GEOTRACES SCIENTIFIC STEERING COMMITTEE
ANNUAL REPORT TO SCOR 2017/2018

May 1st, 2017 to March 30th, 2018

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1. SCOR Scientific Steering Committee (SSC) for GEOTRACES

Co-Chairs
Andrew Bowie, Australia
Phoebe Lam, USA

Members
Eric Achterberg, Germany
Adrian Burd, USA
Zanna Chase, Australia
Jay T. Cullen, Canada
Susanne Fietz, South Africa
Tina van de Flierdt, UK
Vanessa Hatje, Brazil
Marina Kravishina, Russia
Rob Middag, Netherlands
Hajime Obata, Japan
Haojia (Abby) Ren, China-Taipei
Yeala Shaked, Israel
Kazuyo Tachikawa, France
Antonio Tovar-Sanchez, Spain
Liping Zhou, China-Beijing

The SSC membership (listed above) contains representatives of 15 different countries, with diverse expertise, including marine biogeochemistry of carbon and nutrients; trace elements and isotopes as proxies for past climate conditions; land-sea fluxes of trace elements/sediment-water interactions; trace element effects on organisms; internal cycles of the elements in the oceans; hydrothermal fluxes of trace elements; tracers of ocean circulation; tracers of contaminant transport; controls on distribution and speciation of trace elements; and ocean modelling.

2. Progress on implementation of the project

The GEOTRACES programme is enjoying a very successful implementation, with 105 cruises completed, 935 peer-review publications published and its second Intermediate Data Product released in August 2017.

2.1 Status of GEOTRACES field programme

The GEOTRACES field programme is progressing excellently. Overall 105 cruises have been completed (this included 11 International Polar Year cruises).

During the past year (May 1st, 2017 to March 30th, 2018), 10 cruises have been completed. This includes 3 new section cruises, one from Australia in the Southern Ocean, one from Japan in the Pacific Ocean and one from UK in the Atlantic Ocean (see map below) and 6 process studies (with a total of 7 cruises) from Brazil, Canada France, Netherlands, South Africa and UK.

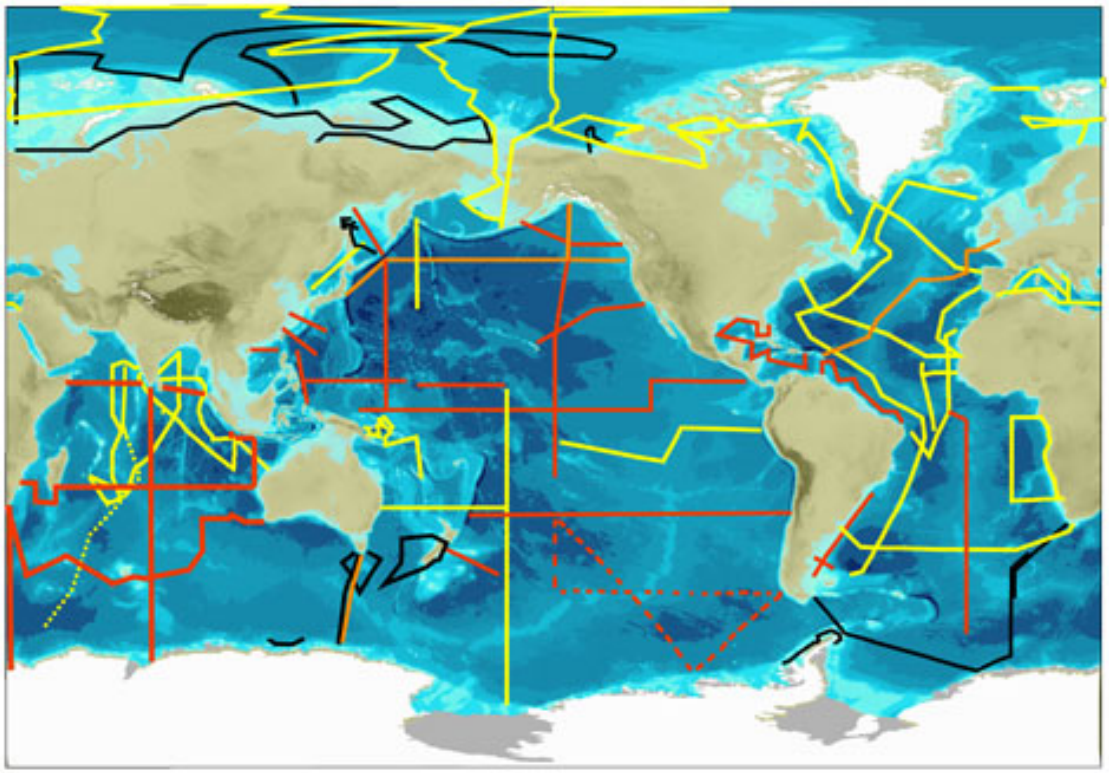

Figure 1. *Status of GEOTRACES global survey of trace elements and their isotopes. In black: Sections completed as the GEOTRACES contribution to the International Polar Year. In yellow: Sections completed as part of the primary GEOTRACES global survey. In orange: Sections completed during the past year.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

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2.2 GEOTRACES Intermediate Data Products

Release of GEOTRACES Intermediate Data Product 2017

The second GEOTRACES Intermediate Data Product (IDP2017) was successfully released on 16 August 2017 at the Goldschmidt 2017 Conference in Paris (France). More than 350 persons attended the launch event.

