GEOTRACES SCIENTIFIC STEERING COMMITTEE
ANNUAL REPORT TO SCOR 2008/2009
July 2009

SCOR Scientific Steering Committee for GEOTRACES

Co-Chairs
Robert F. Anderson, USA
Gideon M. Henderson, UK

Members
Per Andersson, Sweden
Philip Boyd, New Zealand
Ken Bruland, USA
Minhai Dai, China
Hein de Baar, Netherlands
Martin Frank, Germany
Toshitaka Gamo, Japan
Catherine Jeandel, France
William Jenkins, USA
Pere Masque, Spain
Chris Measures, USA
Felipe Niencheski, Brazil
Kristin Orians, Canada
James Orr, France
Carol Robinson, UK
Michiel Rutgers van der Loeff, Germany
Reiner Schlitzer, Germany
Sunil Kumar Singh, India
Jing Zhang, Japan (alternate, Japan)

The SSC membership (listed above) contains representatives of 13 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.

SCOR-supported meetings during 2008/2009

SSC meeting: The third meeting of the GEOTRACES SSC was held for three days (6th-8th November 2008) in Toyama, Japan, hosted by Toyama University. This was attended by all but two of the SSC members. Jing Zhang, Japan, served as local host. The chair of the GEOTRACES Intercalibration Subcommittee (Greg Cutter) also attended, as did Ed Urban, representing SCOR. Ed Mawji (GEOTRACES Data Assembly Centre) and Juan Brown (British Ocean Data Centre) joined the SSC meeting and remained for the meeting of the Data Management Committee (see below).

SSC discussions were wide ranging. The meeting began with a review of national efforts and of GEOTRACES cruises carried out as part of the International Polar Year. Publicizing information about GEOTRACES and providing information in a format appropriate for users is important as the program enters its period of main field activity. Production of a GEOTRACES brochure and upgrading the web site are therefore a priority. The SSC set guidelines for the brochure, but will defer action on the web site until the IPO is staffed (see below). In addition to relationships with other programmes, major issues for discussion included measurement intercalibration, data management, ocean modelling, and criteria for GEOTRACES participation. Topics that received special emphasis include:

• International Project office - funding is in place to hire an executive officer to staff the IPO in Toulouse. Funds will cover salary and expenses for two years. Catherine Jeandel will represent

GEOTRACES in developing a contract with Laboratoire d'Etudes en Geohysique et océanographie Spatiale (LEGOS), the host institution. As there is no national or institutional sponsor of the IPO, it is vital that all nations participating in GEOTRACES seek contributions to sustain the office.

• Intercalibration cruise - Greg Cutter reported on preliminary results from the first GEOTRACES intercalibration cruise, held in June and July, 2008, between Bermuda and Norfolk, Virginia. Of note is the finding that the sampling rosette designed specifically for U.S. GEOTRACES was shown to collect water samples free of contamination for metals such as iron, lead, zinc and mercury. The ability to sample the water column rapidly and without contamination represents a vital technological advance that will enable GEOTRACES to measure trace element distributions at high spatial resolution on a global scale. Other nations are now developing clean sampling systems based on this design. Several hundred seawater samples from SAFE and GEOTRACES have been archived to use as working standards during future cruises.

• Data Management - The SSC heard a report from Ed Mawji, the GEOTRACES Data Liaison Officer, on steps being takes to establish the GEOTRACES Data Assembly Centre at BODC. The role of GDAC includes:
1) Establish a global database of GEOTRACES parameters
2) Provide guidance on metadata requirements

The next SSC meeting is scheduled for 4-6 November, 2009 in Washington, D.C. Ed Urban is overseeing local arrangements.

Ocean Basin Workshops in 2008 A workshop to set research priorities and plan the implementation of GEOTRACES science in the Arctic Ocean was held 8 - 10 June, 2009, at the Hanse Institute for Advanced Study, Delmenhorst, Germany. This workshop followed the precedent of the three successful international workshops held in 2007 to set priorities for the three major ocean basins – Pacific, Atlantic, and Indian.

Information about the Arctic workshop was publicized on the GEOTRACES website. Travel subsidies were provided for many participants with support from SCOR, from the European COST Action (see below), and from a variety of national sources. During the meeting workshop participants identified the key regions and research questions for the Arctic basin, and discussed opportunities for international collaboration to address the goals laid out in the GEOTRACES science plan. International collaboration will be necessary due to the difficult logistics involved when working in the Arctic Ocean.

The Arctic Ocean workshop report will be published on the GEOTRACES web site. It is intended mainly for use by national and regional planning groups for implementing GEOTRACES cruises. The SSC will extract material from these reports to prepare an overview document to be disseminated more widely.

Measurement Intercalibration during the GEOTRACES programme

There was early recognition during the planning of GEOTRACES that intercalibration of measurements between laboratories would be critical to the success of the program. To that end, intercalibration, along with data management, has been one of the two primary "enabling" activities

since the establishment of the GEOTRACES program. To date, GEOTRACES has completed two major intercalibration cruises:

1) 8 June - 12 July, 2008; sampling mainly at the Bermuda Atlantic Time Series Station, but also in continental slope waters near the east coast of the U.S.

2) 6 - 30 May, 2009; sampling mainly at the SAFE station in the eastern subtropical North Pacific Ocean, but also in Santa Barbara basin, off the west coast of the U.S. Samples were collected at the SAFE site to test the collection and analysis of samples for a broad spectrum of dissolved and particulate trace elements and isotopes. Samples were collected in the Santa Barbara Basin to test analytical methods used under low-oxygen conditions to measure the chemical speciation of redox-sensitive trace elements.

Results from the first intercalibration cruise were presented and discussed at a workshop (13 - 14 December, 2008; San Francisco, USA) attended by about 45 persons. Team leaders compared results from participating labs worldwide, both in terms of different classes of trace elements and isotopes and in terms of different sampling techniques.

In general, results from different sampling systems were found to be in agreement. For many of the trace elements, interlab agreement was good as well, although some problems were identified. However, agreement was poorer than expected for some of the radioisotope measurements. These results led to the design of new tests to be conducted during the second intercalibration cruise (May, 2009). Results from that cruise are not yet available.

A final workshop (March, 2010, Norfolk, USA) will synthesize results from the intercalibration activities and begin preparation of a "Best Practices Manual" documenting lessons learned form the intercalibration and making recommendations to facilitate acquisition of reliable data on future GEOTRACES cruises. The manual will be completed by the GEOTRACES Standards and Intercalibration Committee (Greg Cutter, Chair) and made available via the GEOTRACES web site.

Data Management for GEOTRACES

The Data Management Committee, chaired by Chris Measures and Reiner Schlitzer, met immediately following the SSC meeting on 9 - 10 November in Toyama, Japan. There, progress in establishing the international GEOTRACES Data Assembly Centre in the UK was reviewed, and priorities for future activities of the centre were developed. Currently the GDAC is operating under two years of funding provided in equal amounts by the UK NERC and by the US NSF. It is anticipated that future support for the GEOTRACES data management office will be provided via a national subscription policy. Each nation that carries out a GEOTRACES cruise is expected to include in the overall cruise budget a request for data management funds. The precise level of funding expected from each cruise remains to be established by the data management committee.

