GEOTRACES National Reports (2012)

Australia

Meetings and workshops

- GEOTRACES presentations by Australian scientists at Ocean Sciences 2012 (Salt Lake City, Feb. 2012) and joint Australian–New Zealand Marine Sciences conference (Hobart. July 2012).
- Participation of Tomas Remenyi (University of Tasmania) in the GEOTRACES Data Quality Workshop in Geel (Belgium) in May 2012, funded by the Australian Academy of Science under EU COST Action 0801. Tomas delivered a summary presentation of the skills learnt at the workshop to a small group at the Australian–New Zealand Marine Sciences conference, and at a University of Tasmania seminar.

Cruises

- Participation of Australian team in French-led KEOPS-2 cruise near Kerguelen Islands (Oct./Nov. 2011) (PI: Blain). GEOTRACES-approved process study. Dissolved and particulate trace element studies in naturally iron-fertilised region in the Indian Ocean sector of the Southern Ocean.
- Expression of Interest submitted for shiptime on the new Australian research vessel *Investigator* in 2014-2015. Proposed cruise is the zonal GI05 section (Hobart or Fremantle to Kerguelen Island; exact track to be determined) in the Indian sector of the Southern Ocean (part of a joint Australian-French study?). Difficult getting sufficient interest nationally to complete a full GEOTRACES section (feedback from SSC). Seeking international collaboration. Decision whether to go to a full proposal for that season will be take in late August 2012.
- Preparations underway for GEOTRACES-approved process study SIPEX-2 in the sea ice zone near Casey Station, Antarctica in Sept./Oct. 2012 (ACE CRC leading lab). Multidisciplinary biogeochemistry team to cover some core GEOTRACES parameters.

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. No dedicated national funds available for GEOTRACES activities. Recent departure of Christel Hassler to Europe has decreased the number of active GEOTRACES researchers in the region.

New results

- Preliminary results and continuing analyses from GEOTRACES GP13 cruise (voyage ss2011_v02) in Southwest Pacific Ocean along approximately 30°S.
- Data from Australian cruises GIPY2 (au0703), GIPY3 (au0701), GIPY6 (au0806) and GPpr02 (SS10_v01 PINTS) will be submitted to GDAC for the GEOTRACES Intermediate Data Product later this year.
- Participation and sample analyses of GEOTRACES intercalibration exercises for dissolved (Bruland), particulate (Sherrell) and aerosols (Landing) trace elements (Bowie lab). Data submitted to lead PIs.

Publications

- 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 126 (1-4), 108-113.
- 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 58 (21-22), 2059-2070.
- Bowie A.R., Trull T.W., Dehairs F., 2011. Estimating the sensitivity of the subantarctic zone to environmental change: The SAZ-Sense project. Deep Sea Research II 58 (21-22), 2051-2058.
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- 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 58 (21-22), 2113-2125.
- 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 Part II 58 (21-22), 2094-2112.
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- Remenyi T.A., Nesterenko P.N., Bowie A.R., Butler E.C.V., Haddad P.R., 2011. Fast and sensitive determination of aluminium with RP-HPLC using an ultra-short monolithic column. Analytical Methods 3 (11), 2488-2494.
- Sinoir M., Butler E., Nesterenko P., Bowie A., Mongin M., Hassler C., 2012. Zinc marine biogeochemistry in seawater: a review. Marine and Freshwater Research, in press.
- Tagliabue A., Mtshali T., Aumont O., Bowie A.R., Klunder M., Roychoudhury A.N., Swart S., 2011. A global compilation of over 13,000 dissolved iron measurements: focus on distributions and processes in the Southern Ocean. Biogeosciences 9, 2333-2349, doi:10.5194/bg-9-2333-2012.
- 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 116, G03017, doi:10.1029/2010JG001628.
- Wake B.D., Hassler C.S., Bowie A.R., Haddad P.R., Butler E.C.V., 2012. Phytoplankton selenium requirements: the case for species isolated from temperate and polar regions of the Southern Hemisphere. Journal of Phycology 48(3), 585-594, doi:10.1111/j.1529-8817.2012.01153.x.

Other activities

- Short-term Scientific Mission for Dr. Fanny Chever from University of Brest (France) to ACE CRC (University of Tasmania, Australia) under EU-Cost Action ES0801 (project: "Effect of natural iron fertilization by krill and whales on the Southern Ocean carbon cycle")
- Design specifications for GEOTRACES sampling requirements implemented for new Australian oceanographic research vessel *Investigator* (to be commissioned in mid-2013). In addition, indicative funds for new Marine National Facility equipment for GEOTRACES sampling equipment have been awarded: Laboratory clean container ($85k, cat. 2), Trace-metal rosette ($153k , cat. 2),

In situ pumps ($240k, cat. 3), Trace metal rainwater sampler ($15k, cat. 4). Category 2 and 3 items are likely to be funded (results announced later in 2012).

Submitted by: Andrew Bowie

Belgium

Meetings

- KEOPS 2 pre-cruise workshop, Banyuls, March 2011
- EGU 2012 annual meeting: Session on sensitivity of marine ecosystems, biogeochemical cycles and carbon uptake to global change; talk by Planchon, Cavagna, Cardinal, André & Dehairs: "Late summer carbon export and remineralisation in the Southern Ocean determined from ^{234}Th and particulate biogenic Ba tracers"
- Organisation of the COST-GEOTRACES training school: Are your GEOTRACES data reliable? Institute for Reference Materials and Measurements, Geel, Belgium; 30 May- 1 June 2012 (organisers Damien Cardinal, LOCEAN, Paris VI, Marc Elskens, Vrije Universiteit Brussel, Brussels)

Cruises

- GEOTRACES GP13 (R/V *Southern Surveyor*), Pacific Ocean, May-June 2011: dissolved Ba
- DIAPICNA (R/V *Dom Carlos I*), Azores Current, July-August 2011: Primary Production, N_2 fixation, $\delta^{15}N$, $\delta^{18}O$ nitrate.
- KEOPS 2 (R/V *Marion Dufresne*), Southern Ocean, Kerguelen area, Oct.-Nov. 2011. Primary Production; New production; ^{234}Th-based export and subsurface remineralisation fluxes (excess ^{234}Th, particulate biogenic Ba); $\delta^{15}N$, $\delta^{18}O$ nitrate; dissolved Ba.
- WOCE section I 9 (R/V *Aurora Australis*), Southern Ocean, Nov.-Dec. 2011: dissolved Ba

New funding

- Belgian Science Policy, Science for Sustainable Development programme; "BIoGeochemical cycles in the SOUTHern ocean: Role within the Earth System" (BIGSOUTH); 2011–2014.
- FP7-EUROFLEETS: "DIAzotrophic PIco-Cyanobacteria in the North Atlantic open ocean: their abundance and importance as a source of new nitrogen at the Azores Front/Current" (DIAPICNA); 2011-2014.
- Flanders Research Foundation, "The biological carbon pump and role of diazotrophs in open ocean carbon export"; 2011-2014.

New results

- Dissolved Ba data for the GP13 section in the South-West Pacific; completes the existing data diss. Ba base for the Southern Ocean
- POC export and mesopelagic remineralisation along Greenwich Meridian (Cape Basin–northern Weddell Gyre).
- Estimates of the contribution of N_2 fixation to primary production in Azores Current region
- Primary production, New production, POC export and mesopelagic remineralisation in the (naturally) iron-fertilised Kerguelen area
- Nitrate isotopic composition in oligotrophic Azores Current region and Kerguelen area

Relevant publications

- Hoppema M., F. Dehairs, J. Navez, C. Monnin, C. Jeandel, E. Fahrbach, H.J.W. de Baar, 2010. Dissolved barium distributions in the Weddell Gyre: Impact of circulation and biogeochemical processes, Marine Chemistry, 122,118-129.
- Fripiat F., A.-J. Cavagna, N. Savoye, F. Dehairs, L. André and D. Cardinal, 2011. Isotopic constraints on the Si-biogeochemical cycle of the Antarctic Zone in the Kerguelen area (KEOPS), Marine Chemistry, 123, 11-22.
- Cavagna A-J., F. Fripiat, F. Dehairs, D. Wolf-Gladrow, N. Savoye, L. André and D. Cardinal, 2011. Silicon uptake and supply during a Southern Ocean iron fertilization experiment (EIFEX) tracked by Si isotopes, Limnology and Oceanography, 56, 147-160.
- Fripiat F., K. Leblanc, M. Elskens, A.-J. Cavagna, L. Armand, L. André, F. Dehairs and D. Cardinal, 2011. Summer efficient silicon loop across the Polar Front and SubAntarctic Zones despite contrasted diatom Si-affinity, Marine Ecology Progress Series, 435, 47-61.
- Fripiat F., A.-J. Cavagna, F. Dehairs, S. Speich, L. André, and D. Cardinal, 2011. Silicon pool dynamics and biogenic silica export in the Southern Ocean inferred from Si-isotopes, Ocean Sciences, 7, 1-15, doi:10.5194/os-7-1-2011.
- Jacquet S.H.M., F. Dehairs, I. Dumont, S. Becquevort, A.-J. Cavagna and D. Cardinal, 2011. Twilight zone organic carbon remineralization in the Polar Front Zone and Subantarctic Zone south of Tasmania, Deep-Sea Research II, 58, 2222-2234.
- Bowie A.R., F. B. Griffiths, F. Dehairs and T.W. Trull, 2011. Oceanography of the subantarctic and polar frontal zones south of Australia during summer: setting for the SAZ-Sense study, Deep-Sea Research II, 58, 2059-2070.
- Jacquet S.H.M, P.J. Lam, T.W. Trull and F. Dehairs, 2011. Carbon export production in the Polar Front Zone and Subantarctic Zone south of Tasmania, Deep-Sea Research II, 58, 2277-2292.
- Cavagna A-J., M. Elskens, F. B. Griffiths, S.H.M. Jacquet and F. Dehairs, 2011. Contrasting regimes of productivity and potential for carbon export in the SAZ and PFZ south of Tasmania, Deep-Sea Research II, 58, 2235-2247.
- Bowie A.R., T.W. Trull & F. Dehairs, 2011. Estimating the Sensitivity of the Subantarctic Zone to Environmental Change: the SAZ-Sense project, Deep-Sea Research II, 58, 2051-2058.
- Thomas H., E. Shadwick, F. Dehairs, B. Lansard, A. Mucci , J. Navez, Y. Gratton, F. Prowe, M. Chierici, A. Fransson, T. Papakyriakou, E. Sternberg, L. Miller, C. Monnin, 2011. Barium and Carbon fluxes in the Canadian Arctic Archipelago, Journal of Geophysical Research-Oceans, 116, C00G08, doi:10.1029/2011JC007120.
- Baeyens W., Bowie A., Buesseler K., Elskens M., Gao Y., Lamborg C., Leermakers M., Remenyi T., Zhang H., 2011. Size-fractionated labile trace elements in the Northwest Pacific and Southern Oceans, Marine Chemistry, 126, 108-113.
- Fripiat F., A.-J. Cavagna, F. Dehairs, A. de Brauwere, L. André and D. Cardinal, 2012. Processes controlling the Si-isotopic composition in the Southern Ocean and application for paleoceanography, Biogeosciences, 9, 1-15.
- Cavagna A.-J., F. Dehairs, V. Woule-Ebongué, S. Bouillon, F. Planchon, B. Delille, I. Bouloubassi, 2012. Whole water column distribution and carbon isotopic composition of POC-bulk, cholesterol and brassicasterol from the Cape Basin to the northern Weddell Gyre, Biogeosciences Discussion, 9, 1667-1709.
- Planchon F., A.-J. Cavagna, D. Cardinal, L. André and F. Dehairs, 2012. Late summer particulate organic carbon export from mixed layer to mesopelagic twilight zone in Atlantic sector of Southern Ocean, Biogeosciences Discussion, 9, 1-43.
- Maiti K., K.O. Buesseler, S.M. Pike, C. Benitez-Nelson, P. Cai, W. Chen, K. Cochran, M. Dai, F. Dehairs, B. Gasser, R. P. Kelly, P. Masque, L. Miller, J.-C. Miquel, S. B. Moran, P.J. Morris, F. Peine, F. Planchon, A.A. Renfro, M. Rutgers van der Loeff, P. Santschi, R. Turnewitsch, J.T.

Waples, C. Xu, Intercalibration studies of short lived Thorium-234 in the water column and marine particles, Limnology & Oceanography - Methods, accepted for publication.
- Schmidt S., J. Harlay, A.V. Borges, S. Groom, B. Delille, N. Roevros, S. Christodoulou and L. Chou, 2012. Particle export during a bloom of Emiliania huxleyi in the North-Western Bay of Biscay, Journal of Marine Systems, doi: 10.1016/j.jmarsys.2011.12.005 (in press).

Submitted by: F. Dehairs, M. Elskens, M. Leermakers, W. Baeyens, L. Chou, F. Fripiat,

Brazil

In the period between October 2011 and July 2012 the following activities were undertake:

Investments towards improving the Brazilian participation in oceanographic research
- The Brazilian National Research Council approved support to 5 institutes of S&T in the field of marine science. These institutes are virtual entities formed by scientists of different backgrounds and institutions, whose goal is to foster research activities in oceanography. Funds will be partly used to improve/adapt existing oceanographic ships although it is not certain if these upgrades will allow clean work on board as needed in GEOTRACES.
- The State of São Paulo purchased an oceanographic ship that will be available to several institutions located in the region.
- Laboratories on land have also evolved in terms of infrastructure; however, capacity to determine trace elements determination in seawater must be built.
- The CAPES/MEC/BRAZIL and the Integrated Ocean Drilling Program (IODP) of Ocean Science Division of the National Science Foundation USA are just launching a cooperation program. Although the IODP is not directly related to GEOTRACES, the participation of Brazilian scientists will result in increased competencies in marine sciences.

Activities within GEOTRACES
- Dr. Godoy from PUC-Rio completed the analysis of samples collected during the JC-057 cruise. The analytical work included determination of U, Ba, Mo and δD and $\delta^{18}O$ in seawater samples. The results were presented at the GEOTRACES session in the Montreal Goldschmidt Conference and a manuscript is under preparation for submission to an international journal.
- A 30-min. oral presentation of the program GEOTRACES was performed during the COLACMAR 2012 meeting in Santa Catarina, Brazil. The goal was to disseminate GEOTRACES activities among Latin American scientists and to stimulate their participation in the program and in the LA Workshop.
- Organization of the LA Workshop November 2012 included to this date:
  1- Definition of themes
  2- Identification of possible participants
  3- Invitation letters
  4- Definition of activities during the workshop
  5- Preparation and submission of fund requests to 4 Brazilian financial institutions. Two of them already responded positively
  6- Other organizational business
  7- Setting of an informative page in the GEOTRACES Web site with forms for abstract submission (GEOTRACES IPO)

Submitted by: Angela Wagener.

China

Activities

- A co-operation with Prof. Billy Moore from South Carolina University led to the establishment of a new method for determining $^{224}Ra/^{228}Th$ disequilibrium in coastal sediments.
- A part of China-GEOTRACES was accommodated in China "973" projects. There were several cruises carried out in Chinese marginal seas during 2011. Measurements for dissolved REEs, Al, Mn, As, ^{234}Th, ^{228}Th, ^{228}Ra, ^{226}Ra, ^{224}Ra, ^{223}Ra have been conducted.
- Surface and bottom seawater samples have been collected in Bohai Bay and Laizhou Bay using the peristaltic pumping system. Several dissolved metal concentrations (Cu, Pb, Cd, Zn, Ag, Fe) have been measured.

