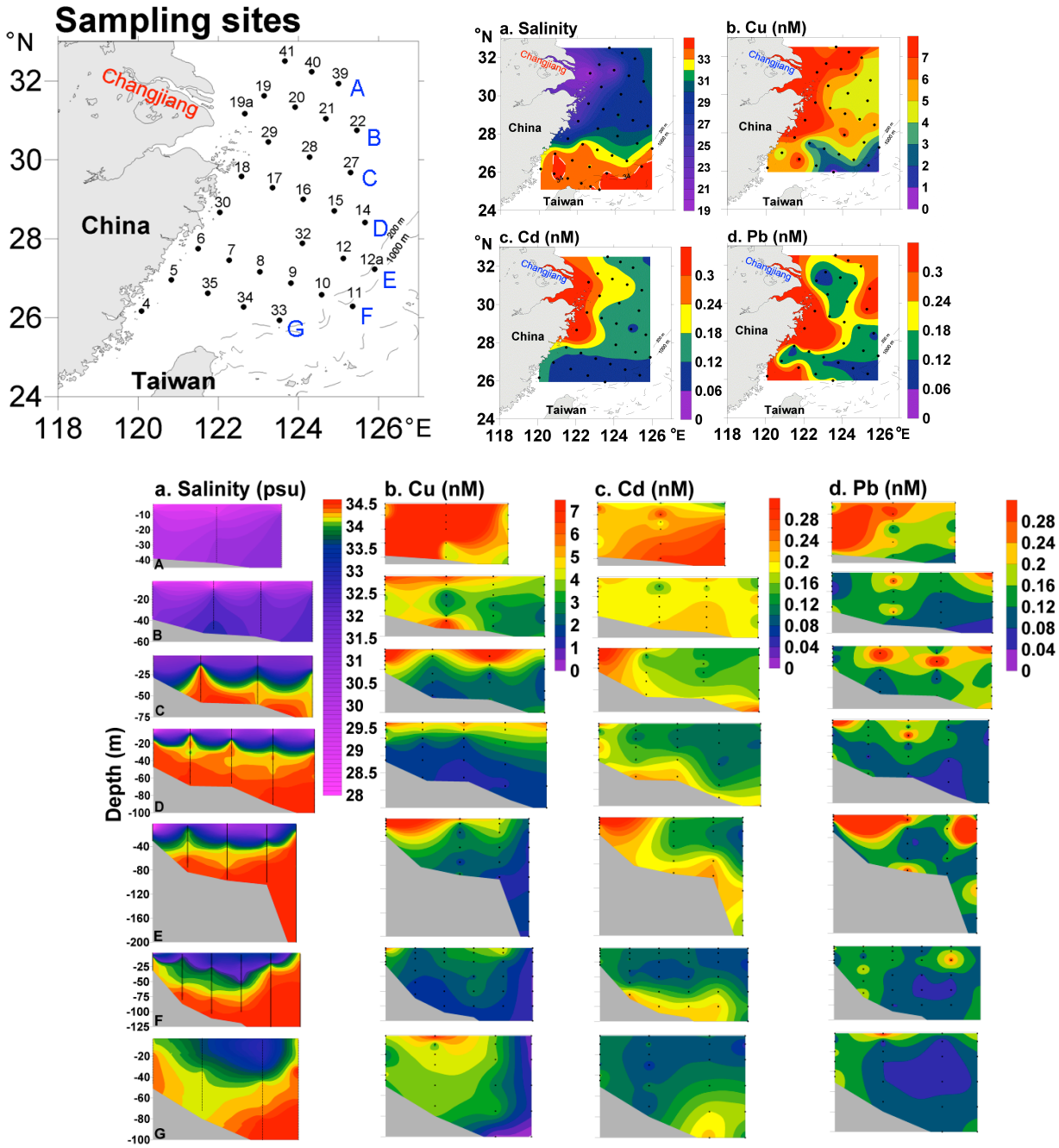


Figure 13. The distribution of some dissolved trace metals in the East China Sea in July in 2010 (Liu and Ho, unpublished data). Trace metals analyzed include: Al, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd and Pb. The concentrations shown in the up-right panel are surface concentrations. The sampling stations (up-left panel) are separated to 7 transects, A, B, C, D, E, F, and G.