During the past year, Ed Mawji (GEOTRACES data liaison officer) has set up a web page (http://www.bodc.ac.uk/geotraces/), established metadata requirements for GEOTRACES cruises, contacted cruise leaders to submit metadata, designed an interface for submission of data and metadata, contacted representatives of national data centres to establish protocols for data transfer, and initiated a web site with information about GEOTRACES cruises. Most recently, he has started to request data from the principal investigators who participated in GEOTRACES IPY cruises.

Modeling in GEOTRACES

Building on the success of the first GEOTRACES international data-model synergy workshop in 2007, the SSC initiated plans for a second workshop, to be chaired by Jean-Claude Dutay (Venue: École Normale Supérieure, Paris, France; 7 - 10 December 2009). Additional information is posted on the GEOTRACES web site: <http://www.geotraces.org/PW2009_Data_Model_Synergy.html>.

Links with other programmes

GEOTRACES remains committed to maintaining strong links to other relevant programmes. During the past year members of the GEOTRACES SSC have held discussions with Doug Wallace, Chair of the SOLAS SSC, to explore opportunities for collaboration. GEOTRACES and SOLAS are both interested in the supply of iron and other micronutrients that are essential for marine organisms, as well as in the biological response to variability in the supply of these micronutrients. In support of that interest, GEOTRACES is considering opportunities to make a limited suite of measurements aboard section cruises that would characterize biological parameters related to organism physiology and their sensitivity to micronutrient limitation. This initiative has been labelled bioGEOTRACES. Meanwhile, SOLAS has identified a related topic "Atmospheric control of nutrient cycling and primary production in the Surface Ocean" as a focus activity for its future research. This is one of the themes to be highlighted at the SOLAS Open Science Conference in Barcelona. Ideally, SOLAS and GEOTRACES would join forces to plan a process study that exploits information gained about micronutrient supply from the GEOTRACES sections to test new hypotheses concerning ecosystem response to varying micronutrient availability. At this time, individuals are being sought who would take the lead on organizing such an effort.

Capacity Building

It became evident during the basin planning workshops that many nations with scientists interested in GEOTRACES lack the experience and expertise to collect and process seawater samples free of contamination of certain trace elements. Consequently, it was decided that a training workshop that included the collection and processing of samples at sea would be a valuable capacity building activity for GEOTRACES. Chris Measures (University of Hawaii) volunteered to take the lead in seeking support for the workshop, and to host the workshop in Hawaii. However, despite intense enthusiasm among GEOTRACES SSC members for this capacity building effort, initial requests for support have meet with discouraging responses. At this time, Chris Measures continues to lead an effort to seek alternative sources of funding for the training activity.

GEOTRACES also seeks to build communities of marine biogeochemists within individual nations to expand the network of scientists contributing toward GEOTRACES goals. Toward that end, the Indian Ocean basin-planning workshop was held in India in 2007 to help organize Indian scientists with interests in the marine biogeochemistry of trace elements and their isotopes. It was rewarding, therefore, when the government of India Ministry of Earth Sciences announced its intentions in mid 2009 to support an Indian national GEOTRACES program (see national report from India).

In May, 2009, SSC members Chris Measures and Bob Anderson visited university and government labs in Korea to assist in organizing a Korean GEOTRACES program (see national report from Korea).

GEOTRACES anticipates holding an East Asian regional planning workshop in early 2010. Workshop organizers (Minhan Dai, China, and Jing Zhang, Japan) have offered to hold that workshop in Korea if

doing so will enhance the visibility of Korean GEOTRACES organizing efforts and help secure funding for a Korean GEOTRACES program.

International Project Office

The principal activity during the past year involved developing a legal contract with the hosting institution. This proved to be a time consuming effort. The GEOTRACES SSC wishes to thank Ed Urban for his valuable assistance in completing the contract. The GEOTRACES Executive Officer position was advertised in early July, 2009. It is hoped that the executive officer will be hired and in place by the time of the next GEOTRACES SSC meeting (November, 2009). A search committee consisting of Ed Urban (SCOR), Gideon Henderson and Bob Anderson (SSC co-Chairs), and Catherine Jeandel (local IPO supervisor) will review the applications and interview finalists for the position.

Other Activities

GEOTRACES Co-Chairs Henderson and Anderson attended the SCOR 50th Anniversary Symposium (The Changing Ocean: From Past to Future) and the 2008 SCOR General Meeting in Woods Hole, Massachusetts, USA, on 20-24 October 2008.

Anderson also participated in the Third SCOR Summit of International Marine Research Projects (Newark, Delaware, USA; 30 March-1 April 2009).

European GEOTRACES activities are supported by COST Action ES0801: The ocean chemistry of bioactive trace elements and paleoclimate proxies. This COST Action directly supports the International GEOTRACES Programme, but extends beyond that programme to cover all marine trace-metal research in the COST region. Supported activities include cruise planning, intercalibration, data management and training. For more information, see: <http://costaction.earth.ox.ac.uk/>

GEOTRACES-related sessions at international conferences

GEOTRACES research goals are regularly promoted through special sessions at international conferences. Highlights during the past year include:

Goldschmidt 2009 - Challenges to Our Volatile Planet
21 - 26 June; Davos, Switzerland
Theme 14: Ocean Chemistry Past and Present - Sessions:

- 14a: Present-Day Ocean Chemistry and Biogeochemical Cycling of Elements and Metals
- 14b: New Developments in Marine Geochemical and Isotopic Proxies
- 14c: Past Ocean Circulation
- 14d: Ocean-Lithosphere Exchange and Fluid-Rock Interaction

ASLO Aquatic Sciences Meeting 2009
25 - 30 January; Nice, France

- 009. Progress in the application of short-lived radionuclides as tracers of particle cycling and export in the ocean
- 016. Aquatic biogeochemistry as only skin deep: Trace element exchange, meta-stable speciation and reactions at interfaces

- 081. Biological transformations of trace metals
- 097. Chemical speciation of metals in waters and its dynamics
- 099. IPY-GEOTRACES: Trace Elements and Isotopes in Polar Oceans

Looking forward, two special sessions at the Ocean Sciences meeting (22 - 26 February, 2010; Portland, Oregon) will highlight results pertaining to trace elements and their isotopes:

- CO07: GEOTRACES in the International Polar Year, and
- CO09: Getting the Right Number: Precision and Accuracy in Chemical Oceanography.