Capacity building

- The building of a new Research Vessel specified for marine biogeochemistry research in Xiamen University has officially started. The bidding for preliminary design of XMU's new research vessel has been accomplished. The Glosten Associates Inc., a design firm based in Seattle, was the winner of the design tender.

Publications

- Cai P. et al., 2012. Measurement of $^{224}Ra:^{228}Th$ disequilibrium in coastal sediments using a delayed coincidence counter. Marine Chemistry 138-139, 1-6.

Submitted by Pinhe Cai

Croatia

Croatian GEOTRACES activities are mainly related to (1) improvement of electrochemical methods which, in combination with ICPMS, are used for trace metals speciation (including interaction with organic matter), determination and quantification (mostly Zn, Cd, Pb, Cu, Fe, Ni, Co); (2) development of automatic voltammetric monitoring system and solid (gold wire) micro-sensors for on-site and in-situ metal analysis in seawater; (3) assessment of metal bioavailability in aquatic environment using passive samplers for metals (DGT) and cytosolic metal levels in tissues of aquatic organisms. Very recently, we have started research on development of electroanalytical methods for chalcogenide nanoparticles determination in natural waters.

The Croatian GEOTRACES activities of the past year were manly dominated by preparations and organization for the marine voltammetry-themed workshop: "Voltammetry and GEOTRACES", which will be held in Šibenik, Croatia, at the Rudjer Boskovic Institute marine station Martinska, from October 6 to 9, 2012.

Two PhD students applied and obtained funding for STSM in the frame of COST action ES0801 (The Ocean Chemistry of Bioactive Trace Metals and Paleoclimate Proxies) with the subjects:

- "Colloidal trace metal distribution and speciation in estuary waters" (Host: Dr. Ricardo Riso, Université de Bretagne Occidentale, Institut Universitaire Européen de la Mer, France)

- "Determination of trace metal concentrations by ICP-MS in seawater and biological matrices" (Host: Prof. Dr. Andreas Prange, Helmholtz-Zentrum Geesthacht, Department for Marine Bioanalytical Chemistry, Geesthacht, Germany).

One PhD student obtained funding for training on "Modeling of metal speciation in seawater" (Host: Dr. Cedric Garnier, University of Toulon, France). One PhD student participated in a 3-day essential training school on data quality of marine trace elements and isotopes in Geel, Belgium in May. One PhD thesis with the title "Voltammetry of iron(III) complexes with organic ligands involved in natural processes" was defended in December 2011 at the Rudjer Boskovic Institute in Zagreb.

Meetings

Dr. Ivanka Pižeta participated at a meeting in Salt Lake City on 25 February 2012 as a Full Member of SCOR Working Group 139 on Organic Ligands – A Key Control on Trace Metal Biogeochemistry in the Ocean.

Participation at international conferences

- I. Ciglenečki, E. Bura-Nakić, M.Marguš, I.Milanović, N.Batina. A.Avalos-Perez, D.Krznarić: Nanoparticles in aqueous environments: electrochemical, nanogravimetric, STM and AFM studies Goldschmidt 2011 abstract: Mineralogical Magazine, Vol. 75 (3), 2011, 677.
- E. Bura-Nakić, I.Ciglenečki, E. Viollier: Vertical distribution of Fe and S species in anoxic water column of Pavin Lake (France); electrochemical evidence for nanoparticulate FeS Mineralogical Magazine, Vol. 75 (3), 2011, 597.
- I. Ciglenečki, E. Bura-Nakić, M.Marguš, I.Milanović, N.Batina. A.Avalos-Perez, D.Krznarić: "Electrochemical, nanogravimetric, STM, AFM and DLS studies of nanoparticles in aqueous environment", ASC meting San Diego, March 2012.
- E. Bura-Nakić, M. Marguš, I.Milanović, I. Ciglenečki, Amperometric and voltammetric study of FeS nanoparticles, ISE Regional meeting on Electrochemistry, Buckarest May 2012,
- M. Marguš, N. Batina, E. Bura-Nakić, I. Ciglenečki, Electrochemical and STM studies of FeS nanoparticles in NaCl model solutions, ISE Regional meeting on Electrochemistry, Buckarest May 2012.
- I. Ciglenečki, E. Bura-Nakić, I.Milanović,M. Marguš,D. Krznarić,G .Helz,E. Viollier: Environmental electrochemistry as a tool for water quality monitoring: sulfidic and iron rich environment, GRC Environmental Sciences:Water, Holderness school, NH,US, June 2012
- Ž. Strižak, D. Pröfrock, D. Ivanković, Z. Dragun, H. Helmholz, M. Erk, A. Prange: Cytosolic Metal Profile from Digestive Gland of Mediterranean Mussels as a Potential Indicator of Metal Exposure, 50th ESCA Congress, Venice, Italy, June 2012.
- B. Oursel, C. Garnier, G. Durrieu, S. Mounier, D. Omanovic, Y. Lucas: Marseille agglomeration (SE, France), inputs to coastal waters: metal behaviour study in the wastewaters/rivers mixing with sea using voltammetric techniques, 14th International Conference on Electroanalysis (ESEAC12), Portorož, Slovenia, June 2012.
- D. Omanovic, I. Pizeta, C. Garnier. Signal processing and experimental design in electroanalysis, 14th International Conference on Electroanalysis (ESEAC12), Portorož, Slovenia, June 2012.

Publications:

- E. Bura-Nakić, D. Krznarić, G.R. Helz, I. Ciglenečki: Characterization of iron sulfide species in model solutions by cyclic voltammetry. Revisiting an old problem, Electroanalysis, 23(6) (2011) 13762.
- G.R. Helz, E. Bura-Nakić, N. Mikac, I. Ciglenečki: New model for molybdenum behavior in euxinic basins, Chemical Geology, 284 (2011) 323.

- G.R. Helz, I. Ciglenečki, D. Krznarić, E. Bura-Nakić. Voltammetry of Sulfide Nanoparticles and the FeS(aq) Problem // Aquatic Redox Chemistry / Paul G. Tratnyek, Timothy J. Grundl, Stefan B. Haderlein (ur.). Washington, DC : American Chemical Society, 2011. Str. 265-282.
- A. Sakellari, M.Plavšić, S. Karavoltsos, M.Dassenakis, M.Scoullos, Assessment of copper, cadmium and zinc remobilization in Mediterranean marine coastal sediments. Estuar. Coastal Shelf Sci. 91 (2011) 1.
- M. Plavšić, I. Ciglenečki, S. Strmečki, E. Bura-Nakić. Seasonal distribution of organic matter and copper under stratified conditions in the karstic, marine, sulfide rich environment (Rogoznica Lake, Croatia). Estuarine Coastal Shelf Sci. 92 (2011) 277.
- N. Cukrov, S. Frančišković-Bilinski, D. Barišić, B. Hlača, A recent history of metal accumulation in the sediments of Rijeka harbour, Adriatic Sea, Croatia, Marine Pollut. Bull. 62 (2011) 154.
- V. Cuculić, N. Cukrov, Ž. Kwokal, M. Mlakar, Distribution of trace metals in anchialine caves of Adriatic Sea, Croatia. Estuar. Coastal Shelf Sci. 95 (2011) 253-263.
- P-J. Superville, Y. Louis, G. Billon, J. Prygiel, D. Omanović, I. Pižeta, An adaptable automatic trace metal monitoring system for on line measuring in natural waters. Talanta 87 (2011) 85.
- M. Furdek, M. Vahčič, J. Ščančar, R. Milačič, G. Kniewald, Goran, N. Mikac, Organotin compounds in seawater and mussels Mytilus galloprovincialis along the Croatian Adriatic coast, Mar. Pollut. Bull. 64 (2012) 189.
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- M. Plavšić, S. Strmečki, J. Dautović, V. Vojvodić, G. Olujić, B. Ćosović, Characterization and distribution of organic matter using specific physico-chemical methods: a case study of the southeast Adriatic continental and shelf slope (Albania). Continental Shelf Res. 39/40 (2012) 41.
- P. Vukosav, L. Frkanec, M. Mlakar, Voltammetric investigation of iron (III) complexes with siderophore Chrysobactin in aqueous solution, Electrochim. Acta 59 (2012) 479.

Submitted by: Irena Ciglenečki-Jušić

France

Meetings

- GEOTRACES-France organized the 2nd GEOTRACES Mediterranean Workshop (Toulouse, France, 5 October 2011).
- Participation to the GEOTRACES Data-Model Synergy Workshop, Barcelona, 14-18 November 2011 (10 French participants, among them 3 invited talks). Catherine Jeandel was member of the Planning Group for this workshop and she is currently coordinating together with Rob Sherrell the Synthesis Document for this Workshop.
- Participation to the "Traces and Tracers" Special Issue Editorial Board (*Journal of Marine System*s, after the Liège meeting, 2-6 May 2011).
- Organisation of two Pre-GEOVIDE Cruise (GA01 section) Planning Meetings (Brest, France, in July 2011 and April 2012).
- Participation to the COST-GEOTRACES Training School "Are your GEOTRACES Data reliable?" held in Belgium, 30 May- 1 June 2012 (1 French participant).
- GEOTRACES A01 Cruise Proposal Preparation Meeting (Géraldine Sarthou/Catherine Jeandel, Brest, 5 July 2011).
- Several meetings held with French research funding institutions in order to assure French funding for the GEOTRACES International Project Office.

Cruises

- KEOPS II GEOTRACES Process Study: cruise occurred from October 6 to November 26, 2011 (R/V *Marion-Dufresne II*, Kerguelen Plateau at spring time).
- Pandora cruise (GEOTRACES section GP12): cruise starting from Nouméa on June 27, 2012 and ending in Nouméa on August 7 2012, R/V *Atalante* (mixing and evolution of the water masses when transiting through the Solomon Sea).

New funding

- KEOPS II (GEOTRACES process study): fully funded, both for the cruise and for the science.
- Pandora cruise (GP12 section): funding achieved.
- French clean sampling system: achieved and delivered on June 21, 2012 (a bit late for Pandora!).
- France provides funding and offers free office space to host the GEOTRACES International Project Office.

Selected Publications

- Bown, J., Boye, M., Baker, A., Duvieilbourg, E., Lacan, F., Le Moigne, F., Planchon, F., et al. (2011). The biogeochemical cycle of dissolved cobalt in the Atlantic and the Southern Ocean south off the coast of South Africa. Marine Chemistry, 126(1-4), 193-206. DOI: 10.1016/j.marchem.2011.03.008
- Cossa, D., Heimbürger, L.-E., Lannuzel, D., Rintoul, S. R., Butler, E. C. V., Bowie, A. R., Averty, B., et al. (2011). Mercury in the Southern Ocean. Geochimica et Cosmochimica Acta, 75(14), 4037-4052. DOI: 10.1016/j.gca.2011.05.001
- Dencausse, G., Arhan, M., & Speich, S. (2011). Is there a continuous Subtropical Front south of Africa? Journal of Geophysical Research, 116(C2). AMER GEOPHYSICAL UNION. DOI: 10.1029/2010JC006587
- Faure, V., Arhan, M., Speich, S., & Gladyshev, S. (2011). Heat budget of the surface mixed layer south of Africa. Ocean Dynamics, 61(10), 1441-1458. DOI: 10.1007/s10236-011-0444-1
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Submitted by Catherine Jeandel.

Germany

The GEOTRACES activities in Germany over the past year were marked by continuing work on samples attained on previous cruises and publication of results from IPY expeditions, GEOTRACES section cruises, and the international intercalibration effort. Scientists from GEOMAR participated in the Baltic Sea GEOTRACES cruise (Roland Stumpf, Tianyu Chen).

Tobias Roeske successfully defended his PhD thesis on "Dissolved Barium and particulate Rare Earth Elements as tracers for shelf-basin interaction in the Arctic Ocean" (University of Bremen, November 2011).

Progress was made with the acquisition of a German clean sampling system at GEOMAR (Martin Frank and Eike Breitbarth). A complete clean rosette with CTD and 27 OTE-GOFLO-bottles has been purchased and was delivered in June 2012. The acquisition of a clean van is in its final stages and currently the purchase of a mobile winch is in preparation.

Meetings

- GEOTRACES Arctic cruise planning meeting, Alfred-Wegener Institute, Bremerhaven, April 18-20, 2012 (organized by Michiel Rutgers van der Loeff, funded by COST-Action ES0801).

New Funding

- R/V *Sonne* Transit cruise South Korea-Fiji, Sept.-Oct. 2012, for the collection of seawater and sediment samples for Nd isotope and REE analyses (Katharina Pahnke, funded by the BMBF, German ministry for education and research).

New Results

- Seawater $^{143}Nd/^{144}Nd$ profiles from the South Pacific, samples collected during R/V *Polarstern* expedition ANTXXVI-2 (no GEOTRACES cruise) (Katharina Pahnke, Chandranath Basak, MPI and University of Oldenburg, presented at Goldschmidt 2012).
- Seawater dissolved $^{231}Pa/^{230}Th/^{232}Th$ profiles from the NW Atlantic (*Pelagia* Cruises GA02 leg 1 and 2) (Sven Kretschmer, AWI, presented at Goldschmidt 2012).

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Submitted by: Katharina Pahnke

Greece

There were several GEOTRACES-related activities in Greece the last year (June 2011-2012).

Meetings

- Two young scientists, Dr. Theodosi Christina and Ms. Nicolaou Panagiwta, from University of Crete attended the 3-day training school on data quality of marine trace elements and isotopes held from 30 May until 1 June 2012 at the Institute for Reference Materials and Measurements in Geel, Belgium.
- Prof. Mihalopoulos Nikolaos from University of Crete attended the annual COST meeting held in Alexandroupolis (Greece, 20-22/7) and presented the ES0801activities on behalf of the consortium.

New funding

- A consortium of Greek scientists from University of Crete and Hellenic Center of Marine Research (HCMR), granted an amount of 600K euros from Greek government in the frame of THALIS projects, to study the role of Aeolian deposition as a source of micronutrients and its impact on marine productivity of the Eastern Mediterranean. To achieve the aims, results from long-term monitoring of nutrients and trace metals at Finokalia sampling site, a regional background station, will be used (www.finokalia.chemistry.uoc.gr).

Other activities

- Within the framework of the Crete mesocosm facilities, an international consortium composed by scientists from Israel, Turkey, UK, France and Greece (University of Crete, HCMR, University of Athens) studied the changes in dissolved and particulate abiotic components and the impact of dust on the autotrophic and heterotrophic surface microbial populations during a transitional spring season that is characterized by high inputs of dust events.

Submitted by: Nikos Mihalo

India

All the nine projects of GEOTRACES (India) have initiated work to achieve the goals of GEOTRACES programme. A cruise onboard *Sagar Sampada* was conducted in the Arabian Sea. Initially, this cruise was planned to follow GIO2 track along 65°E, however, due to security threat from pirates, it followed 68°E from 1°N to 21°N. Water samples at various stations were collected for measuring isotope compositions of Nd, Hf ,Th and Ra. In addition, chemical composition of the ambient aerosols over the Arabian Sea were measured online and aerosol samples were collected for their source determination.

As far as clean sampling is concerned, we have already acquired a CTD, bottles etc. We expect to get the clean van within the next 15 days. Winch and cables are expected to come within next two to three months. The entire system should be operational by the end of this year.

Nd isotope compositions in water columns of the Bay of Bengal along the 87°E transect were analysed. Results display significant contribution of non-radiogenic Nd from the Ganga and the Brahmaputra river systems to the Bay of Bengal water. 10 to 65% of the dissolved Nd in the BoB is contributed by its release from particulate matters or from shelf sediments (Excess Nd, Figure 2). This study emphasises the important role of boundary exchange in contributing to the dissolve Nd budget of the global oceans.