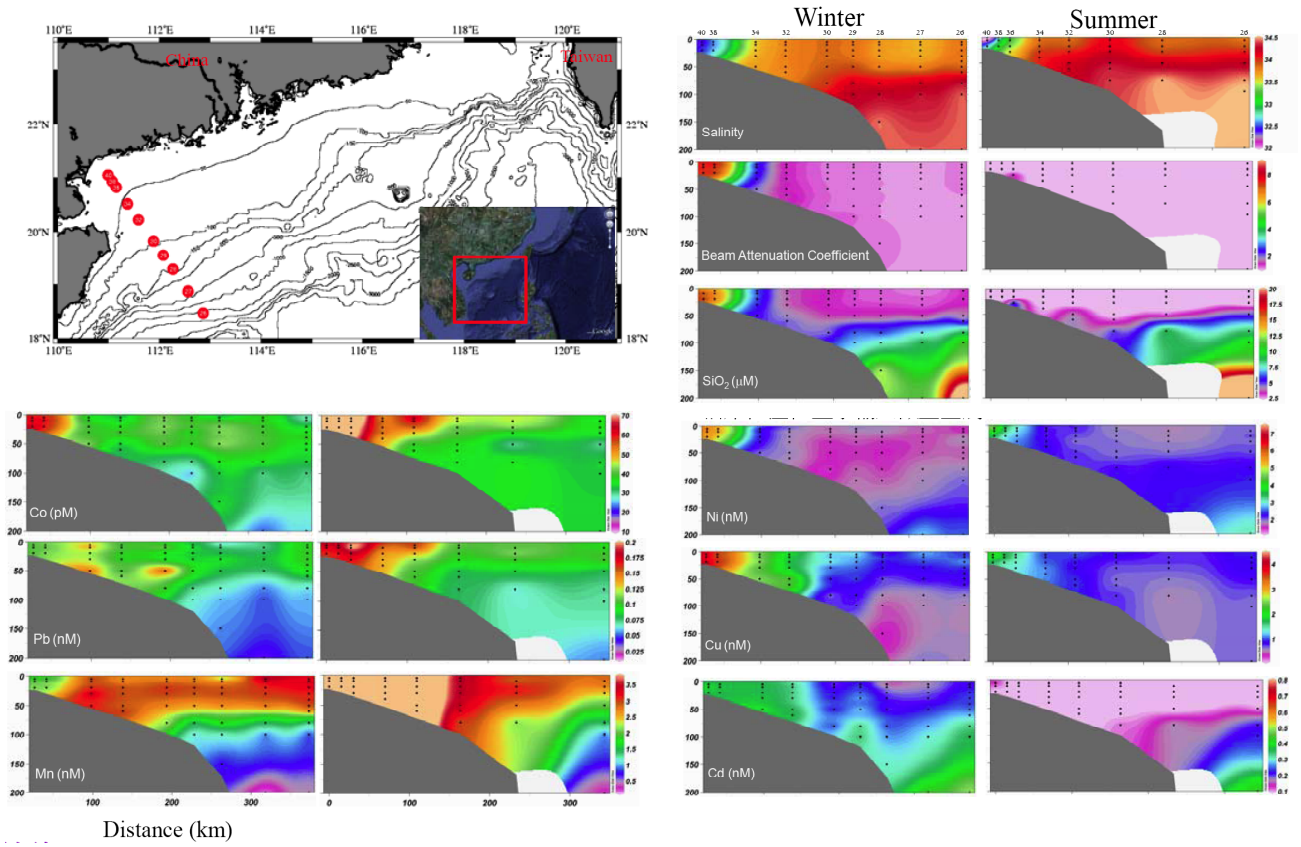


Figure 14. Seasonal variability of some dissolved trace metal distribution in the water column of the continental shelf of the northern South China Sea. The sampling sites are shown as the red circles in the map of the up-left panel. The cruises were carried out in July (summer) and December (winter) in 2010. Trace metals analyzed include: Al, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd and Pb. (Ho et al. unpublished data).