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

Summary of Australian GEOTRACES activities in the period July 2008-June 2009:

- Metadata and cruise reports from IPY-GEOTRACES projects *SIPEX*, *SAZ-Sense* and *SR3* submitted to Edward Mawji at BODC in the United Kingdom
- IPY-GEOTRACES voyages (*SIPEX*, *SAZ-Sense* and *SR3*) -- analyses and interpretation ongoing, publication outputs listed below
- SS01/2010 voyage planning underway for international interdisciplinary study of the macro- / micro-nutrient gradients and biogeochemistry in the Tasman Sea (Jan/Feb 2010); looking for endorsement as a GEOTRACES process study (PI: Christel Hassler)
- Australian Government funds new oceanographic research vessel; looking to be operational 2012/13. Requests from Bowie/Butler for vessel to conform to GEOTRACES "standards"
- Proposal submitted to Australian Marine National facility for shiptime in May/June 2011 for joint Australian-NZ GEOTRACES two-ship voyage along line P06 (~30ºS) east of Australia (153ºE to 160ºW) (PI: Andrew Bowie)
- Australia joins European Union COST Action ES0801 for GEOTRACES ("The ocean chemistry of bioactive trace elements and paleoclimate proxies") as non-COST international participant (National representative: Andrew Bowie)

Outputs from IPY-GEOTRACES activities involving Australian researchers:

Journal articles:

- Bowie A.R., Lannuzel D., Remenyi T.A., Wagener T., Lam P., Boyd P.W., Guieu C., Townsend A.T., Trull T.W., 2009. Different processes structure biogeochemical iron budgets in the subantarctic and polar Southern Ocean south of Australia during summer. Global Biogeochemical Cycles, accepted subject to minor revision
- Lannuzel D., Schoemann V., Pasquer B., van der Merwe P., Bowie A.R., 2009. What controls the distribution of dissolved iron in Antarctic sea ice? Spatial, seasonal and inter-annual variability. Journal of Geophysical Research - Biogeosciences, accepted subject to major revision
- van der Merwe P., Lannuzel D., Mancuso Nichols C.A., Meiners K., Heil P., Norman L., Thomas D., Bowie A.R., 2009. Biogeochemical observations during the winter-spring transition in East Antarctic sea ice: evidence of iron and exopolysaccharide controls. Marine Chemistry, accepted subject to minor revision
- Lannuzel D., Remenyi T., Lam P., Townsend A., Ibisanmi E., Butler E., Wagener T., Schoemann V., Bowie A.R., 2009. Distributions of dissolved and particulate iron in the sub-Antarctic and polar frontal Southern Ocean (Australian sector). Deep-Sea Research II, accepted subject to minor revision
- Ibisanmi E.B., Hunter K.A., Sander S., Boyd P.W., Bowie A.R., 2009. Vertical distributions of iron-(III) complexing ligands in the Southern Ocean, Deep-Sea Research II, accepted subject to minor revision

Conference presentations:

- Bowie A., Lannuzel D., Remenyi T., Wagener T., Lam P., Boyd P., Guieu C., Townsend A., Trull T.W., Griffiths B., SAZ-Sense Team, 2009. Different processes drive biogeochemical iron budgets in the subantarctic and polar Southern Ocean. 2nd International Forum on the Sub-Antarctic (IFSA), Environmental Change in the Sub-Antarctic, Hobart, Australia, 26-27 April
- Trull T.W., Bowie A.R., Boyd P., Cassar N., Davidson A., Griffiths F.B., Rintoul S.R., Thomson P., Tilbrook B., Wright S., SAZ-Sense team, 2009. The Australian SAZ-Sense Study of the sensitivity of the Sub-Antarctic zone to Climate Change, 2nd International Forum on the Sub-Antarctic (IFSA), Environmental Change in the Sub-Antarctic, Hobart, Australia, 26-27 April
- Bowie A., Lannuzel D., Remenyi T., Wagener T., Lam P., Boyd P., Guieu C., Townsend A., Trull T.W., Griffiths B., SAZ-Sense Team, 2009. Different processes drive biogeochemical iron budgets in the subantarctic and polar Southern Ocean. Gordon Research Conference: Polar Marine Science - Beyond IPY: Crossing Boundaries, Lucca, Italy, March 15-20

- Bowie A.R., Boye M., de Baar H., Bathmann U., Cardinal D., Murphy E., Treguer P., 2009. An overview of the biogeochemical features of the Southern Ocean during the International Polar Year. Gordon Research Conference: Polar Marine Science - Beyond IPY: Crossing Boundaries, Lucca, Italy, March 15-20
- Boye M., de Baar H., Bowie A.R., Masque P., Dehairs F., Rutgers van der Loeff M., Butler E., Tovar-Sanchez A., Croot P., Nishioka J., 2009. GEOTRACES in the International Polar Year: an overview. ASLO 2009 Aquatic Sciences Meeting, Nice (France), January 25-30
- Boye M., de Baar H., Bowie A.R., Bathmann U., Cardinal D., Murphy E., Treguer P., 2009. An overview of the biogeochemical features of the Southern Ocean during the International Polar Year. ASLO 2009 Aquatic Sciences Meeting, Nice (France), January 25-30
- Sedwick P., Marsay C., Bowie A., Church T., Cullen J., Giesbrecht T., Johnson R., Lohan M., McGillicuddy D., Ussher S., 2008. Dynamics and speciation of dissolved iron in the Sargasso Sea (BATS Region). Eos, Transactions, American Geophysical Union 89(52), Fall Meet. Suppl., OS21G-03
- Cossa D., Butler E., Heimburger L., Averty B., Bowie A., Watson R., Remenyi T., 2008. Methylmercury distribution in the upper part of the Southern Ocean (SR3, GEOTRACES). Eos, Transactions, American Geophysical Union 89(52), Fall Meet. Suppl., C11C-0515
- de Baar H.J.W., Bowie A.R., Boye M., Butler E., Croot P., Dehairs F., Masque P., Nishioka J., Rutgers van der Loeff M., Tovar-Sanchez A., 2008. IPY-GEOTRACES : Trace Elements and Isotopes in Polar Oceans. SCAR/IASP IPY Open Science Conference: Polar Research - Arctic and Antarctic Perspectives in the International Polar Year, St Petersburg, Russia, July 8-11
- Trull T.W., Bowie A.R., Davidson A., Griffiths F.B., Thompson P., Rintoul S.R., Tilbrook B., Wright S.W., SAZ-SENSE team, 2008. The Australian SAZ-SENSE study of the sensitivity of the Sub-Antarctic Zone to climate change: an introduction. International Symposium on the Effects of Climate Change on the World's Oceans, Gijon, Spain, May 19-23
- C.S. Hassler, V. Schoemann, E. Alasonati, C. Mancuso-Nichols, V.I. Slaveykova, E.C.V. Butler, 2009. Are sugars the key to ubiquitous control of oceanic iron limitation? Gordon Research Conference on Polar Marine Science. 'Beyond IPY: Crossing Boundaries', Lucca (Barga), Italy.
- V. Schoemann, C.S. Hassler, I. Dumont, F. Masson, A. Bowie, D. Lannuzel, J.T.M. de Jong, and S. Becquevort, 2008. Control of organic ligands on Fe bioavailability, carbon production and export. European Network of Excellence for Ocean Ecosystems Analysis (EUR-OCEAN) Workshop "Controls on organic carbon export and twilight zone mineralisation". Brussels, Belgium.
- C.S. Hassler and V. Schoemann, 2008. Iron bioavailability and primary productivity to model phytoplankton of the Southern Ocean. European Network of Excellence for Ocean Ecosystems Analysis (EUR-OCEAN) Workshop "Controls on organic carbon export and twilight zone mineralisation". Brussels, Belgium.
- C.S. Hassler, and V. Schoemann, 2008. On the role of organically bound iron in controlling iron bioavailability to model phytoplankton of the Southern Ocean. European Network of Excellence for Ocean Ecosystems Analysis (EUR-OCEAN) Workshop "Iron biogeochemistry across marine systems at changing times". Gothenburg, Sweden.
- V. Schoemann, C.S. Hassler, I. Dumont, F. Masson, A. Bowie, D. Lannuzel, J.T.M. de Jong, and S. Becquevort, 2008. European Network of Excellence for Ocean Ecosystems Analysis (EUR-OCEAN) Workshop "Iron biogeochemistry across marine systems at changing times". Gothenburg, Sweden.