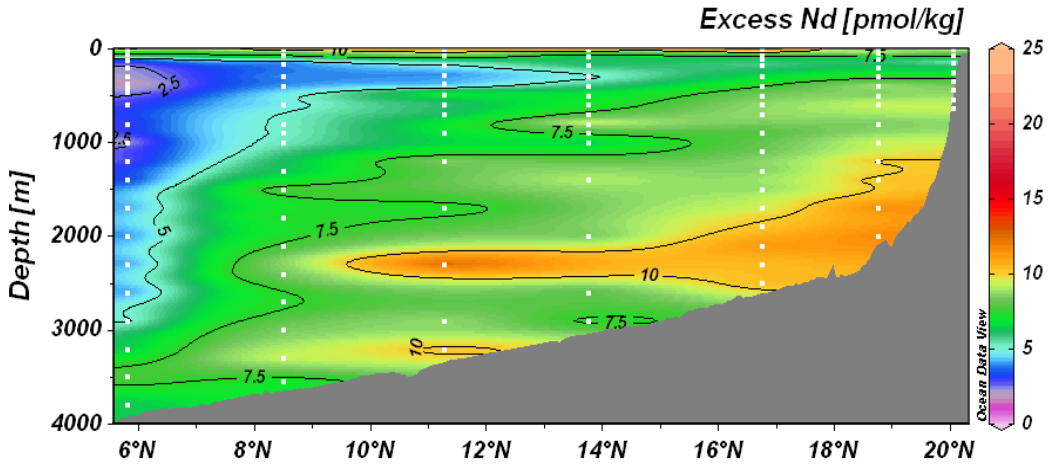

Figure 2. *Dissolved Nd released from particulate matter in the water columns of Bay of Bengal*

Publications

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Completed Cruise

- Arabian Sea: Cochin – Goa, April- May, 2012: along 68° E from 1° N to 21° N
  Basic Objectives of this cruise were:

  (i) online measurement of chemical constituents of the ambient aerosol and collecting aerosol samples to determine their sources using isotopes,
  (ii) collecting water samples for measuring Nd, Th, Hf, Ra, and stable isotopes.

Planned Cruise

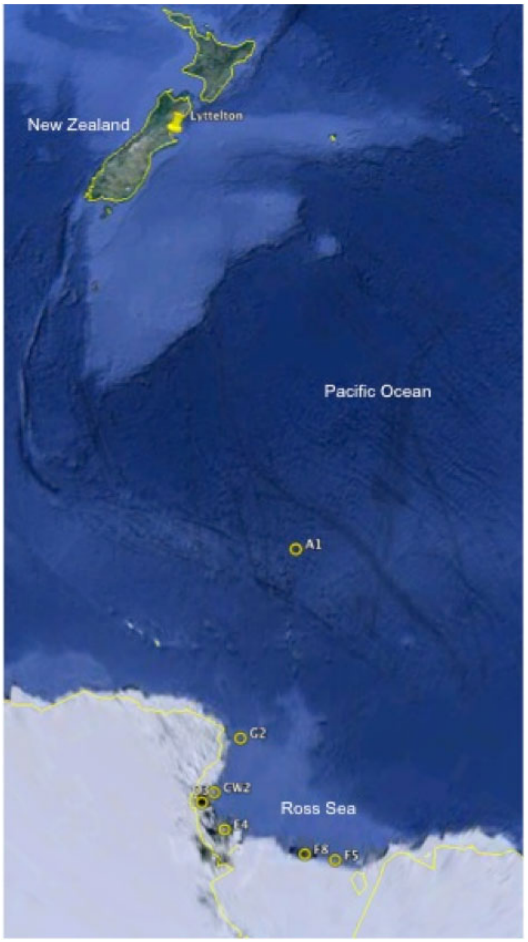
- Indian Ocean: Chennai-Australia-Chennai: March to May 2013, onboard *Sagar Kanya*.

Submitted by: Sunil Kumar Singh

Italy

Cruises, sampling activities

- Gabriele Capodaglio (DAIS, Ca' Foscari University, Venice) and Clara Turetta (IDPA-CNR, Venice)



Ross Sea-Antarctica. Seawater samples were collected during the XXVII Italian Expedition in Antarctica (R/V *Italica*) in the Ross Sea to determine trace elements (Figure 3). The sampling cruise was funded by the Italian National Research Program in Antarctica (PNRA). Seawater was collected using a rosette equipped by 24 Niskin bottles (12 L) and 20L GO-FLO bottles for comparison. Samples were immediately transported in the mobile clean (class 100) laboratory available on board, filtered, and collected in clean LDPE bottles, and stored frozen at −20°C for transport to Italy without any additional treatment.

All samples will be analysed at IDPA-CNR/Ca' Foscari University laboratory to determine trace element and Rare Earth Element (REE) concentrations by ICP-SFMS (Element2, Finnigan-MAT, Bremen, Germany) after sample dilution and acidification following the methodology developed in our laboratory.

Figure 3: *Sampling sites of XXVII PNRA oceanographic survey. The analyses will be performed in the next months. Results of trace element determinations from previous sampling survey in the Ross Sea have been published.*

- Paolo Montagna (ISMAR-CNR, Bologna)

Mediterranean Sea. Seawater samples for Nd isotopes were collected during the cruise Medcor (2009, R/V *Urania*) in the Siculo-Tunisian Strait and cruise Arcadia (2010, R/V *Urania*) in the Southern Adriatic Sea (Figure 4). Both cruises were led by Marco Taviani (ISMAR-CNR, Bologna) and funded by the Italian National Research Council and the FP7 projects Hermes and Hermione. The cruises were primarily devoted to sampling seawater and biogenic carbonates for proxy calibration.

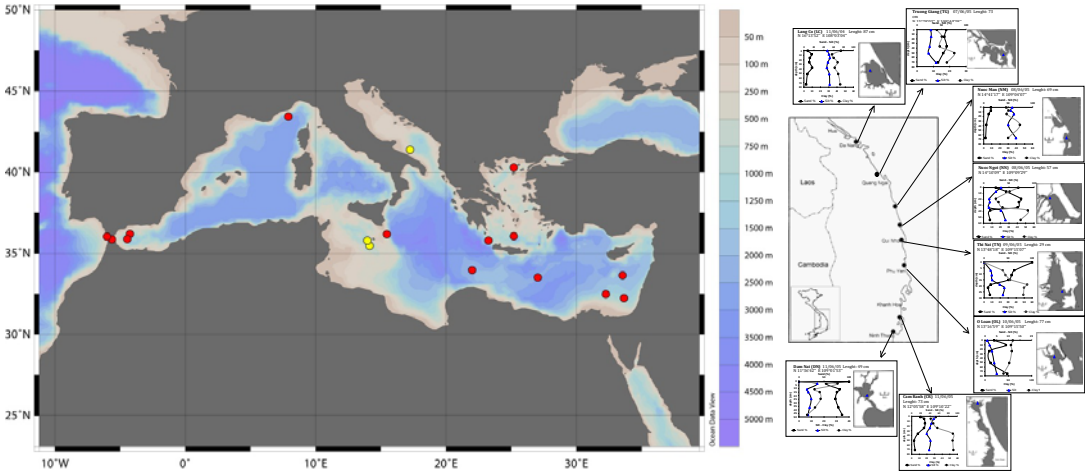
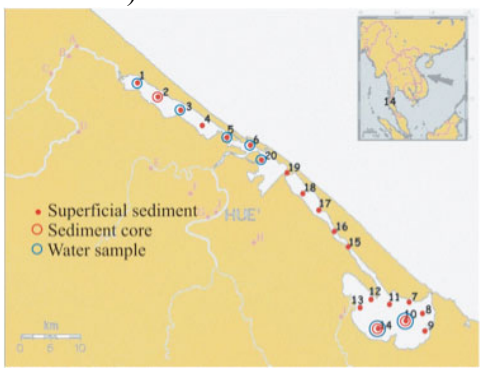


Figure 4: *locations of all the Mediterranean stations with εNd data (red circles: stations with published values; yellow circles: cruises Medcor in the Siculo-Tunisian Strait and Arcadia in the Adriatic Sea; Montagna et al., unpublished data).*

Ten-litre filtered (AcroPak 500 cartridge) seawater samples were drawn into pre-cleaned cubitainers from 12L Niskin bottles attached to the ship's rosette, acidified to pH = 2, sealed with parafilm and stored with double bag before sending to the laboratory.

All the seawater samples were analysed at LDEO (Columbia University) as part of the Marie Curie IOF project coordinated by Paolo Montagna in collaboration with Prof. Steve Goldstein (LDEO, Columbia University) and Dr. Norbert Frank (LSCE, Gif-sur-Yvette). Neodymium isotopes were measured as NdO^+ on a Micromass Sector 54-30 thermal ionization mass spectrometry by dynamic multicollection after Nd pre-concentration with ferric hydroxide and extraction using Eichrom RE-spec resin and α-HIBA acid and cation resin.

- Clara Turetta (IDPA-CNR, Venice) and Gabriele Capodaglio (DAIS, Ca' Foscari University, Venice)



Vietnam Lagoons. Seawater and sediment samples were collected from several Vietnamese lagoons in the framework of a Vietnamese-Italian Cooperative Project. Water samples were collected using a metal-free pump and immediately filtered by single-use filter (PTFE membrane, pore size 0.20 μm), acidified (2% with ultrapure HNO_3) and stored refrigerated until the analysis. Sediment samples were kept frozen until the arrival in the laboratory, then were freeze-dried and homogenized before analysis.

All the analyses were performed at IDPA-CNR/Ca' Foscari University laboratories to determine trace element and Rare Earth Element (REE) concentrations by ICP-SFMS (Element2, Finnigan-MAT, Bremen, Germany) for water analysis and by ICP-QMS (Agilent 7500) for sediment analysis.

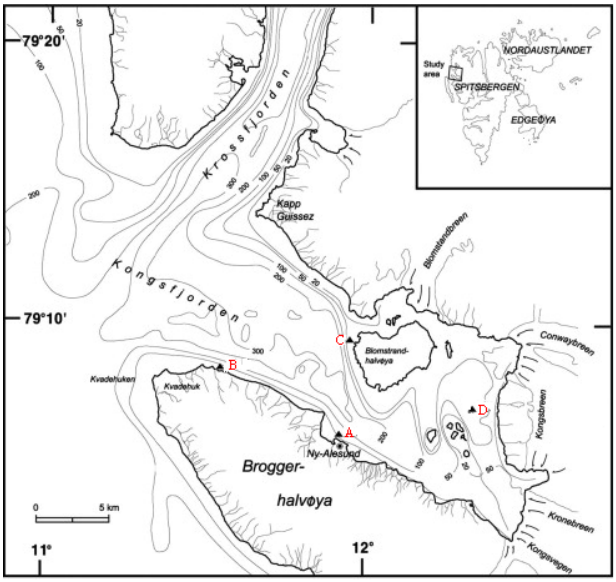
- Clara Turetta (IDPA-CNR, Venice)

Adriatic Sea. Seawater samples were collected along the northwestern coast of the Adriatic Sea, from the Adige River mouth to Venice Lagoon, during a seasonal sampling survey in the framework of Q-ALiVe Project funded by the Regione Veneto (Italy, L.R. 15/2007) to recognise the input from rivers and lagoon. Samples were preserved refrigerated until the arrival in laboratory where were filtered in the clean-room (Class 100) of IDPA-CNR, diluted and acidified for analysis.

Samples were analysed to determine the concentration of trace elements and REEs by ICP-SFMS (Element2, Finnigan-MAT, Bremen, Germany) following the methodology developed in our laboratory.

- Clara Turetta (IDPA-CNR, Venice)

Artic Sea (Ny Alesund). Seawater samples were collected in the Kongsfjorden (Ny Alesund, Norway) in the framework of PRIN09 Project, funded by Italian Ministry of Education, University and Research (MIUR). The sampling survey was devoted to characterise different sites with different glacial run-off and antrophic impact. The same sites will be re-sampled in August and the samples will be analysed to determine the REE content. Sample analyses will be performed by means of ICP-SFMS (Element2, Finnigan-MAT, Bremen, Germany) after dilution and acidification following the methodology developed in our laboratory.



Meetings

- Paolo Montagna (ISMAR-CNR, Bologna) attended the GEOTRACES Mediterranean Planning Workshop, which was held in Nice (France) on 4-6 October 2010. Paolo Montagna presented the Nd isotopic values for seawater and biogenic carbonates collected in the Mediterranean Sea.
- Andrea Spolaor (IDPA-CNR, Venice) attended the Liege Colloquium, Liege (Belgium), 2-6 May 2011.
- Paolo Montagna (ISMAR-CNR, Bologna) attended the GEOTRACES Mediterranean Cruise Planning Workshop, which was held in Toulouse in September 2011 and discussed the possibility to submit a proposal to CNR to allocate ship time with R/V *Urania* for a GEOTRACES transect in the Central Mediterranean Sea.

Publications

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- Montagna P., Goldstein S., Taviani M., Frank N. (2010). Neodymium isotopes in biogenic carbonates: reliable archives of seawater eNd. GEOTRACES Mediterranean Planning Workshop, 4-5 October 2010, Nice (France).
- C. Turetta, C. Barbante, G. Capodoglio, A. Gambaro, P. Cescon. "The distribution of dissolved thallium in different water masses of the western sector of the Ross Sea (Antarctica)". Microchemical Journal, 96 (2) 194-202, 2010.
- S. Romano, C. Mugnai, S. Giuliani, C. Turetta, N.H. Cu, L.G. Bellucci, D.H. Nhon, G. Capodaglio, M. Frignani. "Metals in Sediment Cores from Nine Coastal Lagoons in Central Vietnam". American Journal of Environmental Sciences, 8 (2), 130-142, 2012.

Submitted by: Clara Turetta

Japan

Summary

Japan GEOTRACES has been steadily progressing this last year, although Japan is in a very difficult situation after the 11 March disaster. In the coming years, Japanese GEOTRACES expertise should be brought to bear to making the most of this unintentional, globe-spanning experiment.

During the second ASIAN GEOTRACES cruise by the R/V *Hakuho Maru* (KH-11-07), the radionuclides released from the Fukushima Nuclear Plant were assessed. These are becoming remarkable as new tracers for environmental assessment; some of the work during the associated cruise was intended to lay a solid foundation for using these tracers in the future. The next *Hakuho Maru* zonal cruise along 47°N in the North Pacific (GP02) will sail in late August 2012. A new 1400-ton ship is being built now and will be available in late 2013.

Meetings

- A national GEOTRACES symposium was held on 8-9 March 2012, at AORI, Chiba. Twenty two talks were given; recent research activities of GEOTRACES and future research/cruise plans were discussed by 45 participants.