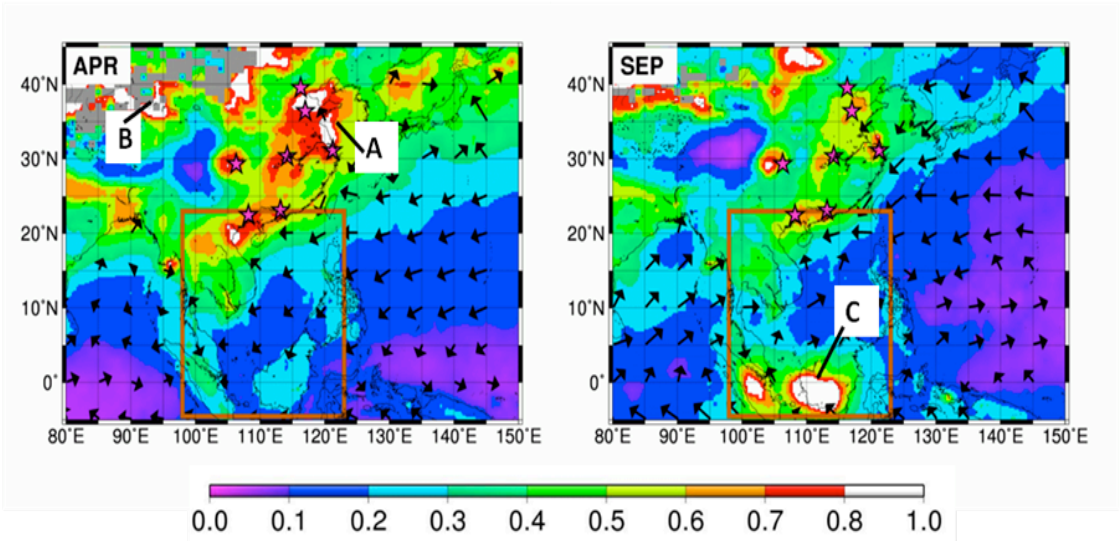


Figure 15. Terrestrial aerosol sources to the western North Pacific and the marginal seas as observed by three-year (2002–2004) averaged total AOT (Aerosol Optical Thickness) data from the NASA MODIS sensor. A: anthropogenic aerosols from Eastern China; B: desert dust; C: biomass burning from Indo China. QuikSCAT ocean-surface wind vectors are overlaid. Major Chinese cities are annotated in stars. (I.-I. Lin, unpublished data)

UK

GEOTRACES activities in the UK have centred around three section cruises:

GA10: South Atlantic (Cape Town to Montevideo)

The RRS Discovery left Cape Town in October 2011 on this zonal section cruise. The cruise was led by Gideon Henderson (University of Oxford), and funded by a NERC consortium grant to ten UK institutes. It featured the full complement of GEOTRACES Key Parameters, to be measured over the full water column. Major science questions in this are:

i. What supplies the micronutrients to support the band of high productivity at 40°S
ii. What processes set the micronutrient concentration of AAIW and NADW before they upwell to the surface to the north and south of the section respectively
iii. What are the controls on key paleoproxies including Pa/Th and δ^{30}Si in seawater and surface sediments.

Sadly a required medical emergency approximately one third the way across the Atlantic prevented the cruise from meeting its full set of objectives. Remaining ship time was used to accomplish repeat stations and high density sampling of the eastern third of the proposed section.