Other publications:

- E.C.V. Butler, and A.R. Bowie, 2008. Tracing elements in the ocean. Australian Antarctic Magazine, (14): 20.
- C.S. Hassler, 2008. Bioavailability of organically bound iron to phytoplankton of the Southern Ocean. SOLAS Newsletter, (7): 2–3.

Prepared by: Andrew Bowie (Antarctic Climate & Ecosystems CRC)
Ed Butler (CSIRO Marine & Atmospheric Research)

Brazil

Workshop:

State of Knowledge on Southwestern Atlantic Ocean Margin Processes (16-21 Nov).

Although considerable research has been carried out on the Southwestern Atlantic Ocean Margin, there has been little integration of results across disciplines and the few recent summaries of research that have been published do not take into account more recent scientific findings in the region.

The purpose of the Montevideo´s workshop is to bring together scientists from Brazil, Uruguay, Argentina and the U.S. to assess the state of knowledge on ocean margin processes of the Southwestern Atlantic Ocean. The goal is to develop a summary of the present understanding of physical and biogeochemical processes operating in this region and how they are linked and to identify major areas of uncertainty. The anticipated outcomes of the workshop are: 1) to initiate the pursuit of cooperative research projects/programs in the region that articulate with more global research agendas and 2) to enhance North-South American, and regional national collaborations.

Multidiscipline syntheses of research in this region will not only benefit regional researchers in planning future efforts, but will also serve the wider marine research community by providing a better overview of the state of knowledge of this important ocean region.

Scientific activities:

1. We have realized the first observations of naturally occurring geochemical tracers (^{222}Rn, ^{223}Ra, ^{224}Ra) in the coastal waters as proxies of SGD into the Albardão shelf, extremely Southern Brazil, close to the Uruguayan borders.

Coastal seawater and shallow beach groundwater (<4m deep) were sampled in January 2007 and September 2008.

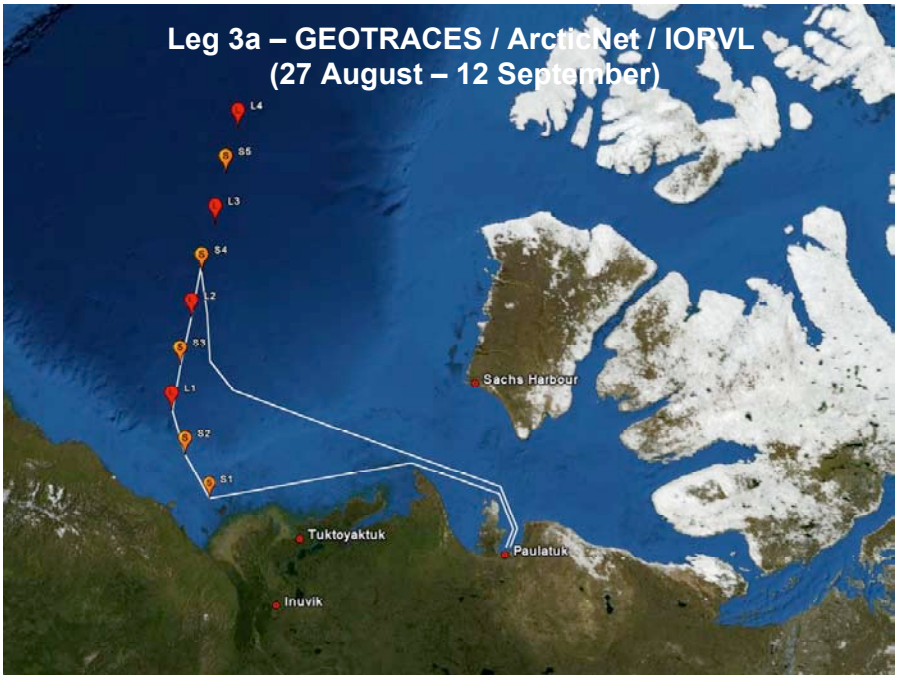
Groundwater samples were collected with a stainless steel drive point piezometer system ("Retract-a-Tip'' from AMS®). For measuring ^{222}Rn (t1/2 = 3.8 days), we used a portable, continuous radon-in-air monitor modified for radon-in-water (Rad-7, Durridge Company) deployed on a rubber boat at the surf zone. Radium sampling was carried out by passing large volumes of water (~20 L for groundwater; ~200 L for surface waters) through a "Mn fiber" adsorber. Activities of ^{223}Ra (t1/2 = 11.4 days) and ^{224}Ra (t1/2 = 3.7 days) were then measured on a delayed coincidence counter.

Offshore radium transects indicated a nearshore groundwater source. Given the environmental conditions of the southern Brazilian continental shelf (e.g., wavy, open shoreline), radium may provide more consistent information than radon, as it is difficult to estimate the influence of waves on radon atmospheric evasion.

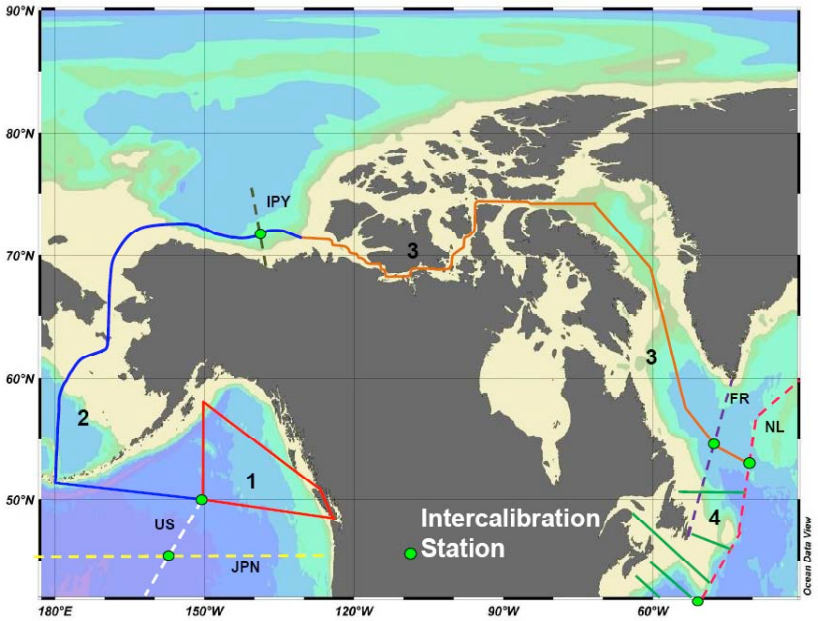
2. We are in contact with Brazilian Navy to realize three transects (from the coast up to the shelf break) in between latitude 26º - 33º S, to analyze macronutrients and isotopes. This is a joint project involving the Navy, IEAPM (Instituto de Estudos Almirante Paulo Moreira) and IRD/CNEN (Instituto de Radioproteção e Dosimetria/Comissão Nacional de Energia Nuclear). It´s scheduled for 2009. The scientists involved took part in the the *Ubatuba*, *Brazil* SGD assessment intercomparison that was held in 2005.