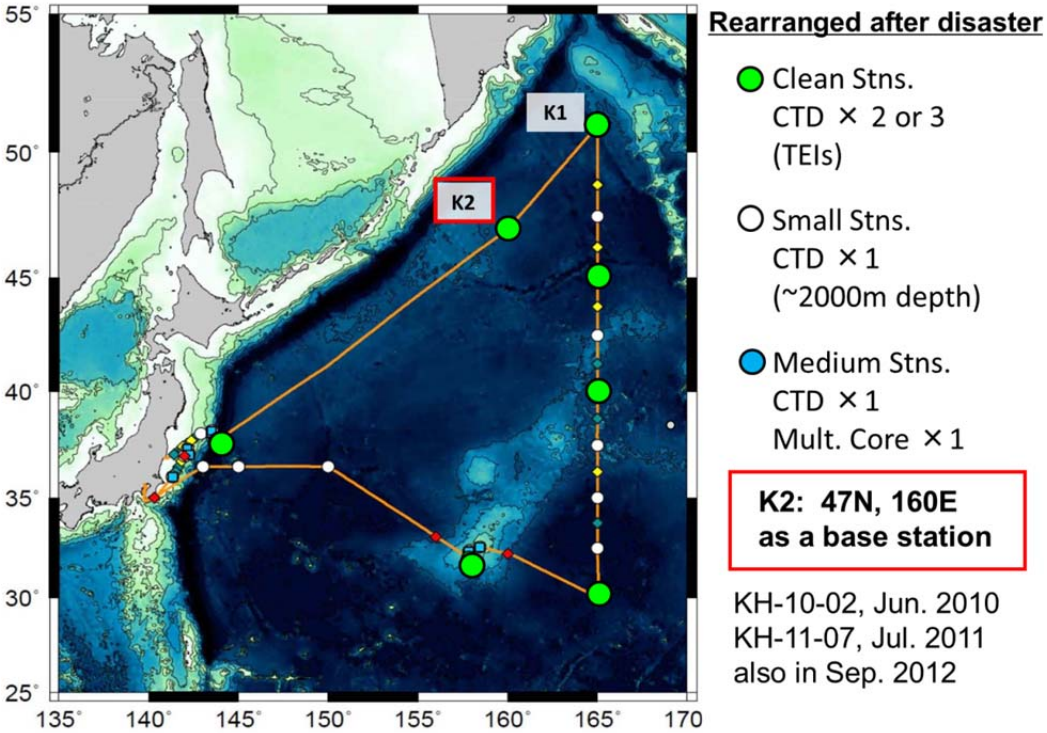

Figure 5: *R/V Hakuho-Maru KH11-07 Cruise Plan (Jul16-Aug04)*

Cruises completed

- KH-11-07 cruise by the R/V *Hakuho Maru* (Figures 5 and 6).

The Japanese GEOTRACES cruise (GP18), "Marine biogeochemical studies and behavior of trace elements and isotopes in the Western North Pacific", 16 July–4 August 2011 (PI: J. Zhang), was completed. Because of the 11 March disaster, the original cruise plan of GEOTRACES section GP18

was modified: the section on 165°E was with lower resolution for GEOTRACES, and the focus shifted to process studies, including those focusing on cold seep biogeochemistry and earthquake mechanisms/ocean radionuclide impact studies off NE Japan and Fukushima area, as well as GEOTRACES. The clean stations covered the clean work and key parameters of GEOTRACES. A total of 31 scientists, graduate students took part in the cruise to pursue international/regional collaborative studies on GEOTRACES. These scientists came from eighteen institutions in four countries. There were 30 individual projects, including GEOTRACES and related projects. As during the previous KH-10-2 cruise in 2010, we conducted a water sampling workshop for more than forty chemical analyses, to educate young scientists from Asia, and four seminars (Science Coffee in *Hakuho-Maru*).

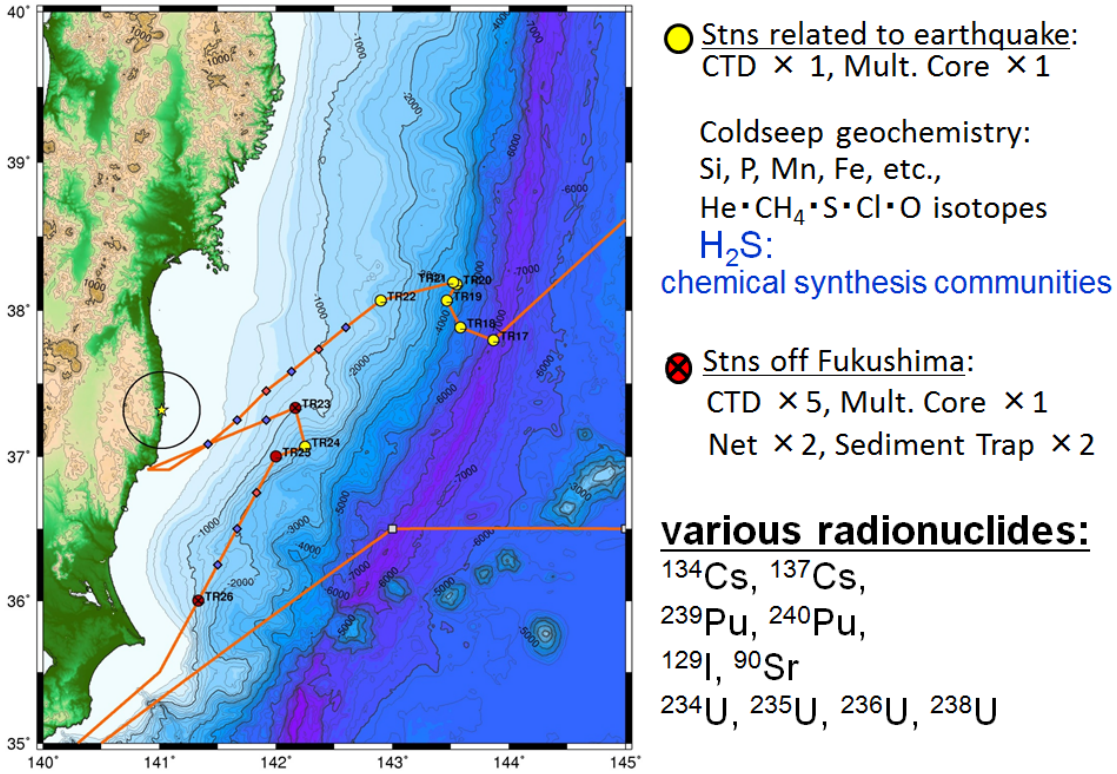

Figure 6: *Observations off Fukushima and NE Japan*

Coordinating Activities

- During the 2012 ASLO Aquatic Sciences Meeting, tentative agreements between several east Asian countries (Jing Zhang, Yoshiki Sohrin, Min-Han Dai and Tung-Yuan Ho) were made to coordinate activities of the regional GEOTRACES studies in the regional marginal seas. In the upcoming 2015 field effort in the East China Sea, Japan, China, and Taiwan will run simultaneous cruises to complete the regional GEOTRACES sections. These activities strengthened the cooperation of the Asian regional marine biogeochemical and ocean/environmental sciences community.

Cruise Planning:

- Cruise by the R/V *Hakuho Maru*.

GEOTRACES section GP02, zonal GEOTRACES cruise in the North Pacific along 47°N (Figure 7) from Tokyo to Vancouver (August 23–October 3, 2012) (PI: T. Gamo) will sail soon. There will be 33 participants from 15 institutions in four countries.

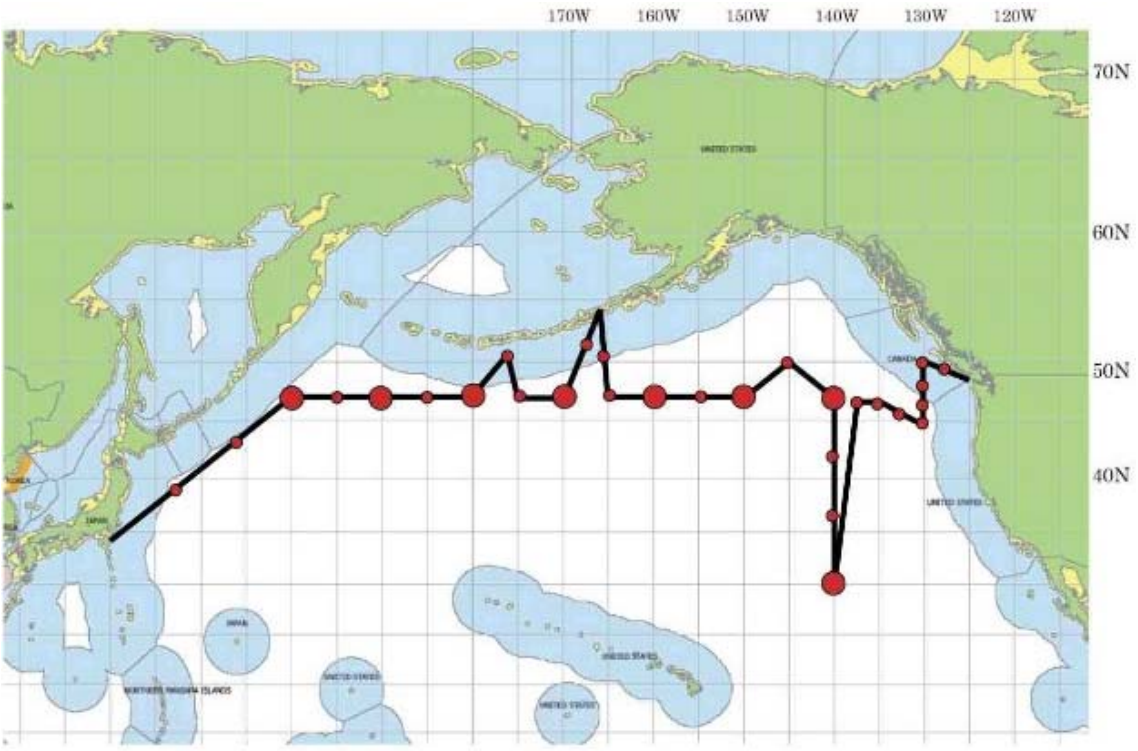

Figure 7: *R/V Hakuho-Maru KH12-04 Cruise Plan (Aug 23-Oct 03)*

Future Cruises:

- Cruises by R/V *Hakuho Maru*.
  - GEOTRACES section GP10 and GP19, meridional GEOTRACES cruise in the Pacific, planned for winter 2014 (PI: T. Gamo).
  - GEOTRACES section GP06, regional GEOTRACES cruise in the East China Sea, planned for fall 2015 (PI: J. ZHANG).

New ship building

- After 11 March, a 1400-ton new ship R/V *Shinsei-maru* was commissioned on a "fast-track" production schedule. It will have a large deck area for eight containerized laboratories including clean rooms, ten winches including clean Kevlar winch, etc. Acceptance testing will start in summer and training cruises in late 2013.

Submitted by: Jing Zhang

Mexico

Meetings

Two oral presentations by Mexican participants were given in the Third GEOTRACES Model-Synergy Workshop (November 13-17, 2011, Barcelona, Spain).

Two poster presentations devoted to marine trace element biogeochemistry, related to GEOTRACES program were presented on the 11th International Conference on the Biogeochemistry of Trace Elements (July 3-7, 2011, Florence, Italy).

Cruises

R/V *Francisco de Ulloa* (CICESE, Ensenada, Mexico) was used to deploy an automated sediment trap in Soledad (San Lázaro) Basin located in the Gulf of Ulloa, west off Baja California peninsula, as well as another automated sediment trap in the Alfonso Basin (La Paz Bay, south-western Gulf of California) to collect settling particulate matter for further major and trace element analyses and vertical particulate element fluxes calculation. Both traps were programmed for July 2011–August 2012 time series.

R/V *Río Suchiate* (Mexican Navy) was used in September and October 2011 in the western Gulf of California, in front of Santa Rosalía copper mining region to collect surface sediments and sediment cores. These samples are necessary for geochemical studies of heavy metal pollution of the marine environment occurred as a consequence of ancient mining, as well as for the assessment of the combined impact of anthropogenic sources and water column oxygen minimum zone influence on the geochemistry of redox-sensitive trace elements with special attention to uranium and lanthanides.

New funding

There is no direct funding for GEOTRACES activities in Mexico. However, GEOTRACES-related projects obtained financial support from CONACyT (Mexican Council for Science and Technology) fundamental research fund. Limited financial support for the research and educational centers in the National Polytechnic Institute of Mexico system is also available.

Ongoing projects

a) CONACyT funding:

1. "Biogeochemistry of trace metals in the southern part of the Southern California Bight: a region influenced by the California Current, upwelling and anthropogenic inputs". Multidisciplinary project awarded to Universidad Autónoma de Baja California, Mexico with the funding of $2,500,000 pesos (P.I.- Dr. Francisco Delgadillo-Hinojosa; duration: 2010-2013).

Many trace metal distributions in the water column of the coastal zone are strongly controlled by biological (e.g., photosynthesis, respiration) and physical (e.g., upwelling, horizontal transport, vertical mixing) processes. However, in some cases, anthropogenic inputs of metals from adjacent land masses may be more significant than natural sources and processes. Consequently, the relative contributions of those natural and anthropogenic processes need to be determined in order to resolve their influence on trace metal concentrations in neritic or coastal waters, as well as their fluxes to oceanic waters. This proposal is designed to distinguish the impact of natural and anthropogenic inputs of selected trace metals (Fe, Cd, Mn and Cu) into the southern part of the Southern California Bight (SSCB), a region which is influenced by the California Current, seasonal upwelling, and relatively constant anthropogenic inputs from the Mexican city of Ensenada. The main aims of this project are (1) to determine the spatial distribution and seasonal variability of Fe, Mn, Cu and Cd concentrations in the water column and sediments in the SSCB; and (2) to identify and quantify the fluxes associated with the different sources of these metals (atmospheric, benthic and anthropogenic) to the SSCB.

2. "Atmospheric fluxes of bioactive metals and their solubility in the Gulf of California: a scene towards climate change". Multidisciplinary project awarded to Universidad Autónoma de Baja California, Mexico, with the funding of $3,619,000 pesos (P.I.- Dr. José A. Segovia-Zavala; duration: 2012-2015).

Atmospheric deposition of macronutrients and micronutrients sets important controls on marine ecology and biogeochemistry. Atmospheric fluxes have been varying during time due to climate

change and human influences. Contemporary patterns of marine biogeochemistry may to some degree reflect variations in time of the atmospheric input of nutrients. Modeling studies suggest that changes in climate and land-use practices over recent decades may have altered dust fluxes and thus aeolian contributions to open ocean regions affecting the ocean biogeochemistry. It has been demonstrated that atmospheric contribution of bioactive metals (e.g., Fe and Mn) towards the open ocean is capable to modulate the marine biogeochemistry and productivity, as well as the sequestration of CO_2 from the atmosphere towards the ocean. Surprisingly, despite its importance, the role of the aerosols in the biogeochemical cycles of the trace elements in the oceanic margins has not been adequately evaluated. These limits include estuaries, continental shelves, and marginal seas, which are regions that generate an important fraction of primary organic productivity. Especially, the Gulf of California (GC), one of the most productive semi-enclosed seas of the world, has not been sufficiently studied from the perspective of the biogeochemistry trace metals, including important bioactive elements such as Fe, Mn, Co and Cu. Therefore, the main goals of this project are (1) to determine the spatial distribution and seasonal variability of atmospheric fluxes of particles and associate metals (Fe, Mn, Cu and Co), as well as to identify processes that control the concentration of these trace elements in the surface layer of this enclosed sea; (2) to evaluate the natural contributions of metals from the surrounding deserts, its solubility in the surface layer and its impact on the GC primary organic production; and (3) to generate a conceptual model that will allow to design scenarios of possible impact produced by the intensification of El Niño and La Niña phenomena, which increase with climate change. The expected results would help designing managing and conservation strategies for productive seas of Mexico and other parts of the world.

b) Funding from “Secretaría de Investigación y Posgrado” of the National Polytechnic Institute of Mexico (Instituto Politécnico Nacional).
1. Multidisciplinary project “Geochemical and ecotoxicological evaluation of the contamination state by heavy metals of the coastal environment of Santa Rosalía mining region (Southern Baja California)”, with the funding of $750,000 pesos (P.I.- Dr. Evgueni Shumilin; duration: 2011-2012)

New results

Scientific highlights

The geochemical behavior of As, Hg, and other trace elements from geothermal sources in the shallow marine ecosystem of the Santispac mangroves and lagoon, as well as the Mapachitos shallow submarine hydrothermal area of the Concepción Bay (western Gulf of California) was characterized. The obtained data show that intertidal geothermal springs and hydrothermal vents are the main source of As and Hg in water, sediment, and algae of the Santispac area of the bay. Arsenic remained largely in the dissolved fraction. This element spread a longer distance from the source and precipitated only in the close vicinity of a hot spring or hydrothermal vent. In contrast to As, Hg was rapidly deposited in sediments near the discharge point and did not contaminate the surrounding area waters. The organic, sulfide-rich sediments, sequestered some quantities of the mentioned elements, while the rest of these escaped with tidal waters to the lagoon and adjacent part of the Concepción Bay. The brown seaweed *Sargassum sinicola* from the intertidal hot springs of the Santispac bight area, accumulates large quantities of As (168 mg kg^{-1}), and is also enriched in Cs, Ge, Hg and Sb. The *Sargassum sinicola* collected near hydrothermal vents displays larger quantities of As (above 600 mg kg^{-1}), surpassing its common concentration in the genus *Sargassum* by an order of magnitude. In contrast to As, the seaweed does not significantly accumulate Hg.