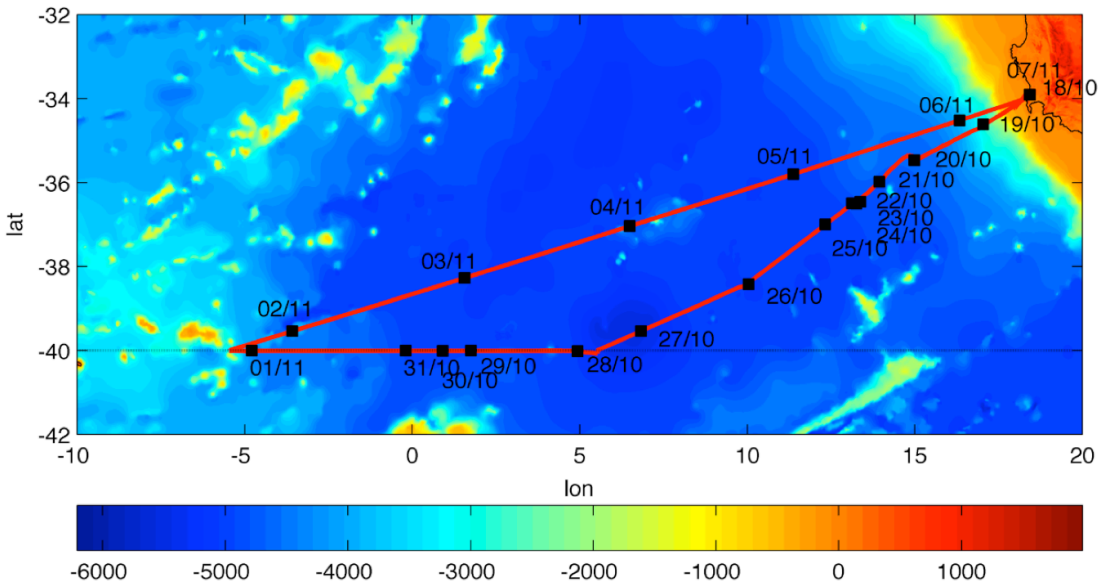


Figure 16*: Portion of the GA10 section completed during 2010.*

Following this incomplete cruise, NERC have generously provided additional funding and ship time to enable completion of the initial objectives. The rescheduled cruise will depart Port Elisabeth on 24th Dec 2011 on the RRS James Cook, heading for Montevideo on 27th January 2012.

GA06: Tropical Atlantic

The RRS Discovery sailed in February 2011 on a trajectory that ran perpendicular to the African coast to assess marginal fluxes from redox zones, and then on a broadly southward trajectory to cross the Saharan dust plume. The cruise was led by Eric Achterberg (University of Southampton) and funded by a NERC standard grant. The major scientific focus was on assessing the relative sizes of Fe fluxes in this region from sediments, dust, and upwelling, and to understand the relationship between Fe supply and nitrogen fixation. The cruise experienced initial delay due to engine problems, but made up

time during the cruise and completed its sampling objectives. Samples were collected for the full range of GEOTRACES Key Parameters, and over the full water column.

N08: Greenland-Iceland-Norway Seas

The next UK target section broadly follows the N08 section proposed during the Arctic workshop in June 2009. A proposal is being prepared, led by Carol Robinson (University of East Anglia) with Co-Is Maeve Lohan (University of Plymouth) and Eric Achterberg (University of Southampton). This will be submitted for a July 1st deadline and, if successful, will lead to a cruise in 2013 or 2014. The scientific goal of the cruise will be to link nutrient and trace metal distributions to the distribution and activity of phytoplankton and bacteria in the GIN Seas.

In other activities, the UK continues to host the GEOTRACES Data Assembly Centre at Liverpool, employing Ed Mawji to oversee UK and International GEOTRACES data. GEOTRACES has been represented at a number of UK meetings, and there have been meetings dedicated to each of the three cruises. UK scientists also play an active role in COST activities, and will take part in the forthcoming Baltic GEOTRACES Section led by the Polish.

Further details about UK GEOTRACES activities can be found at http://www.ukgeotraces.com/

USA

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

1) Implementation of a North Atlantic zonal section,
2) Preparation for a Pacific section between Peru and Tahiti, and
3) Long-range planning for work in the Arctic Ocean

Cruises

North Atlantic The RV Knorr (KN199-4) sailed from Lisbon Portugal on 15 October 2010 to carry out the first U.S. GEOTRACES section cruise. The planned cruise track (Figure 17) headed south to the Mauritanian upwelling system, and then west-northwest towards Woods Hole. The cruise was terminated prematurely on 4 November due to mechanical problems with the ship. Science personnel disembarked in the Cape Verde Islands to return to their home institutions. One third of the total number of planned stations was completed successfully before the cruise was terminated.