Canada

The Canadian GEOTRACES IPY cruise in the Arctic Ocean was delayed until 27 August - 15 September 2009. It is anticipated that all key GEOTRACES parameters will be measured, with the possible exception of aerosols. The cruise track is shown below.



The Canadian GEOTRACES community is also looking forward to collaborating with other nations in a larger study of the Arctic Ocean.



Tentative plan for a Canadian GEOTRACES NSERC Strategic Network.

China

GEOTRACES Activities in China
An annual report for 2008-2009
July 15, 2009
By China-GEOTRACES Working Group

1. Activities:
1) Participation to the international GEOTRACES activities- inter-comparison:
Xiamen University: Th, Ra, Pb and Po
East China Normal University (Jinzhou Du): U, Ra.
Ocean University of China (Jingling Ren): Al and As
2) Attendance in the International Polar Year-GEOTRACES program
3) Continue to explore the possibility of a trace metal sampling/analysis training workshop with Chris Measures
4) "973" Carbon project–part of China-GEOTRACES has been accommodated in this project and there is the first cruise to Chinese Marginal Seas between July-September, 2009
5) Planning of a 3rd Asian-GEOTRACES workshop, with the exploration of a Korean host
6) Start to plan a GEOTRACES process cruise in Pacific in 2011

2. Products:
1) Preliminary results from GEOTRACES inter-calibration exercise are available. Details not shown.
2) Supported by the Alexander von Humboldt Foundation and BMBF, the cooperation between Xiamen University and Alfred-Wegener Institute of Polar and Marine Research in the POC export studies in the Arctic Ocean and the Southern Ocean has led to two submitted manuscripts of Cai et al., 2009 (JGR-Oceans) and Rutgers van der Loeff et al., 2009 (DSR II). The major findings are the very low POC export in the central Arctic Ocean (Figure not shown) and that simultaneous determinations of ^{234}Th is crucial for understanding the geochemical behaviors of other particle reactive elements, like Mn and Fe (Figure not shown).
3. Promotion of GEOTRACES in China:
1) China-GEOTRACES theme has been in the NSFC key project proposal call in 2009 on "Ocean response to terrestrial input in western Pacific and its marginal seas--A biogeochemistry study of trace elements and their isotopes". We are trying to extend this same proposal call in 2010.
2) Capacity building on trace metals start to accumulate
A) a couple of "clean" systems will be tested for underway and stationary trace metal sampling in an upcoming cruise to South China Sea in July-September 2009
B) We have shown capacity to measure Fe isotopes in suspended particulate material collected in the South China Sea, a largest marginal sea in the West Pacific.

France

The French GEOTRACES held a planning workshop attended by 30 participants (represeneting roughly 50 interested people). Scientists from Belgium and Spain participated as well, reflecting anticipated international collaboration.

GEOTRACES-France confirms its plan to carry out a section along the "OVIDE" North Atlantic track (between France and Greenland) in 2014 (Catherine Jeandel, lead investogator). GEOTRACES-France is also considering an Indian Ocean action (Keops II) and probable section (at least from La Reunion to Kerguelen, both driven by Stephane Blain, possibly as early as 2012. A pre-proposal has been submitted to test the willingness of the French scientific committees to support such an operation. Finally, plans are being initiated for a Mediterranean GEOTRACES action under the direction of C Guieu.

GEOTRACES-France has ordered a clean rosette with the cable and 12 bottles. It is anticipated that the winch will be purchased in the next year.

Germany

Many activities were related to the GEOTRACES IPY expeditions with RV Polarstern to the central Arctic (July-Oct, 2007) and to the Atlantic sector of the Southern Ocean (ZERO and DRAKE, Febr-Apr, 2008):

Post-cruise workshops of these IPY Polarstern expeditions took place:

- Antarctic expedition ZERO and DRAKE: ANT XXIV/3 (AWI, Bremerhaven, September 2008)
- Arctic expedition ARK XXII/2 (AWI, Bremerhaven, June 2009)

Results based on GEOTRACES-related work on these IPY expeditions were presented at international conferences (ASLO-Nice; Goldschmidt-Davos) and led to the submission of a first set of publications.

In addition to the three Basin workshops organized in 2007, an international Arctic Cruise Planning workshop was held in Delmenhorst 8-10 June, 2009 (http://www.geotraces.org/PW2009_ArcticCruise.html) to discuss and coordinate future GEOTRACES activities in the Arctic.

Directly after the Delmenhorst meeting a cruise preparation meeting for a German RV Meteor GEOTRACES expedition to the tropical Atlantic (Meteor M81/1, February 2010 Las Palmas – Port of Spain (Trinidad and Tobago), chief scientist Martin Frank) was held on June 10th.

India

Indian GEOTRACES Report

Sunil Kumar Singh

After the successful organisation of GEOTRACES Indian Basin Planning workshop at Goa during October 2007, further interaction among Indian scientists resulted in concurrence to submit a combined proposal under GEOTRACES (India) to the Ministry of Earth Sciences (MoES) to get funding and required facilities to study Trace Elements and Isotopes (TEIs) in Indian and Southern oceans. In the beginning of 2009, nine proposals dealing with biogeochemistry of TEIs in Indian Ocean from various institutions in India were put together. These proposals plan to study the various aspects of biogeochemistry of TEIs, such as their sources-sinks, water column distribution, inter-oceanic exchange etc. As the coordinator of this programme, I presented these proposals to MoES in a meeting chaired by the secretary, MoES in middle of April 2009. Immediately after the talk, the secretary announced the formation of GEOTRACES (India) and assured us all the financial and logistical helps including the ship timing for this programme. He also agreed to provide necessary funding for acquiring a clean sampling system including the clean van and other instruments under GEOTRACES (India) programme. We hope to start the acquisition process for the clean sampling system and other instruments in late September, 2009.