M.S. and Ph.D. theses related to local "GEOTRACES" problems.

Choumiline K., 2011. Geochemistry of settling particulate matter and recent sediments of Alfonso Basin, La Paz Bay". M.S. Thesis. Centro Interdisciplinario de Ciencias Marinas - Instituto Politécnico Nacional, La Paz, Baja California Sur, Mexico, 143 p (in Spanish).

Posada Ayala I.H., 2011. Environmental geochemistry of the San Antonio mining district, sediments of the arroyos of San Juan de Los Planes Basin and continental shelf of the La Ventana Bay, Baja California Sur, Mexico. M.S. Thesis. Centro Interdisciplinario de Ciencias Marinas - Instituto Politécnico Nacional, La Paz, Baja California Sur, Mexico, 211 p (in Spanish).

Vázquez Figueroa V., 2011. Geochemical characterization of the surficial marine sediments of the Wagner and Consag Basins, Northern Gulf of California". Universidad Nacional Autónoma de México (UNAM), Mexico City, Mexico (in Spanish).

Renteria Cano M., 2011. Trace elements in the zooplankton of the northern and central parts of the Gulf of California. Ph.D. Thesis. Centro Interdisciplinario de Ciencias Marinas - Instituto Politécnico Nacional, La Paz, Baja California Sur, Mexico, 193 p (in Spanish).

Leal Acosta, M.L., 2012. Influence of geothermal and hydrothermal sources on the biogeochemistry of trace elements in Concepción Bay, Gulf of California. Ph.D. Thesis. Centro Interdisciplinario de Ciencias Marinas - Instituto Politécnico Nacional, La Paz, Baja California Sur, Mexico, 328 p (in Spanish).

Publications

Journal articles

Rentería-Cano M.E., Sánchez-Velasco L., Shumilin E., Lavín M.F., J.Gómez-Gutiérrez, 2011. Major and trace elements in zooplankton from the Northern Gulf of California during summer. Biological Trace Element Research, 142: 848-864.

Segovia-Zavala J.A., Delgadillo-Hinojosa F., Lares-Reyes M.L., Huerta-Diaz M.A., Munoz-Barbosa A., Santa María del Angel E., Torres-Delgado E.V. and S.A. Sanudo-Wilhelmy, 2011. Vertical distribution of dissolved iron, copper, and cadmium in Ballenas Channel, Gulf of California. Ciencias Marinas, 37 (4 A): 457-469.

Shumilin E., Gordeev V., Rodriguez Figueroa G., Demina L., K.Choumilin, 2011. Assessment of geochemical mobility of metals in surface sediments of the Santa Rosalía mining region, western Gulf of California. Archives of Environmental Contamination and Toxicology. 60:8-25.ISSN: 0090-4341.

Shumilin E., Rodríguez-Figueroa G., Sapozhnikov D., Yuri Sapozhnikov Yu. and K. Choumiline, 2012. Anthropogenic and authigenic uranium in the marine sediments of the Central Gulf of California adjacent to the Santa Rosalía mining region. Archives of Environmental Contamination and Toxicology. DOI : 10.1007/s00244-012-9776-1.

Shumilin E., Rodríguez Figueroa G., Sapozhnikov D. and N. Mirlean, 2012.Vertical profiles of cobalt and zinc in the marine sediments of the Gulf of California in front of the Santa Rosalía mining region, Mexico. J. Iberian Geology (accepted).

Other activities

During the interaction by correspondence and exchange of ideas between the Mexican researchers who wish to participate in GEOTRACES activities, the following specific interests and challenges of the forming "GEOTRACES-Mexico" national programme were defined:

1. Coastal studies are of most importance at the present moment due to increasing anthropogenic impact.
2. Geothermal and hydrothermal inputs of trace elements into the marine environment and their impact on the related ecosystems are under-estimated and/or under-investigated.
3. The need of training the scientific and technical personal of Mexico in the reliable determination of the key trace elements and isotopes (TEIs) in estuarine and sea waters under clean conditions suggests the search of scientific advising from the principal participants of the GEOTRACES international programme, as well as further involvement in the intercalibration activities.
4. The participation of the representatives of Mexico in international R/V cruises in the Pacific and Atlantic oceans is strongly desired, especially in those devoted to the distribution and source determination of TEIs from the deep submarine hydrothermal fields off northwestern Mexico; as well focusing on the importance of redox-sensitive TEIs in the Oxygen Minimum Zone, which extends from the Northern Chile and Peru zones to the Mexican part of the Pacific Ocean.

Submitted by: Evgueni Choumiline

The Netherlands

The Dutch GEOTRACES project aimed to map the distribution of important trace elements and isotopes (PI: Hein de Baar) and to investigate the deep-sea microbiology (PI: Gerhard Herndl) in the West Atlantic Ocean. In addition, Gerhard Herndl is involved in bioGEOTRACES together with Penny Chisholm (MIT) and Julie LaRoche (now at Dalhousie University). In 2011/2012 our work focused on (1) the compilation and analysis of the data collected in the western Atlantic Ocean in 2010 and 2011, (2) the preparation of a cruise for August 2012 to cover stations we missed due to storms during the first western Atlantic leg, and (3) preparation meetings and proposals for GEOTRACES cruises in the Mediterranean Sea (planned in 2013), the Black Sea (planned in 2013), the Arctic Ocean and Laptev Sea (planned in 2015) and across Fram Strait (up to the Greenland coast) and from Svalbard to the Norwegian coastline (planned in 2016).

Meetings

- Planning of Mediterranean GEOTRACES: Micha Rijkenberg attended the Mediterranean GEOTRACES workshop on 5 October 2011 in Toulouse, France, hosted by Laurent Coppola and Catherine Jeandel to discuss GEOTRACES activities in the Mediterranean and Black seas.
- Ocean Sciences 2012 conference in Salt Lake City, Utah, USA: Micha Rijkenberg, Rob Middag, and Stephanie Owens chaired 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”.
- Barcelona post-cruise meeting NIOZ GEOTRACES cruises leg 1, 2 & 3: 29-30 September 2011, hosted by Pere Masqué and Viena Puigcorbé on the Campus de la Universitat Autònoma de Barcelona.
- Planning meeting of 2 Arctic GEOTRACES cruises: Hein de Baar and Micha Rijkenberg attended an Arctic GEOTRACES planning workshop at AWI in Bremerhaven hosted by Michiel Rutgers van der Loeff on 18-20 April 2012 to discuss a GEOTRACES transect in the central Arctic and Laptev Sea in 2015 and sections across Fram Strait (up to the Greenland coast) and from Svalbard to the Norwegian coastline in 2016.

Cruises

A small crew with Micha Rijkenberg as chief scientist will leave with the RV *Pelagia* from Reykjavik (Iceland) on 29 July 2012 to sample 5 stations between 40-60°N which were missed due to storms during the first leg of the West Atlantic GEOTRACES transect (cruise 64PE319) in 2010 (Figure 8). RV *Pelagia* will return to Texel (Netherlands) on 20 August 2012.

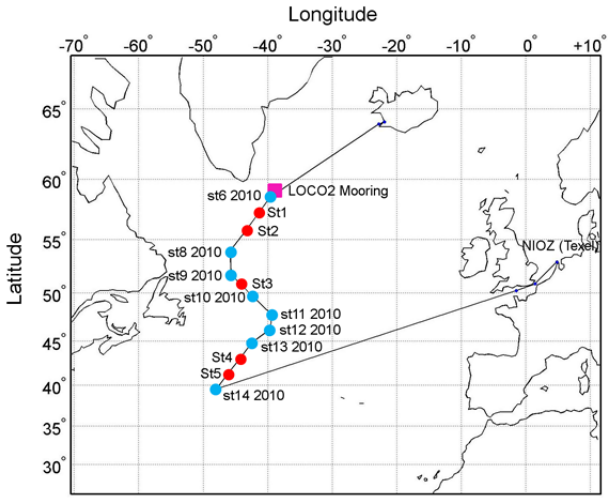

Figure 8*: Cruise tracks for servicing the LOCO2 mooring and the GEOTRACES western North Atlantic Ocean 2012 transect from Reykjavik (Iceland) to NIOZ (Netherlands). The stations sampled during this cruise are indicated with red dots and are given in context of the stations sampled during GEOTRACES 64PE319 in 2010 as indicated with blue dots.*

New funding

A proposal was submitted to the Dutch NWO Open Competition for GEOTRACES transects in the Mediterranean Sea and Black Sea. A formal decision on funding of this proposal is anticipated soon.

New results

Investigators are making good progress in the sample analysis and subsequent interpretation of the data collected in the western Atlantic Ocean. Many results of the western Atlantic transect have been presented at international conferences and start to appear in journal publications. Most of the results of the International Polar Year/GEOTRACES cruises in the Arctic and Antarctic have been published now.

Presentations

- de Baar, H., Keijzer, E., Laan, M., Laan, P., Middag, R., Bruland, K., Biller, D., Lamborg, C., Performance of novel ultraclean pristine samplers for trace metals in the GEOTRACES program: Intercomparison with Goflo samplers at the Bermuda Atlantic site, Ocean Sciences meeting in Salt Lake City, USA, February 2012, oral
- de Baar, H.J.W., Rijkenberg, M.J.A., Gerringa, L.J.A., Middag, R., van Hulten, M.M.P., Laan, P., Schoemann, V., de Jong, J.T.M., Sterl, A. and van Aken, H.M., 2012. Contrasting Biogeochemical Cycling of Iron and Aluminium along the GEOTRACES West Atlantic section. Goldschmidt Conference in Montréal, Canada, June 2012, oral
- de Baar, H., Klunder, M., Thuroczy, C-E., Laan, P., Gerringa, L., Alderkamp, A-C., Middag, R., Arrigo, K., Keynote: Dissolved Iron in the Arctic and Antarctic Oceans, Goldschmidt Conference in Montréal, Canada, June 2012, oral

- Bowman, K., Kading, T., Swarr, G., Lamborg, C., Hammerschmidt, C., Rijkenberg, M., Mercury species and thiols from GEOTRACES cruises in the North and South Atlantic Ocean, Goldschmidt Conference in Montréal, Canada, June 2012, oral
- Church, T. M., Rigaud, S. B., Choi, H. Y., Puigcorbé, V., Bermejo, M., Masque, P., Gerringa, L., Rijkenberg, M., Middag, R., Processes leading to 210-Po and 210-Pb disequilibrium along the GEOTRACES meridional transect of the western North-Atlantic, Ocean Sciences meeting in Salt Lake City, USA, February 2012, oral
- Deng, F., Thomas, A., Henderson, G., Rijkenberg, M., Controls on seawater 231-Pa, 230-Th and 232-Th concentrations along the flow paths of major deep-water masses in the Southwest Atlantic, Goldschmidt Conference in Montréal, Canada, June 2012, oral
- van Heuven, S., Hoppema, M., de Baar, H., Meijer, H., Quantifying the rate of storage of anthropogenic carbon in the South Atlantic Ocean. A watermass-based estimate from 35 years of interior ocean carbon data, Ocean Sciences meeting in Salt Lake City, USA, February 2012, oral
- Kenna, T. C., Masque, P., Camara-Mor, P., Puigcorbé, P., Garcia-Orellana, J., Frank, M., Rijkenberg, M., Gerringa, L., de Baar, H., Henry, C. L., Anthropopgenic radionuclides in the Atlantic GEOTRACES sections A11 and A02, Ocean Sciences meeting in Salt Lake City, USA, February 2012, poster
- Middag, R., Van Aken, H. M., De Baar, H. J., Dissolved Aluminium in the West-Atlantic Ocean from Greenland to the Falkland Islands/Malvinas, Ocean Sciences meeting in Salt Lake City, USA, February 2012, oral
- Middag, R., Van Aken, H.M., De Baar, H.J.W.. Dissolved Aluminium in the West Altantic Ocean. Poster presentation at the 2011 Gordon Research Conference on Chemical Oceanography, 15/16-08-2011, Proctor Academy, Andover, NH, USA.
- Puigcorbé, V., Masqué, P., Owens, S., Buesseler, K. O., Rutgers van der Loeff, M., Stimac, I., Kretschmer , S., Rijkenberg, M., Gerringa, L., Benitez-Nelson, C. R.,234Th: 238U disequilibrium along the western Atlantic Ocean during GEOTRACES AG02 and POC export flux estimates, Ocean Sciences meeting in Salt Lake City, USA, February 2012, oral
- Rijkenberg, M., Gerringa, L., Laan, P., Schoemann, V., Middag, R., van Heuven, S., Salt, L., de Jong, J., van Aken, H., de Baar, H., The distribution of dissolved iron in the western Atlantic Ocean, Ocean Sciences meeting in Salt Lake City, USA, February 2012, oral
- Rijkenberg, M.J.A., Gerringa, L.J.A., Laan, P., Schoemann, V., Middag, R., van Heuven, S.M.A.C., Salt, L., van Aken, H.M., de Jong, J.T.M. and de Baar, H.J.W., 2011. Dissolved Fe in the Western Atlantic Ocean: Distribution, sources, sinks and cycling. Goldschmidt Conference 14-19 August 2011, Prague, oral.

Journal articles

Charles-Edouard Thuróczy completed his PhD thesis comprising 5 research articles on the organic complexation of Fe in the Polar Oceans on 21 November 2011 at the University of Groningen (http://irs.ub.rug.nl/ppn/338020667). Daniele De Corte defended his thesis comprising 5 research articles on the interactions between viruses and prokaryotes on 23 April 2012 at the University of Groningen (http://irs.ub.rug.nl/ppn/341380326). Maarten Klunder will defend his thesis on Fe in Polar Oceans 5 October 2012 at the University of Groningen. Several articles of the Antarctic *Polarstern* expedition ANT XXIV/3 appeared in a special issue of *Deep-Sea Research II*.

- Alderkamp, A.-C., Mills, M.M., van Dijken, G.L., Laan, P., Thuróczy, C.-E., Gerringa, L.J.A., de Baar, H.J.W., Payne, C.D., Visser, R.J.W., Buma, A.G.J. and Arrigo, K.R., 2012. Iron from melting glaciers fuels phytoplankton blooms in the Amundsen Sea (Southern Ocean): Phytoplankton characteristics and productivity. Deep Sea Research Part II: Topical Studies in Oceanography, 71–76(0): 32-48.