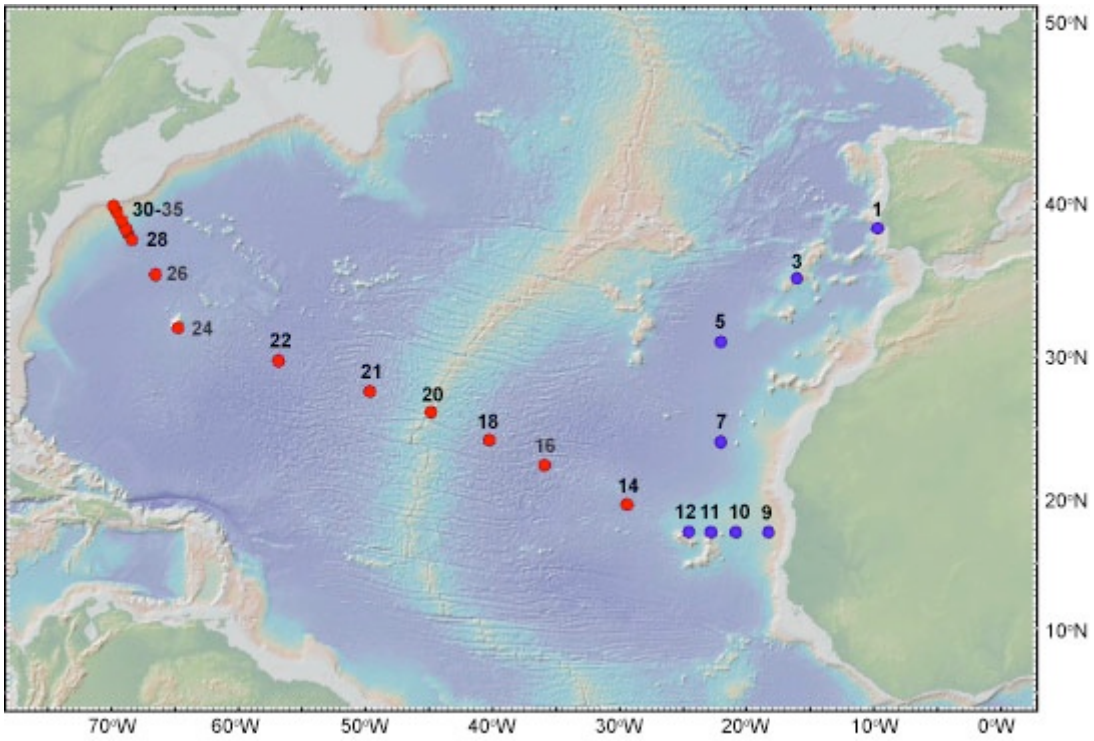


Figure 17. Locations of full depth stations planned for the U.S. North Atlantic zonal section (GA03). Shallow stations to 1000 m are not shown. Sampling was completed at stations in blue. Ship time has been scheduled to complete the remaining stations in November-December 2011. Map courtesy of K. Pahnke.

Scientific objectives of the cruise included:

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.

Following the unfortunate termination of the cruise the US NSF authorized ship time in late 2011 to complete the section, as well as funds to cover the added cost of demobilization of the terminated cruise and remobilization for the completion of the section. The US GEOTRACES SSC coordinated the planning and re-budgeting for the completion of the section.

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 (Figure 18).