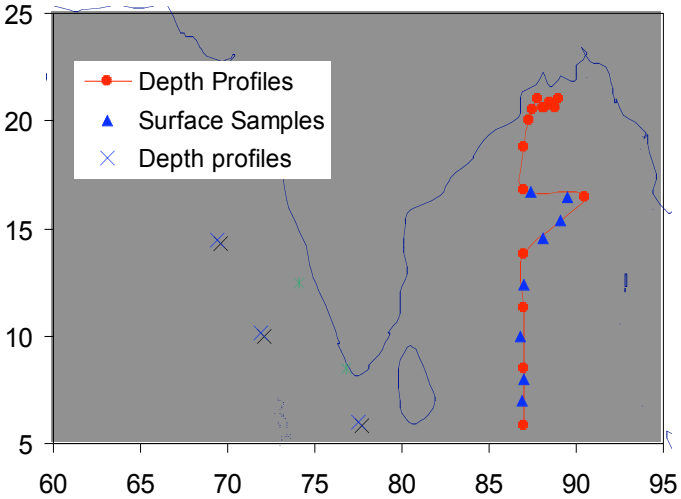


Fig. 1: Cruise track and sampling location in BoB and AS

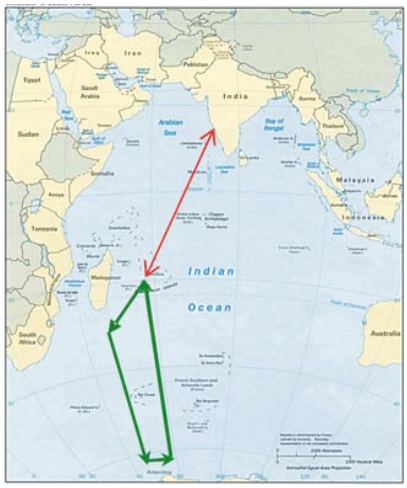


Fig. 2: Cruise track in Southern Ocean

As has been discussed earlier, we had initiated some work related to GEOTRACES by studying U, Mo, Re and Ba distribution in the Bay of Bengal and Arabian Sea. During November 2008, we arranged a 25 days cruise in the Arabian Sea (AS) and the Bay of Bengal (BoB) to collect seawater samples from various depth profiles (Fig. 1). Further, we participated in the Southern Ocean cruise Akademik Boris Petrov, Cruise # 35 during February 12 to April 14, 2009 and seawater samples were collected along the cruise track shown in Fig. 2

The samples from BoB have been analysed for Ba, U, Re and Mo and some of the initial results given in Fig. 3.

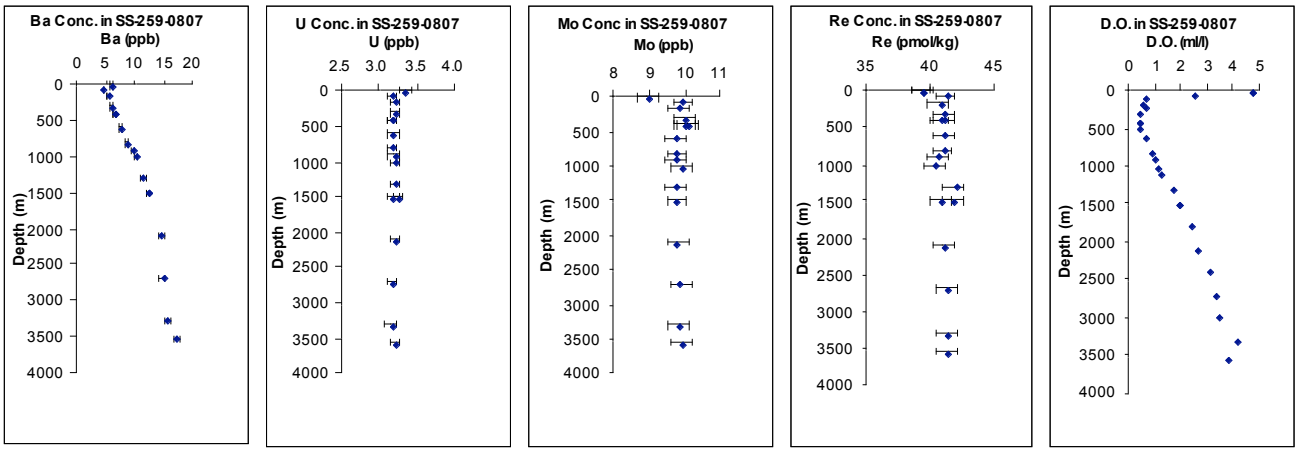


Fig. 3: Ba, U, Mo, Re and D.O. concentrations in the Bay of Bengal

Japan

Major GEOTRACES-related activities in Japan during the past year are as follows:

1) Publication of two special sections in Journal of Oceanography (Oceanographical Society of Japan) Vol.64 (Nos. 2 and 3) on GEOTRACES-related studies in the east Asia. Vol.64(2) was published in April 2008, which contains 11 papers including Preface by W.S. Broecker and R.F. Anderson and Introduction by the guest editors (J. Zhang, T. Gamo, M. Dai, C-T. A. Chen, and Y. Sohrin), and Vol. 64(3) was published in June 2008, which contains 7 papers. Titles and abstracts of these papers have been uploaded in the TERRAPUB web site (http://www.terrapub.co.jp/journals/JO/index.html).

2) Participation in the intercalibration cruise in June. Two young researchers from Japan took part in the US GEOTRACES intercalibration cruise Leg. 1 from Norfolk to Bermuda (from 8th to 27th June, 2008) as observers. During the cruise, Dr. Hajime Obata (ORI, U. Tokyo) and Dr. Kazuhiro Norisuye (ICR, Kyoto Univ.) used Niskin-X samplers for clean water sampling, and showed that the samplers are clean enough for contamination-prone trace metals, like Zn and Hg.

3) Although many of the Japanese geotracers as well as some foreign geotracers had been actively preparing for the GEOTRACES Indian Ocean cruise scheduled in December 2008 to January 2009, the cruise was postponed to the next year (November and December 2009) due to unusual rising of oil price.

4) A five-year proposal of a new grant-in-aid (totally 14M$) for GEOTRACES studies in Japan was submitted to the Government in April 2008, but it was not adopted. A revised proposal was again submitted in December 2008.

GEOTRACES-Japan will begin its first major ocean section cruise in November, 2009, covering a meridional transect in the western Indian Ocean.

Korea

- Planning project for a Korea GEOTRACES Program (K-GEOTRACES) were funded and started from November 2008.

- The scientific committees and working groups (Intercalibration and TEI researches) have been formed to develop a K-GEOTRACES in Feb. 2009.

- K-GEOTRACE Planning Committees hosted Dr. Bob Anderson (co-chair of international GEOTRACE program), LDEO, and Dr. Chris Measures, University of Hawaii to get comments and recommendations in developing a Korean GEOTRACES program (K-GEOTRACES) in May 2009 (referred the photo below).

- We organized the open science meeting of interested scientists for launching a K-GEOTRACE program at the bi-annual meeting of Korean Society of Oceanography in May 2009.

- The working groups are planning to get together to prepare a national implementation plan and priority goals for a K-GEOTRACES program and Korean oceanographic community in Aug. 2009.

Dr. Bob Anderson introduced the overview of international GEOTRACE program during the open science meeting at Korea in May 2009.

Netherlands

Netherlands activities focused on continued analysis of samples, and interpretation of results generated during International Polar Year cruises.

Arctic Polarstern cruise July-October 2007
Datasets for Fe, Mn, Al, high accuracy nutrients; samples collected for Ag (to be analyzed with Eric Achterberg), and Cu, Cd, Ni, Zn (to be analyzed with Bill Landing).
Most other Geotraces sampling for Ba, REE and radioisotopes was done by Germany team of Michiel Rutgers van der Loeff.
Manuscript on Al is ready and awaiting few minor corrections before submitting to Marine Chemistry.