- De Corte, D., Sintes, E., Yokokawa, T., Reinthaler, T. and Herndl, G.J., 2012. Links between viruses and prokaryotes throughout the water column along a North Atlantic latitudinal transect. ISME J: 1–12, doi:10.1038/ismej.2011.214
- Gerringa, L.J.A., Alderkamp, A.-C., Laan, P., Thuróczy, C.-E., de Baar, H.J.W., Mills, M.M., van Dijken, G.L., van Haren, H. and Arrigo, K.R., 2012. Iron from melting glaciers fuels the phytoplankton blooms in Amundsen Sea (Southern Ocean); iron biogeochemistry. Deep Sea Res. II, 71-76: 16-31.
- van Heuven, S.M.A.C., Hoppema, M., Huhn, O., Slagter, H.A. and de Baar, H.J.W., 2011. Direct observation of increasing CO2 in the Weddell Gyre along the Prime Meridian during 1973-2008. Deep Sea Res. II, 58(25-26): 2613-2635.
- van Hulten, M.M.P., Sterl, A., Tagliabue, A., Dutay, J.-C., Gehlen, M., de Baar, H.J.W. and Middag, R., 2012. Aluminium in an ocean general circulation model compared with the West Atlantic Geotraces cruises. J. Mar. Syst., in press, doi: 10.1016/j.jmarsys.2012.05.005
- de Jong, J., Schoemann, V., Lannuzel, D., Croot, P., de Baar, H. and Tison, J.-L., 2012. Natural iron fertilization of the Atlantic sector of the Southern Ocean by continental shelf sources of the Antarctic Peninsula. J. Geophys. Res., 117(G1): G01029, doi: 10.1029/2011jg001679
- Klunder, M.B., Bauch, D., Laan, P., de Baar, H.J.W., van Heuven, S. and Ober, S., 2012. Dissolved iron in the Arctic shelf seas and surface waters of the central Arctic Ocean: Impact of Arctic river water and ice-melt. J. Geophys. Res., 117(C1): C01027, doi: 10.1029/2011jc007133
- Klunder, M.B., Laan, P., Middag, R., de Baar, H.J.W. and Bakker, K., 2012. Dissolved iron in the Arctic Ocean: Important role of hydrothermal sources, shelf input and scavenging removal. J. Geophys. Res., 117(C4): C04014, doi: 10.1029/2011jc007135
- Klunder, M.B., Laan, P., Middag, R., De Baar, H.J.W. and van Ooijen, J.C., 2011. Dissolved iron in the Southern Ocean (Atlantic sector). Deep Sea Res. II, 58(25-26): 2678-2694.
- Middag, R., de Baar, H.J.W., Laan, P. and Huhn, O., 2012. The effects of continental margins and water mass circulation on the distribution of dissolved aluminum and manganese in Drake Passage. J. Geophys. Res., 117: C01019, doi: 10.1029/2011JC007434
- Middag, R., de Baar, H.J.W., Laan, P., Cai, P.H. and van Ooijen, J.C., 2011. Dissolved manganese in the Atlantic sector of the Southern Ocean. Deep Sea Res. II, 58(25-26): 2661-2677.
- Middag, R., van Slooten, C., de Baar, H.J.W. and Laan, P., 2011. Dissolved aluminium in the Southern Ocean. Deep Sea Res. II, 58: 2647-2660.
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- Roeske, T., Rutgers vd Loeff, M., Middag, R., Bakker, K., in press. Deep water circulation and composition in the Arctic Ocean by dissolved barium, aluminium and silicate. Marine Chemistry, 132-133, 56-67.
- Rutgers van der Loeff, M., Cai, P.H., Stimac, I., Bracher, A., Middag, R., Klunder, M.B. and van Heuven, S.M.A.C., 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, 58(25–26): 2749-2766.
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- Thuróczy, C.-E., Gerringa, L.J.A., Klunder, M.P., Laan, P., Le Guitton, M. and de Baar, H.J.W., 2011. Distinct trends in the speciation of iron between the shelf seas and the deep basins of the Arctic Ocean. J. Geophys. Res., 116: C10009, doi:10.1029/2010JC006835.
- Thuróczy, C.E., Gerringa, L.J.A., Klunder, M.B., Laan, P. and de Baar, H.J.W., 2011. Observation of consistent trends in the organic complexation of dissolved iron in the Atlantic sector of the Southern Ocean. Deep Sea Res. II, 58(25-26): 2695-2706.

Submitted by: Micha Rijkenberg

New Zealand

In June 2011, New Zealand successfully completed the middle leg (NE of New Zealand to SE of Tahiti) of the zonal Pacific GEOTRACES section from Brisbane to Lima. Our main activities since July 2011 have been the sample and data analysis from this voyage, which is ongoing. Highlights from the voyage include:

- Detailed water sampling (trace metals, electrochemistry, microbiology) around an underwater volcano on the Kermadec Ridge.
- The anticipated availability of paired datasets on trace metals and nanonutrients (including nitrate, phosphate, ammonium).
- Sampling of aerosols and rain storms.
- Sampling for bioGEOTRACES.

Other activities have included the write-up, publication, and oral communication of the findings from the GEOTRACES-ratified process study FeCycle II that investigated iron biogeochemistry of high iron (0.6 nmol/l) offshore waters. A list of submitted manuscripts is at the end of this report. Some of these findings were presented at the AGU/ASLO/TOS Ocean Sciences meeting in Salt Lake City. Highlights include:

- Evidence that microbes sequester much of the available winter reserve inventory of new iron and hence control the diatom bloom duration and magnitude.
- The region is supplied with iron from a combination of water mass communication with shelf sediments and then eddy shedding from a western boundary current (see Figure 9)

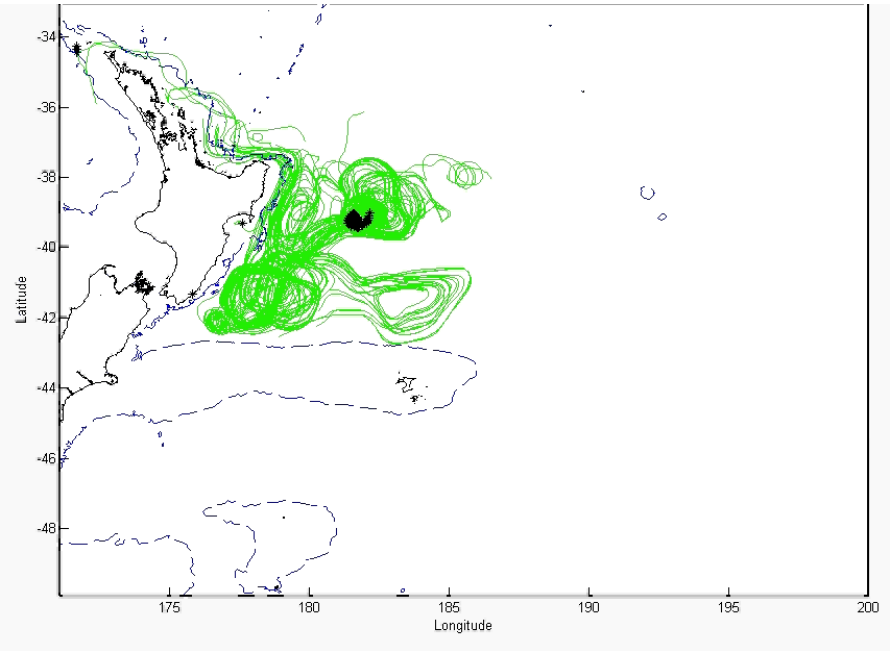

Figure 9: *FeCycle II eddy (black symbols) and sources of the waters that formed the eddy E of New Zealand (green trajectories, from an altimetry model). Dashed lines denote shelf break. From Boyd et al. (in review).*

Other related highlights

We have recently obtained three years of funding to enable the development of dual-spike stable iron isotopic method, to complement ongoing research with cadmium stable isotopes, and collaboration with Michael Ellwood at ANU in Canberra on iron stable isotopes. Sylvia Sander from the University of Otago is the co-chair of the new SCOR Working Group 139 on Trace Metal binding ligands, that will be liaising closely with GEOTRACES. Their first meeting after the Salt Lake City Ocean Sciences was attended by Sander and Boyd. The results from the ongoing ship of opportunity Pacific dust sampling programme (Japan to New Zealand) were presented at the SOLAS workshop by Tim Jickells, who contrasted and compared their Atlantic Meridional Transect dust data with those from the Pacific meridian over multiple years. Boyd, along with Carol Robinson continues to co-ordinate the bioGEOTRACES sampling programme; for example, samples were taken on the Australian and New Zealand legs of the Brisbane-to-Lima zonal transect for bioGEOTRACES. Boyd and collaborators at Stanford University have produced detailed circumpolar maps of phytoplankton iron acquisition and compared them with maps of iron supply across the Southern Ocean, including surface supply of hydrothermally derived iron from the deep ocean.

Publications

Boyd et al. (in review) Microbial control of diatom bloom dynamics in the open ocean. Geophysical Research Letters.

Boyd, P.W.; Arrigo, K.R.; Strzepek, R.; van Dijken, G.L. (2012). Mapping phytoplankton iron utilization: Insights into Southern Ocean supply mechanisms. J. Geophys. Res., Vol. 117, No. C6, C06009 http://dx.doi.org/10.1029/2011JC007726

Submitted by: Philip Boyd

Norway

Overview

Work on trace elements and their isotopes in the ocean included primarily global ocean modeling. In the past year, at the University of Bergen and the Bjerknes Centre for Climate Research, a modeling study on radionuclides and potentially changing particle fluxes as a consequence of progressing ocean acidification has been refined and presented at two different workshops (see below under meeting presentations). All respective model runs with the HAMOCC biogeochemical ocean general model have been repeated several times for slightly improved model versions (among other issues: improved sediment coverage with respect to open ocean $CaCO_3$ weight fraction). Primarily, simulations of the radioisotope ^{230}Th were used to better constrain marine particle fluxes and their changes due to increasing CO_2 (decreasing pH and CO_3^{2-} saturation). A draft for a corresponding manuscript in preparation has been written (also for a deliverable of the EU FP7 project EPOCA, which has been coordinated by J.-P. Gattuso, France.)

Presentations in meetings

- Heinze, C., and T. Ilyina, 2011a, Potential of radionuclides to detect large scale impacts of ocean acidification, IPCC WGII/WGI Workshop on Impacts of Ocean Acidification on Marine Biology and Ecosystems, Okinawa, Japan, 17-19 January 2011 (poster).
- Heinze, C., and T. Ilyina, 2011b, Monitoring the impact of ocean acidification through 230Th – where and when? 3rd GEOTRACES Data-Model Synergy Workshop, Universitat Autonoma de Barcelona, Spain, November 14-17, 2011 (oral presentation, plenary).

Submitted by: Christoph Heinze

Poland

Meetings

- 2nd Cruise planning meeting (September 15-16 – SOPOT, Poland). Participants: Jacek Beldowski, Martin Frank, Gideon Henderson, Johan Ingri, Jaromir Jakacki, Karl Kulinski, Janusz Pempkowiak, Kimberly Pyle, Robert Goodard, Till Oehler, Beata Szymczycha, Michael Staubwasse, Sussanne Bauer, Susann Henkel, Daniel Whiter. Meeting included an outline of GEOTRACES goals and activities, and detailed planning of Baltic GEOTRACES cruise in November (see Figure 10).

Cruises

- Cruise onboard R/V *Oceania* took place in November 3-13. Three main scientific targets were foci for the cruise:

    1) Trace element and isotope (TEI) impact of the reducing conditions in the deep basins of the Baltic Sea,
    2) TEI fluxes from marginal Baltic basins (e.g., Bothnia Gulf) and chemistry on mixing, and
    3) TEI fluxes out of the Baltic Sea to the Atlantic Ocean.

  Scientists from 6 institutions from UK, Germany, Sweden and Poland performed the research. The cruise track included 10 major stations with high-resolution Pump CTD redoxcline profiling, and a number of minor stations for the monitoring of physical parameters variability between stations. Major stations are presented in Figure 10.

New results

- Data collected during the Nov. 2011 *Oceania* cruise are now being analyzed. At all the profiles collected with high resolution, agglomeration of particles was observed above the halocline. Based on O_2 and nutrient profiles, dominating processes behind that behavior will be determined.

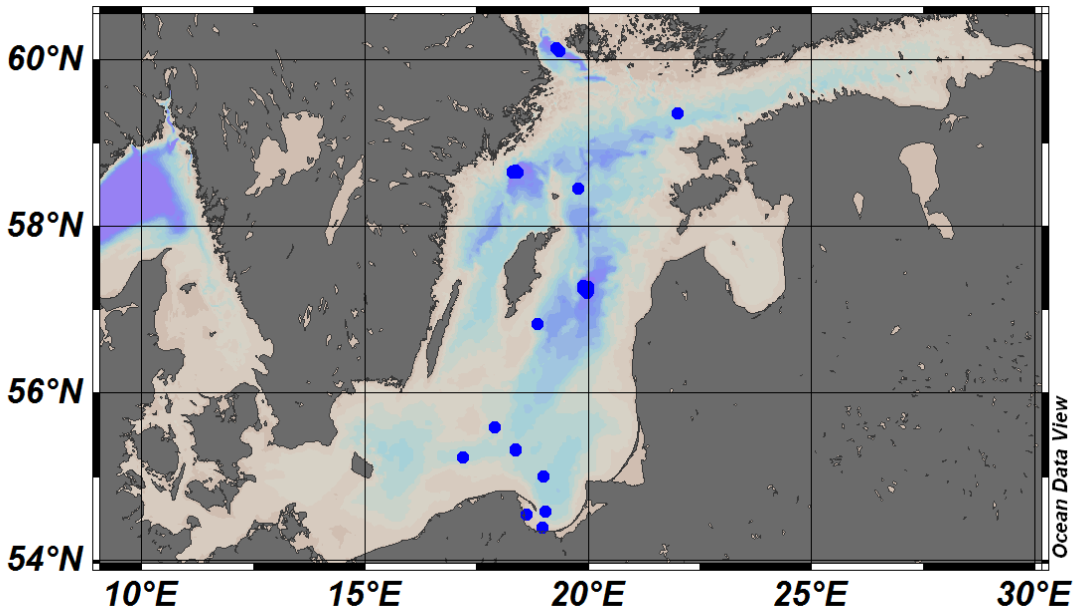

Figure 10. *Major sampling stations location.*

Submitted by: Jacek Bełdowski

Russia

Meetings and Workshops

- Russian representatives took part in the workshop "Changes in arctic climate" in Vancouver in May 2012 with support from SCOR. It was the first participation of Russian scientists in the GEOTRACES meetings at an official level, including Sergey Shapovalov, head of the Center for Coordination of Ocean Research of the Russian Academy of Sciences and Lyudmila Demina, Senior Research Fellow from the P.P. Shirshov Institute of Oceanology. They made two presentations: L. Demina about research on trace metals in estuaries of Russian Arctic rivers by the Institute of Oceanology of RAS and S. Shapovalov about research of Russian institutes in the Arctic Ocean during the last decade.
- Russian GEOTRACES Workshop scheduled on 27-30 November 2012 in Moscow (Russia). The main objective of this workshop is to acquaint the international scientific community with the research of Russian scientists in the field of GEOTRACES and to discuss the possibility of cruises in 2015 in the Russian economic zone in Arctic Ocean. Workshop organizers also hope to establish a Russian National Committee for GEOTRACES during the workshop.