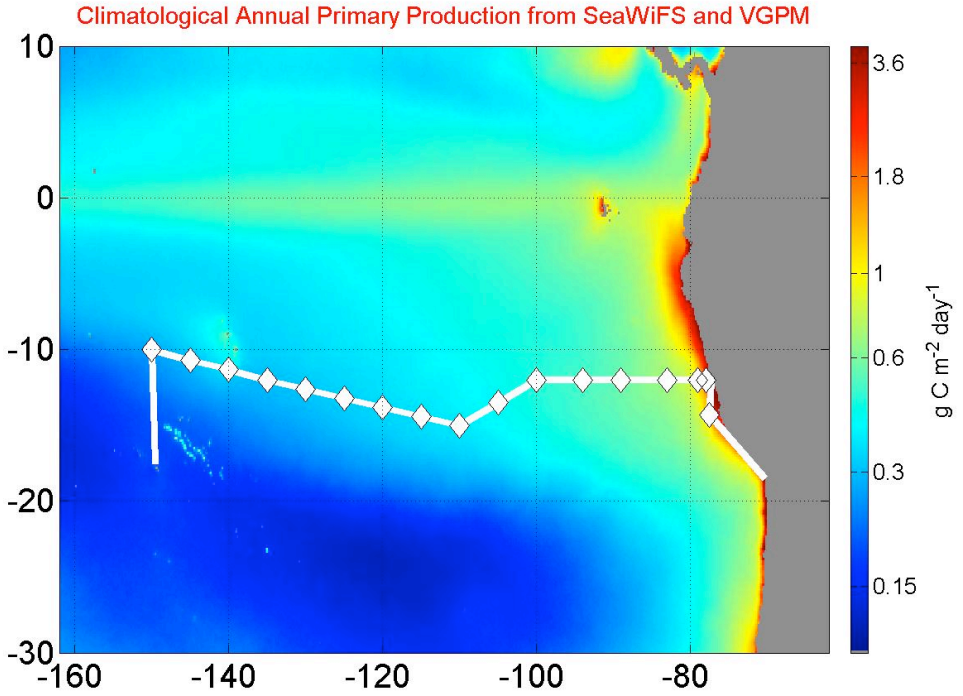


Figure 18. Tentative locations of full depth stations planned for the U.S. eastern tropical south Pacific zonal section. Shallow stations to 1000 m are not shown. The cruise is planned for late 2013. Map and productivity calculations courtesy of M-E Carr.

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.

Implementation of the Pacific cruise has been delayed by approximately one year by the disruption and delay in completion of the North Atlantic section. Target dates for the Pacific section are now late 2013.

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 US GEOTRACES project office. A formal decision on funding of these proposals is anticipated soon.

New results

Preliminary results from the North Atlantic cruise were presented and discussed at a workshop in March (see below). Investigators are making good progress in analyzing samples and interpreting results, but none of the preliminary results are in yet in a state to present here.

Meetings

US GEOTRACES sponsored two large workshops during the past year.

An Arctic planning workshop held at the US NSF (29 September - 1 October, 2010) was attended by approximately 40 US investigators as well as by several key international partners. The workshop defined the rationale for a US GEOTRACES Arctic research program and identified options for international collaboration to secure access to this remote and logistically challenging region. A report from the workshop is posted on the US GEOTRACES web site <http://www.usgeotraces.org/documents/arcticDOC/ArcticWorkshopRpt.pdf>.

A follow-up meeting was held at NSF on 1 June that included David Kadko (Chair US GEOTRACES Arctic planning committee), Bob Anderson (Chair US GEOTRACES SSC), Don Rice (representing NSF Ocean Sciences) and Bill Wiseman and Hedy Edmonds (representing NSF Polar Programs). The principal outcome of this meeting was the decision that Kadko and Anderson will approach the US GEOTRACES SSC with a proposal to defer the third planned US GEOTRACES section (Alaska to Tahiti) and insert an Arctic GEOTRACES expedition into the decadal timeline of US GEOTRACES activities. This proposal will be reviewed when the SSC meets on 15 September 2011.

A second workshop was held 7-9 March 2011 (Old Dominion University) to plan the logistics for completion of the US GEOTRACES North Atlantic section. Logistics were particularly complicated because the vessel assigned to complete the section was changed twice before a firm plan was in place. Lessons learned during the first North Atlantic cruise were used to generate a revised station plan and cruise schedule for the remainder of the section. These lessons produced both changes to station schedules to allow for more efficient operation of the sampling systems and changes to the sampling plan to allow certain features in the water column at intermediate depths to be sampled with greater resolution.

This workshop also provided a venue for scientists to see preliminary results from their colleagues and discuss implications for interpretation of the overall data set.

Publications (GEOTRACES and GEOTRACES-related*)

*Crusius, J., Schroth, A.W., Gasso, S., Moy, C.M., Levy, R.C. and Gatica, M., 2011. Glacial flour dust storms in the Gulf of Alaska: Hydrologic and meteorological controls and their importance as a source of bioavailable iron. Geophysical Research Letters, 38: L06602 doi:10.1029/2010GL046573.

John, S.G. and Adkins, J.F., 2010. Analysis of dissolved iron isotopes in seawater. Marine Chemistry, 119(1-4): 65-76.

Web site

The web site hosted by the US GEOTRACES project office at the Lamont-Doherty Earth Observatory has been revised. Information about international GEOTRACES activities has been removed, and transferred to the web site hosted by the IPO <www.geotraces.org>. The US GEOTRACES web site <www.usgeotraces.org> now presents information about US GEOTRACES activities as well as links to the web sites managed by the IPO and the DMO.

Submitted by Bob Anderson.