Antarctic Polarstern cruise February-April 2008
Datasets for Fe, Mn, Al, high accuracy nutrients; samples collected for Ag (to be analyzed with Eric Achterberg), and Cu, Cd, Ni, Zn (to be analyzed with Bill Landing).
most other Geotraces sampling for Ba, REE and radioisotopes was done by Germany team of Michiel Rutgers van der Loeff.
Moreover more trace metals research by team of Peter Croot, Kiel, Germany

Results form the zero meridian for Fe, Al, Mn and Fe speciation & colloids will appear in a special issue DSR II for this cruise.

During all the above cruises, SAFe samples have were and results for Fe, Al and Mn were submitted to SAFe data coordinator Ken Bruland. There is excellent agreement between several labs for Fe, also for the few labs for Al, for Mn.

Hein de Baar co-chaired with Marie Boye (France) an IPY Geotraces session at ASLO, January 2009 in Nice. Some 22 abstracts were received.

A Netherlands GEOTRACES cruise has been approved and granted to conduct the West Atlantic Ocean section to in 2010 and 2011. We are now are looking into all the logistics etc to first come up with a ship time plan (which months we will use for each of these 4 sections)

New Zealand

The following activities have been conducted over the last 12 months:

a) The first GEOTRACES process study – an interdisciplinary study of trace metal cycling and budgets during a spring bloom event in high iron waters east of New Zealand.
b) Ongoing ship-of-opportunity sampling for aerosol iron between Japan and New Zealand, Australia and New Zealand, and Tasmania and East Antarctica.
c) Planning and co-ordination with Australian colleagues of a joint GEOTRACES survey voyage from N Queensland to Tahiti (i.e. Western portion of the WOCE P06 zonal section).

The process study took place in September 2008, and involved 31 scientists from New Zealand, Australia, USA and Canada. We successfully captured the onset and development of the spring bloom, and were able to sample in a quasi-Lagrangian mode by locating the centre of an almost stationary eddy. The voyage had a strong physics component to underpin the daily sampling of trace metals using both specialised clean rosettes and particle pumps. Samples were taken for a wide range of chemical (such as redox speciation, metal isotopes, electrochemistry) and biological (uptake and recycling of metals, trace metal content of individual cells and organisms) processes. A voyage data workshop will take place in Wellington in December 2009, and we will liaise closely with GEOTRACES data management in both the UK (BODC) and US (BCO-DMO). Samples for both dissolved and particulates have been archived from the voyage and will be available to other GEOTRACES labs for inter-comparison.

Three meridional transects (17 aerosol samples per transect) were sampled between Japan and New Zealand in the last 12 months. These samples are analysed at UEA (UK) by the Jickells/Baker group to enable the inter-comparison between Atlantic (AMT) and Pacific transects. Due to ship logistics only one transect was sampled between Tasmania and E Antarctica in 2008/9, as was the case for the Melbourne/Auckland zonal section.

New Zealand has secured 26 days shiptime for one of the legs (SE of New Caledonia) of the joint Australian/New Zealand survey. We contributed to the writing of the Australian shiptime proposal and hope to be able to confirm voyage dates in the next six months.

Sweden

Report on GEOTRACES related activities in Sweden during 2008

The Swedish GEOTRACES activities during 2008 include participation in planning activities for GEOTRACES projects in both the Arctic and Antarctic regions. During 2008 also one major expedition with GEOTRACES related work was conducted in the East Siberian Sea.

Planning work related to GEOTRACES

The Swedish icebreaker *Oden* is rented by NSF on a five year contract with the main task to clear a channel for resupply operations into the US McMurdo base in Antarctica. The agreement also include approximately 20 dedicated science days each year in conjunction with ice breaking service. At a joint Swedish-US workshop outside Stockholm in February 10-13, 2008 about 50 Swedish and US scientists and science administrators discussed the capabilities of the vessel and possible scientific usage. The discussion also included projects related to the GEOTRACES programme. A report from the workshop is available at NSF and Swedish Science Council (VR) and can be downloaded from http://www.vr.se/download/18.72e6b52e1211cd0bba880006699/Oden_workshop_report08.pdf

During 2008 Sweden also joined the COST action ES0801 ”the ocean chemistry of bioactive trace elements and paleoclimate proxies”, which directly support the international GEOTRACE programme. Most of the Scandinavian countries are involved in the ES0801 action and an increased interest in the GEOTRACES programme from all countries have been noticed during latter part of 2008 and early 2009. A suggest workshop for trace metal work in the Baltic Sea is currently being launched by the Finnish community. This is a very positive development for the GEOTRACES programme in Scandinavia.

A workshop, supported by COST action ES0801 on GEOTRACES project planning in the Arctic Ocean, Bering Sea and the Nordic Seas took place in Delmenhorst, Germany, during 8-9 June, 2009. The workshop included 4 Swedish participants.

Expedition work related to GEOTRACES

Scientists from the Swedish Museum of Natural History, Stockholm University and Luleå Technical University took part in the analyses of samples collected during the GEOTRACES intercalibration cruises 2008-09.

The International Siberian Shelf Study 2008 (ISSS-08) was a “GEOTRACES-compliant” cruise and a major IPY ship-based programme along the entire Eurasian-Arctic continental shelf with combined biogeochemical and geophysical observations (see Fig 1). The work was conducted from the Russian research vessel *R/V Yakov Smirnitsky* during 15 Aug. to 25 Sept.

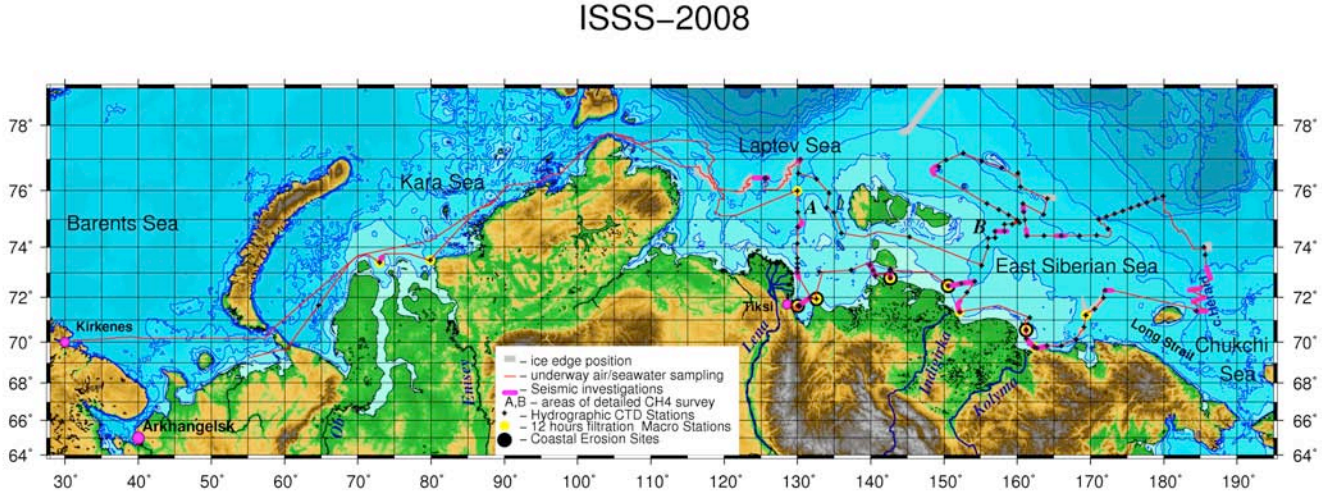


Fig. 1. The transect of the ISSS-08 starting and ending in Kirkenes, Norway. Over 130 stations for CTD and water sampling, 100 sediment coring sites, and 4 coastal erosion sites were investigated.