Submitted by: Sergey Shapovalov

Slovenia

Meetings

- COST-GEOTRACES-GMOS International Workshop on "Mercury in the marine environment: a global metrology challenge" organized by M. Horvat, C. Lamborg, G. Henderson and N. Ogrinc from May 9 to 12, 2011 in Piran, Slovenia dedicated to Hg analysis and speciation in the marine environment. More than 60 known experts and instrumental producers attended the workshop. The following issues were exposed during the workshop:

    1. Hg species in open and coastal marine environment: evidence from various ocean environments (Mediterranean, Atlantic, Pacific, Baltic, Artic, etc..)
    2. What to measure and why? Which mercury species need to be measured and which ancillary data are needed?
    3. Metrology support in relation to appropriate reference materials.
    4. Recent improvements for Hg speciation in marine environments.
    5. Planning of intercomparisons in the framework of GMOS (Global Mercury Observation Systems) project and GEOTRACES.
    6. Available instrumentation and demonstrations – last developed analytical systems.

All presentations are available on CD:
HORVAT, Milena (ur.)/et al. International Workshop on Mercury in the Marine Environment: a Global Metrology Challenge, Marine Biological Station, Fornače 41, Piran, Slovenia, 9.-12. May 2011/. Ljubljana: Jožef Stefan Institute, Department of Environmental Sciences, 2011. 1 optični disk (CD-ROM). ISBN 978-961-264-034-7.
http://cobiss.izum.si/scripts/cobiss?command=DISPLAY&base=COBIB&RID=256315904

- Participation at the Workshop "The ocean chemistry of bioactive trace elements and paleoclimate proxies" May 29 to June 1, 2012, Geel, Belgium (L. Benedik – acting as an invited speaker, M. Vahčič as a participant).

Cruises

Participation of M. Vahčič and A. Bratkič on the *James Cook* South Atlantic Ocean cruise led by G. Henderson (University of Oxford, UK) from December 2011 to January 2012. The activities were related to the cycling of Hg species in marine environment including deep water profiles of dissolved gaseous Hg (DGM), total (THg), monomethyl Hg (MeHg) and dimethyl Hg (DMeHg) in open ocean waters. Special attention was paid to the distribution of DGM, which plays the major role in the exchange of Hg between water and atmosphere. At some locations, sediment samples also were collected. In these samples THg and MeHg will be determined. The results performed on this cruise provide reliable and relevant vertical high-resolution data for modelling global (ocean) cycle of Hg and allow for more accurate predictions of its transport and fate with regard to human perturbations and climate change.

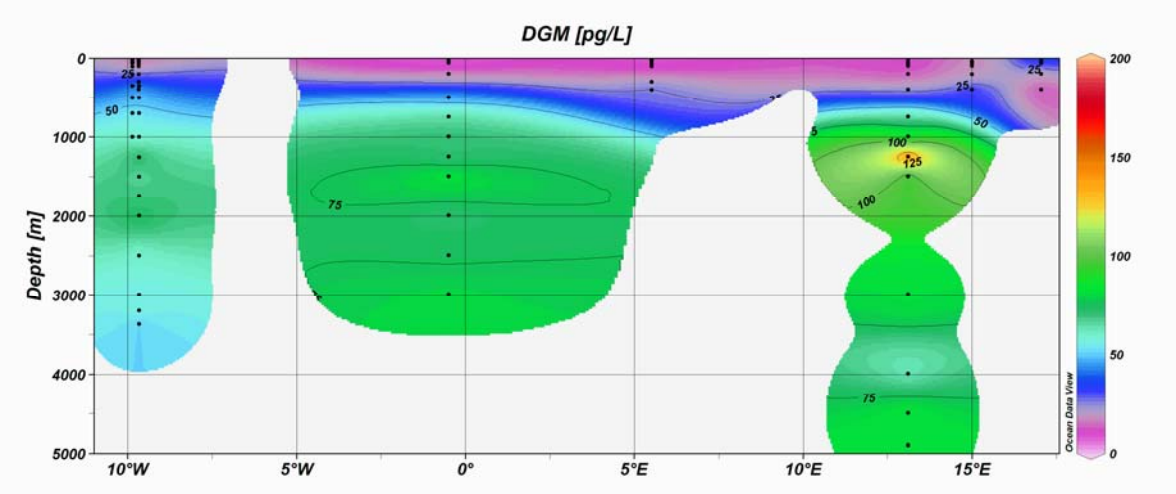

Figure 11. *Depth profiles of dissolved gaseous mercury (DGM) in deep-sea waters.*

New funding

- Participation in the *James Cook* South Atlantic cruise was partially financed by EU project GMOS.

New results

- Samples obtained on the *James Cook* cruise are still under investigation. Preliminary results on DGM are presented in Figure 11. Depth profiles along transect 40°S show a depletion of DGM in the upper layers of the ocean. DGM is rather uniformly distributed deeper in the water mass, with slight variations in concentrations, which could be attributed to different water masses at different depths. Lower concentrations obtained at the surface are related to evaporation and photoreduction of DGM.

Other activities

- S. Tamše obtained a GEOTRACES fellowship to perform his research on stable isotope composition of N and O in nitrates in marine samples. The research will be conducted at the Laboratoire de Glaciologie et Géophysique de l'Environnement (CNRS/UJF), Grenoble, France.

Publications

- N. Ogrinc, M. Vahčič, A. Bratkič, J. Kotnik, F. Sprovieri, N. Pirrone, M. Horvat (2012) Mercury speciation in deep-sea waters of the Mediterranean Sea, presented at the 22th Goldschmidt conference June 24-29, 2012 in Montreal in a special session 13d. Geotraces, the international science program.

Submitted by: Nives Ogrinc

South Africa

Figure 12: *The new South African research vessel: SA Agulhas II*

South Africa has taken the delivery of the new ice-breaker (*SA Agulhas II*) in May (Figure 12). The *SA Agulhas II* provides South Africa with a golden opportunity to address important issues facing us. These include protection of our population and property from extreme weather events, such as increasing frequency and severity of storms, and climate impact on biodiversity. This is a well-equipped supply and research vessel and with specialized laboratories to conduct GEOTRACES-related activities. The ship took its maiden voyage in July as a shakedown cruise to the ice edge in the Southern Ocean, not only to test the ship and the equipment but also to collect much needed winter biogeochemical data.

Activities of Interest and Personnel Training

In 2011, definitive activities have started to kick-start and expand GEOTRACES activities in South Africa. A Center for Trace and Experimental Biogeochemistry has been established by Prof Roychoudhury of Stellenbosch University to further the mandate of GEOTRACES in South Africa. Thanks to SCOR funding, Dr Thato Mtshali was able to participate in GEOTRACES GP13 where he was trained in protocols of seawater sampling and analysis for trace elements, to work in a clean trace metal container van, how to deploy and retrieve trace metal rosette (for TDFe and DFe) and McLane pump (for PFe) and how to measure TDFe and DFe concentrations in seawater using Flow Injection Analyser (FIA). Another PhD student,

Center for
Trace & Experimental
Biogeochemistry

Ms. Riana Rossouw, also visited the laboratory of Bill Landing at FSU to learn analysis of bioactive trace metals using ICP-MS techniques. She will be responsible to set-up these methods at Stellenbosch University over the course of next couple of years.

Conferences

3rd GEOTRACES Data-Model Synergy Workshop

Alessandro Tagliabue (2011) Sensitivity of TEI cycles to metal-organic complexes in biogeochemistry models

Alessandro Tagliabue, Thato Mtshali, Olivier Aumont, Andrew R. Bowie, A.N. Roychoudhury, and Sebastiaan Swart (2011) A global compilation of over 13,000 dissolved iron measurements: focus on distributions and processes in the Southern Ocean

A.N. Roychoudhury, B. von der Heyden, S.C.B. Myneni (2011) Chemical characteristics of iron-rich nano- and colloid-sized particles in the South Atlantic and Southern Oceans

Goldschmidt Conference

A.N. Roychoudhury, B.P. von der Heyden, and S.C.B. Myneni (2011) The Fe L_3-edge as a probe for Fe oxide speciation. 21st Annual V M Goldschmidt Conference, Prague, Czech Republic, Aug. 14-19, 2011

B.P. von der Heyden, A.N. Roychoudhury and S.C.B. Myneni (2011) Chemical speciation of Fe-rich colloids and nanoparticles in the Southern Ocean. 21st Annual V M Goldschmidt Conference, Prague, Czech Republic, Aug. 14-19, 2011

Publications

Tagliabue, Alessandro, Mtshali, T., Aumont, O., Bowie, A.R., Klunder, M.B., Roychoudhury, A.N., and Swart, S (2012) A global compilation of over 13 000 dissolved iron measurements: focus on distributions and processes in the Southern Ocean, Biogeosciences, 9, 2333-2349.

Sebastiaan Swart, Nicolette Chang, Nicolas Fauchereau, Warren Joubert, Mike Lucas, Thato Mtshali, Alakendra Roychoudhury, Alessandro Tagliabue, Sandy Thomalla, Howard Waldron, Pedro M.S. Monteiro **(2012)** Southern Ocean Seasonal Cycle Experiment – 2012 (SOSCEx2012): Coupling of Climate and Carbon Cycling at the Seasonal Scale, South African Journal of Science, 108(3/4), 1-3.

Service

Prof. Alakenrda Roychoudhury was appointed as a new member of the Scientific Steering Committee of the GEOTRACES project to serve for the period from 1 January 2012 to 31 December 2014.
Dr. Alessandro Tagliabue was appointed on the standing committee on Data Management of the GEOTRACES project.

Submitted by: Alakendra Roychoudhury

Spain

National committee (under SCOR-Spain)

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

Meetings

- Co-organisation and participation at the GEOTRACES Mediterranean Workshop, Toulouse, September 2011
- Co-organisation of the workshop on the RV *Pelagia* cruises 64PE319 and 64PE321 (Legs 1 and 2 of the GA02 Section) (PIs: H. De Baar, L. Gerringa, M. Rijkenberg, 2010), Barcelona, October 2011
- Co-organisation of the 3rd GEOTRACES Data-Model Synergy Workshop Universitat Autònoma de Barcelona (Spain), Barcelona, November 2011.
- Participation in EU funded COST Action ES0801
- Participation at the Arctic GEOTRACES Meeting, Bremerhaven, April 2012 and submission of two *Polarstern* proposals for expeditions in 2015 and 2016.

Cruises

- Submission of an application to the Spanish National Research Program for funding of a GEOTRACES Mediterranean cruise (PI: P. Ziveri). The proposal was refused in June 2012 due to administration formalism. An appeal was submitted. We are waiting for the final decision. We know, extra-officially, that they are looking for a solution to provide a vessel to do the cruise. Final decision expected in September 2012.
- We participated in the *Meteor* Mediterranean Cruise M84-Leg3 in April 2011 in order to sample Ra isotopes, ^{210}Po and ^{210}Pb. Although this is not a GEOTRACES cruise, the results could be interesting for the GEOTRACES program.

Publications

Co-authored several papers of the Intercalibration special issue in *Limnology and Oceanography Methods*:

- Church, T., Rigaud, S., Baskaran, M., Kumar, A., Friedrich, J., Masqué, P., Puigcorbé, V., Kim, G., Radakovitch, O., Hong, G., Choi, H.-Y., and Stewart, G. (2012). Inter-calibration studies of ^{210}Po and ^{210}Pb in dissolved and particulate sea water samples. Limnology and Oceanography: Methods, in press.
- Kenna, T.C., Masqué P., Mas, J.L., Camara-Mor, P., Chamizo, C., Scholten, S., Eriksson, M., Sanchez-Cabeza, J.A., Gastaud, J., Levy, I., Herrmann, J., Lindahl, P. and Nielsen, S. (2012). Intercal: Intercalibration of selected anthropogenic radionuclides for the GEOTRACES Program. Limnology and Oceanography: Methods, in press.
- Maiti, K., Buesseler, K.O., Pike, S.M., Benitez-Nelson, C., Cai, P., Chen, W., Cochran, J.K., Dai, M., Dehairs, F., Gasser, B., P. Kelly, R., Masque, P., Miller, L., Miquel, J.C., Moran, S.B., Morris, P., Peine, F., Planchon, F., Renfro, A.A., Rutgers van der Loeff, M., Santschi, P., Turnewitsch, R., Waples, J. and Xu, C. (2012). Intercalibration studies of short lived Thorium-234 in the water column and marine particles. Limnology and Oceanography: Methods, In press.

GEOTRACES-related papers:

- Cámara-Mor P., Masqué P., Garcia-Orellana J., Kern, S., Cochran J.K. and Hanfland, C. (2011). Interception of atmospheric fluxes by Arctic sea ice: evidence from cosmogenic ^{7}Be. Journal of Geophysical Research,116, C12, doi:10.1029/2010JC006847.

Presentation of results

Several contributions to:

- 2012 Ocean Sciences Meeting, Salt Lake City, Utah (USA), 20-24 February 2012
- ASLO Aquatic Sciences Meeting, Puerto Rico, 13-18 February 2011
- Goldschmidt Meeting, Montreal, 25-29 June 2012.

Submitted by: Jordi Garcia-Orellana

Taiwan

GEOTRACES-related activities in 2011*:*

1. Taiwanese most modern open ocean research vessel, R/V 5, launched in June 2011 (Figure 13). R/V 5, 72.6 m long, 15.4 m wide, and 2700 ton, is also equipped with a 20-ft trace metal-clean container. The first GEOTRACES test cruise of R/V 5 will be carried out in July 2013 in the Western Philippine Sea.
2. The laboratory of Tung-Yuan Ho was invited to attend Japanese 2011 GEOTRACES cruise carried out in the northwestern Pacific. The measurement of dissolved trace metal samples was all finished. A couple of manuscripts are under preparation by the leading Japanese scientists and Tung-Yuan Ho.
3. There were about 10 GEOTRACES-related research papers published by Taiwanese scientists in 2011. Some examples are shown below:

Ho, T.-Y., W.-C. Chou, H.-L. Lin, and D. D. Sheu (2011) Trace metal cycling in the deep water of the South China Sea: The composition, sources, and fluxes of sinking particles. *Limnology and Oceanography* 56: 1225-1243.

Huh, C.-A., W. Chen, F.-H. Hsu. C.-C. Su, J.-K. Chiu, S. Lin, C.-S. Liu and B.-J. Huang (2011) Modern (<100 years) sedimentation in the Taiwan Strait: rates and source-to-sink pathways elucidated from radionuclides and particle size distribution. *Continental Shelf Research* 31: 47-63.

Shen, C.-C., C.-C. Wu, Y. Liu, J. Yu, C.-C. Chang, D.-D. Lam, C.-J. Chou, L. Lo, K.-Y. Wei (2011) Measurements of natural carbonate rare earth elements in femtogram quantities by inductive coupled plasma sector field mass spectrometry. *Analytical Chemistry* 83: 6842-6848.

Wei, C.-L., S.-Y. Lin, D. D. Sheu, W.-C. Chou, M.-C. Yi, P. H. Santschi, and L.-S. Wen (2011) Particle-reactive radionuclides (^{234}Th, ^{210}Pb, ^{210}Po) as tracers for the estimation of export production in the South China Sea, *Biogeosciences* 8: 3793-3808.

Wei, C.-L., K.-T. Jiann, L.-S. Wen, J.-R. Tsai, and D. D. Sheu (2011) Removal fluxes of Mn and Fe from the nearshore waters along the west coast of Taiwan. *Marine Pollution Bulletin* 62: 1081-1087.