Planned analyses of collected air, seawater, eroding soil and sediment material include molecular and isotopic biomarker composition as well as trace element and isotope characterizations following the protocol launched for GEOTRACES work during IPY.

A more detailed report on ISSS-08 with participants and scientific programmes can be found in the journal EOS http://www.agu.org/journals/eo/eo0917/2009EO170001.pdf#anchor and supplementary information http://www.agu.org/eos_elec/2009/gustafsson_90_17.html

Per Andersson/

Stockholm 21 July, 2009

UK and EU Cost Action

UK-GEOTRACES

1. South Atlantic Zonal GEOTRACES Section

Funding has been secured from the UK funding agency NERC for the A10 GEOTRACES Section along 40ºS from Cape Town to Montevideo in a proposal led by Gideon Henderson (Oxford); Rachel Mills (Southampton); Richard Pancost (Bristol); and Ros Rickaby (Oxford). That proposal also provides funding for the paleoproxy measurements suggested in the GEOTRACES Science Plan. A second proposal has recently been submitted to fund an extensive set of trace metal measurements, which would complete the GEOTRACES key parameters and establish a formal UK-GEOTRACES programme. The cruise is likely to take place in November 2010.

2. Tropical Atlantic Zig-Zag GEOTRACES Section

Funding has also recently been secured from NERC for the A06 GEOTRACES Section under the Saharan dust plume in the north tropical Atlantic via a proposal led by Eric Achterberg (Southampton) and Maeve Lohan (Plymouth). That proposal includes funding for a large number of the GEOTRACES key parameters. The cruise is likely to take place sometime in 2011.

3. Data Management

The UK hosts the GEOTRACES International Data Assembly Centre at the British Oceanography Data Centre in Liverpool. Ed Mawji co-ordinates data management efforts for the programme. See http://www.bodc.ac.uk/geotraces/ for details.

GEOTRACES COST Action

An ESF funded "COST Action" helps to co-ordinate GEOTRACES activities across Europe. Eighteen countries have signed up for the Action and are represented on its Management Committee (Belgium, Croatia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom). Four working groups have oversight of: Cruise Planning; Intercalibration; Data Management; and Training. The Action provides funding for short-exchange visits for scientists travelling from one European country to another to conduct GEOTRACES related science. It has also contributed to the costs and organisation of the recent GEOTRACES Arctic Workshop (8-10 June 2009, Germany) and will do likewise for the forthcoming 2nd Data-Modelling Synergy workshop (7-10 December 2009, France). Future open meetings are planned to discuss GEOTRACES Activities in the Mediterranean and the Baltic.
Full details of the Action can be found at: http://costaction.earth.ox.ac.uk/

USA

U.S. GEOTRACES scientists have been involved in the following activities during the past year.

1) Intercalibration: Both GEOTRACES intercalibration cruises (June-July, 2008, Bermuda to Norfolk; 6 - 30 May, 2009, Honolulu to San Diego) took place aboard the U.S. Research Vessel Knorr. U.S. GEOTRACES hosted the international Intercalibration workshop in San Francisco (13-14 December, 2009).

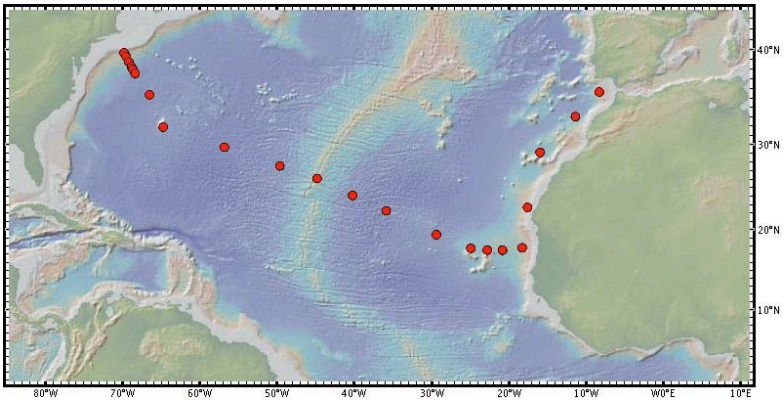
2) Planning Workshops: A Planning and Implementation workshop was held in Woods Hole (22-24 September, 2008) to develop a strategic plan for the first U.S. GEOTRACES section, tentatively planned for late 2010 from Woods Hole to Lisbon. A second Planning and Implementation workshop (1-3 October, 2008; Los Angeles) developed preliminary plans for the second and third U.S. GEOTRACES sections, tentatively in the Pacific Ocean. One section runs from Alaska to Tahiti and the other from Tahiti to Peru.

The report from the Atlantic workshop was quickly revised to produce an implementation plan, which is available via the web:
http://www.whoi.edu/fileserver.do?id=46083&pt=2&p=52929, or at
http://www.geotraces.org/documents/US_GEOTRACES_Atlantic_Impln_23Dec08c_46083.pdf

The Pacific workshop report is also available via the web at:
http://www.geotraces.org/documents/US_GEOTRACES_Pacific_Report_Jun09.pdf

3) The U.S. GEOTRACES SSC met 3-4 June, 2009 at the NSF. Among other topic covered, the US SSC decided that the Tahiti to Peru section would take place before the Alaska to Tahiti section if the two sections could not be run consecutively. A long-range goal is to link the U.S. section from Tahiti to Peru with the combined Australia-New Zealand section running eastward from Northern Australia to produce a complete quasi-zonal section across the southern tropical Pacific Ocean.

4) Proposals from individual scientists seeking to participate in the U.S. GEOTRACES zonal section crossing the North Atlantic were submitted to a NSF deadline 15 February, 2009. A complete count is unavailable, but approximately 20 to 25 proposals were submitted. At the time of this report, funding decisions are still being made concerning those proposals. A small number of additional proposals will be submitted to NSF for a deadline on 15 August, 2009. It is anticipated that all GEOTRACES key parameters will be measured on the North Atlantic section. Representatives from each of the funded projects will create a final section plan at a cruise planning meeting in March, 2010. The cruise dates are not yet set, but the cruise is anticipated to begin sometime between August and November, 2010.



Station locations along the US GEOTRACES North Atlantic cruise track (US GEOTRACES North Atlantic Implementation Plan). Red dots represent stations where full water column sampling is anticipated. Final station locations will be determined by funded investigators at a pre-cruise meeting.