Figure 13: *New Taiwanese R/V 5*

United Kingdom

Further details about UK GEOTRACES activity is available at: http://www.ukgeotraces.com/

Cruises:

UK seagoing efforts within the GEOTRACES programme have focused on two full sections in the Atlantic Ocean, a process study in the Baltic Sea, and planning for future Arctic activity.

GA06: Tropical Atlantic
This section was completed in mid-2011 on board the *RRS Discovery* as cruise D361, led by Eric Achterberg (Southampton). The goals of the cruise were focused on understanding ecosystem responses to cycling of micronutrients, with a major motivation being to understand the relationship between micronutrient supply and nitrogen fixation. Work in the last year has been to complete shore-based measurements on the considerable number of water and particulate samples recovered during this successful cruise.

GA10: South Atlantic
This section was re-scheduled following an incomplete transit of the Atlantic in late 2010. It was completed successfully in Dec. 2011 to Jan. 2012 onboard the *RRS James Cook* as cruise JC068 led by Gideon Henderson (Oxford). The cruise successfully completed work at 24 stations, reoccupying a number of stations in the Cape Basin from the previous cruise (D357), and then completing the transect from Cape Town to Montevideo. The major research goal was to quantify the fluxes and processes providing micronutrients to the highly productive 40^{o}S surface waters, and to deep waters shortly before they upwell in the HNLC Southern Ocean and productive tropical Atlantic. In addition to full-depth CTD casts (e.g., Figure 14) the cruise pursued Stand Alone Pumping for recovery of particulates, mega-coring to retrieve intact sediment surfaces, and velocity microstructure profiler deployments to assess iso- and dia-pycnal mixing rates. Argo floats and a glider were also deployed. Scientists from 10 UK institutes were involved, along with those from New Zealand, the USA, and Slovenia. The cruise met all its ship-board objectives and the work of shore-based analysis is now in full swing.

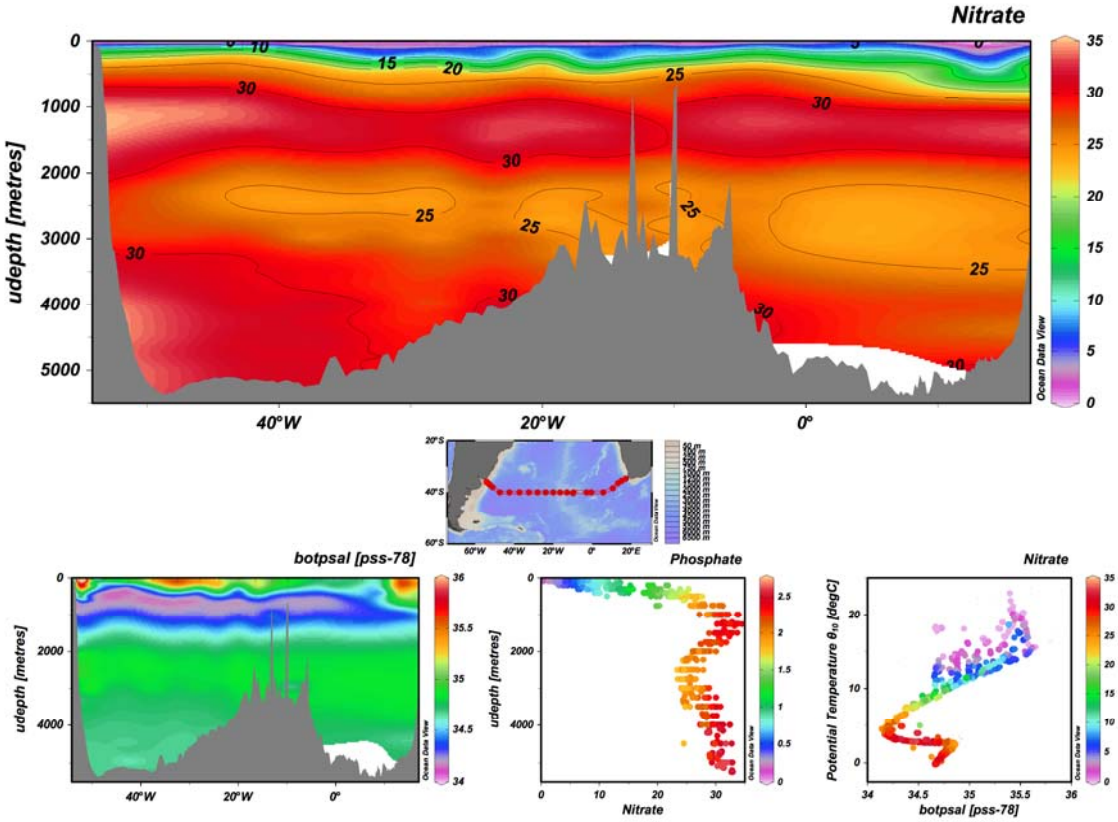

Figure 14: *Ship-board macro-nutrient data for the GA10 (JC068) cruise (Malcolm Woodward), also showing the cruise track and stations.*

Meetings:

- UK scientists have presented GEOTRACES results at AGU, Ocean Sciences, and Goldschmidt conferences.
- UK scientists played a role in organizing the 3rd Data-Model Synergy workshop, and there was significant UK attendance at that meeting
- UK scientists have been involved in planning for future Arctic GEOTRACES efforts through international meetings and dialogue
- UK scientists played a role in organizing the TrainMIC training school, and several UK students attended to learn about quality control issues.
- A post-cruise meeting for GA06 was held in early 2012, and a similar meeting for GA10 will be held in September 2012.
- A COST and SCOR-sponsored meeting focused on trace metal isotopes in seawater will take place in September in London, organized by scientists from Imperial College (Mark Rehkamper and Tina van der Fleirdt).

National and international service:

- A UK GEOTRACES Steering Committee has been established in the last year consisting of Eric Achterberg (Southampton); Walter Geibert (Edinburgh); Gideon Henderson (Oxford); Maeve Lohan (Plymouth); Carol Robinson (UEA); and Tina van der Flierdt (Imperial).
- The UK continues to host the GEOTRACES Data Assembly Centre at the British Oceanographic Data Centre in Liverpool.

- The UK is represented on the International GEOTRACES SSC by Gideon Henderson (Co-Chair) and Maeve Lohan, and on the International Standards and Intercalibration Committee by Maeve Lohan.
- There are three UK representatives on the GEOTRACES-related COST Action Management Committee: Gideon Henderson (Chair); Ed Mawji (Chair Data Working Group); Maeve Lohan (Chair Training Working Group).

Submitted by: Gideon Henderson

United States

Principal activities of the U.S. GEOTRACES program include

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

Cruises

- North Atlantic: As noted in the U.S. report last year, the initial effort to complete GEOTRACES North Atlantic section GA03 was terminated prematurely in November 2010, due to mechanical problems with the ship. U.S. GEOTRACES investigators organized a second cruise that completed the section in December 2011 (Figure 15).

Scientific objectives of the section 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.

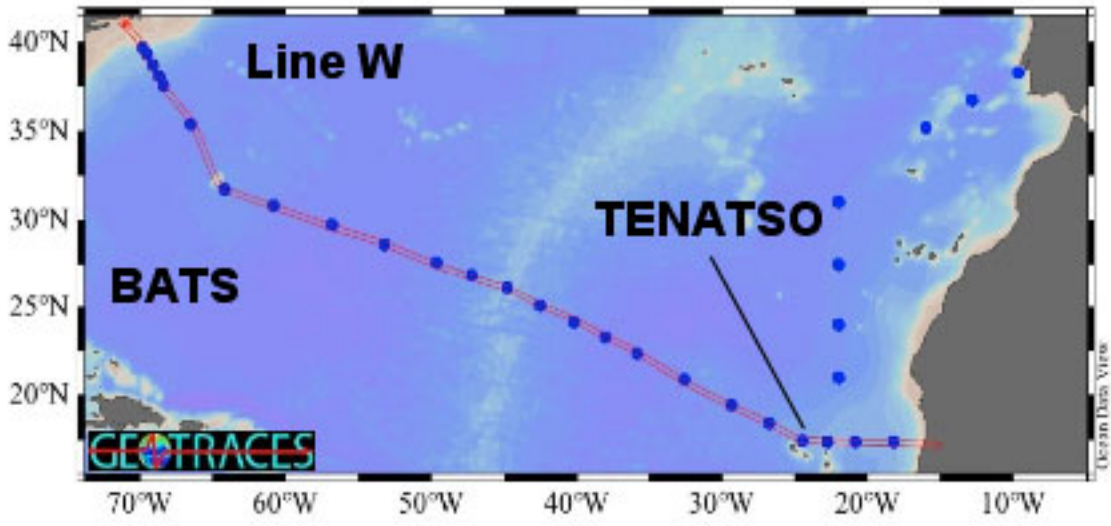

Figure 15: *Locations of stations occupied during the U.S. North Atlantic zonal section. Stations from Portugal to TENATSO were occupied during R/V Knorr cruise KN199-4 in October-November 2010. Stations from Woods Hole (upper left) to TENATSO were occupied during KN204-1 in November-December 2011.*

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

- Eastern Tropical Pacific: The second major section planned by U.S. GEOTRACES is a zonal section in the eastern tropical Pacific roughly between Peru and Tahiti (Figure 16).

The principal scientific objectives of this section include the following:

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, and
4) Quantify TEI sources and sinks associated with the oxygen minimum zone.

A management proposal to secure ship time and to provide for cruise logistics was funded by the U.S. NSF in 2011. Proposals by individual investigators and collaborative proposals involving small groups were submitted to NSF in February 2012. At the time this report was written, investigators are still being informed of the fate of their proposals. It appears that a wide range of TEIs and circulation tracers will be funded, although a final list of funded proposals is not yet available. The dates of the cruise are still being negotiated with the ship schedulers, but the cruise is expected to begin in October or November of 2013.

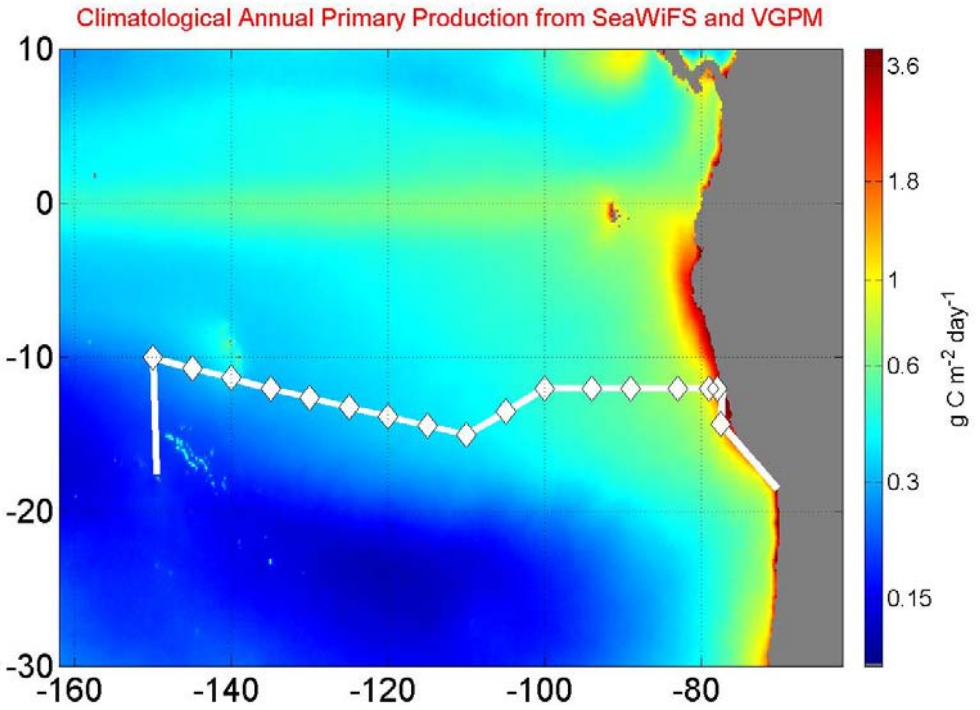

Figure 16: *Tentative locations of full depth stations planned for the U.S. eastern tropical south Pacific zonal section. Shallow stations to 1000 m are not shown. The cruise is planned for late 2013. Map and productivity calculations courtesy of M-E Carr.*

- South Atlantic (Not reported last year): Three individuals from U.S. institutions sailed aboard leg 3 of GEOTRACES section GA02. Stephanie Owens (Woods Hole Oceanographic Institution) sampled for ^{234}Th while Leo Pena and Alison Hartman (Lamont-Doherty Earth Observatory) sampled for rare earth elements and Nd isotopes.

New Funding

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

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

Presentation of results

Preliminary results from the North Atlantic cruise (Figure 15) were presented at three international conferences:

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

U.S. GEOTRACES Meetings

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

1) A planning workshop for the Peru-Tahiti section (Figure16) was held 12-14 September 2011 in La Jolla, California, to set priorities for the cruise and to share information that would facilitate preparation of proposals by individual investigators for submission to NSF on 15 February 2012. This workshop was attended by approximately 60 scientists, ship operators and program officers from NSF.
2) Twenty-three scientists and students from U.S. institutions participated in the 3rd GEOTRACES Data-Model Synergy workshop (14-17 November 2011, Universitat Autònoma de Barcelona, Spain).
3) A town hall meeting was held at the Fall 2011 AGU meeting (6 December 2011) to engage the oceanographic community in planning for a U.S. GEOTRACES field program in the Arctic Ocean.
4) A town hall meeting was held at the 2012 Ocean Sciences meeting (22 February 2012) to engage the oceanographic community in planning for a U.S. GEOTRACES field program in the Arctic Ocean.
5) Four scientists from U.S. institutions participated in a GEOTRACES workshop on Arctic Climate Change (2-4 May 2012, University of British Columbia, Vancouver, Canada). This workshop served to coordinate plans for multiple research cruises in the Arctic Ocean in the time frame of 2015-2016.
6) The international implementation workshop in Vancouver was followed by a workshop at NSF (13-15 June 2012) to refine the research objectives for a U.S. GEOTRACES cruise in the western Arctic Ocean and to develop an implementation strategy to meet those objectives. Approximately 80 scientists, NSF program managers and representatives from the U.S. Coast Guard and NOAA participated in the meeting. The results of the deliberations are currently being synthesized in an implementation plan that will serve to prepare a set of priorities to guide the submission of the U.S. Arctic GEOTRACES management proposal (due October 18, 2012), the submission of individual PI proposals (due 15 February 2014), and the evaluation of those proposals.

Publications (GEOTRACES and GEOTRACES-related*)

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

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

- Anderson, R. F., M. Q. Fleisher, L. F. Robinson, R. L. Edwards, J. A. Hoff, S. B. Moran, M. Rutgers van der Loeff, A. L. Thomas, M. Roy-Barman, and R. Francois, 2012. GEOTRACES intercalibration of 230Th, 232Th, 231Pa, and prospects for 10Be. Limnology and Oceanography Methods, 10: 179-213.

- Auro, M. E., L. F. Robinson, A. Burke, L. I. Bradtmiller, M. Q. Fleisher, R. F.Anderson, 2012. Improvements to 232-thorium, 230-thorium, and 231-protactinium analysis in seawater arising from GEOTRACES intercalibration. Limnology and Oceanography Methods, 10: 464-474.
- Buck, K. N., J Moffett, K. A. Barbeau, R. M. Bundy, Y. Kondo and J. Wu, 2012. The organic complexation of iron and copper: an intercomparison of competitive ligand exchange–adsorptive cathodic stripping voltammetry (CLE-ACSV) techniques. Limnology and Oceanography Methods, 10: 496-515.
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