The new product includes hydrographical and biogeochemical data from 41 cruises (1,866 stations) across all five ocean basins. More than 325 scientists from 22 countries have contributed data from 51,005 samples to the product. In total 470 parameters are included in the new product, ranging across micronutrients, contaminants, and radioactive and stable isotopes of trace elements. An exciting new feature compared with the first data product, released in 2014, is that the 2017 IDP also includes biological, aerosols and rain parameters.

The IDP consist of two parts:

The **digital data** (available at www.bodc.ac.uk/geotraces/data/idp2017/) contains hydrographic and biogeochemical data from more than 1,800 stations from 39 cruises. The data covers the global ocean, with the data density being highest in the Atlantic Ocean.

A *new feature of the IDP2017* is that it offers a new user-friendly on-line interface **webODV** that allows selecting and downloading subsets of digital data. This new interface was developed by Reiner Schlitzer and Sebastian Mieruch (AWI, Bremerhaven, Germany) and it is available here: https://webodv.awi.de/geotraces

The **eGEOTRACES Electronic Atlas** (available at www.egeotraces.org) is based on the digital data package and provides section plots and animated 3D scenes for many of the parameters, allowing quick overviews of the occurrence of geochemically relevant tracers. It includes 590 section plots and 130 animated 3D scenes.

Figure 2 and 3. *GEOTRACES Intermediate Data Product release event at Goldschmidt 2017.*

IDP2017 version 2

A corrected and updated version of the GEOTRACES Intermediate Data Product 2017 (IDP2017v2) was made available in February 2018 during a Town Hall event at the 2018 Ocean Sciences Meeting. A document describing the main revisions made is available here: http://www.geotraces.org/images/stories/geotraces/idp/IDP2017_V2_CHANGES.pdf

IDP2017 publication

A publication describing IDP2017 has been submitted and accepted by the journal *Chemical Geology*:

Schlitzer, R., et al., The GEOTRACES Intermediate Data Product 2017, *Chemical Geology*, in press.

Acknowledgments

The IDP2017 is the result of a truly international effort involving 326 researchers from 22 countries and the giant work of a core group of about 15 persons, including members of the Standards and Intercalibration Committee, the GEOTRACES Data Assembly Centre, the Data Management Committee, the International Project Office under the leadership of Reiner Schlitzer (AWI, Germany) and Bob Anderson (Lamont, NY, USA). Special thanks to all of them.

Intermediate Data Product download statistics

Overall the GEOTRACES Intermediate Data Products have been downloaded more than 2,000 times (as per April 2018). That is, the IDP2017 has been downloaded more than 600 times since its release in August 2017, while the IDP2014 has been downloaded 1,451 times since its release in February 2014.

2.3 GEOTRACES Publications

During the reporting period, 117 new peer-reviewed papers have been published. In total the GEOTRACES peer-reviewed papers database includes 935 papers.

It is important to highlight that an on-line search tool functionality has been added to the GEOTRACES publication database. This new feature allows for simple searches (e.g., author, title or journal), but it also allows for more GEOTRACES-specific searches such as by GEOTRACES cruise or GEOTRACES parameter (please see the International Project Office report below for further details on this new functionality).

Publicity articles to promote GEOTRACES continue to be published nationally and internationally. The complete list of promotional articles is available here: http://www.geotraces.org/outreach/publicity-documents

For complete information about GEOTRACES publications please check the following web pages:

- GEOTRACES peer-reviewed papers database: http://www.geotraces.org/library-88/scientific-publications/peer-reviewed-papers
- GEOTRACES special issues: http://www.geotraces.org/library-88/scientific-publications/geotraces-special-issues

2.4 GEOTRACES Science highlights

The GEOTRACES International Project Office regularly edits highlights of published articles, which are posted on the website (http://www.geotraces.org/science/science-highlight) and in the electronic newsletter (http://www.geotraces.org/outreach/geotraces-enewsletter). Among the numerous highlights published since last year's report, we selected the following five:

Climate change-induced spectacular increase of the land-ocean inputs in the Arctic Ocean

Measurements of radium-228 (^{228}Ra) in the framework of the 2015 U.S. GEOTRACES Arctic Transect (GN01), revealed that the surface water content of this tracer has almost doubled over the last decade, specifically in the Transpolar Drift near the North Pole.

Radium isotopes are excellent tracers of land-ocean inputs. A mass balance model for ^{228}Ra allowed Kipp and co-workers (2018, see reference below) to suggest that this increase is due to an intensification of shelf-derived material inputs to the central basin (Figure 4). These coastal changes, in turn, could also be delivering more nutrients, carbon, and other chemicals into the Arctic Ocean and lead to dramatic impacts on Arctic food webs and animal populations.

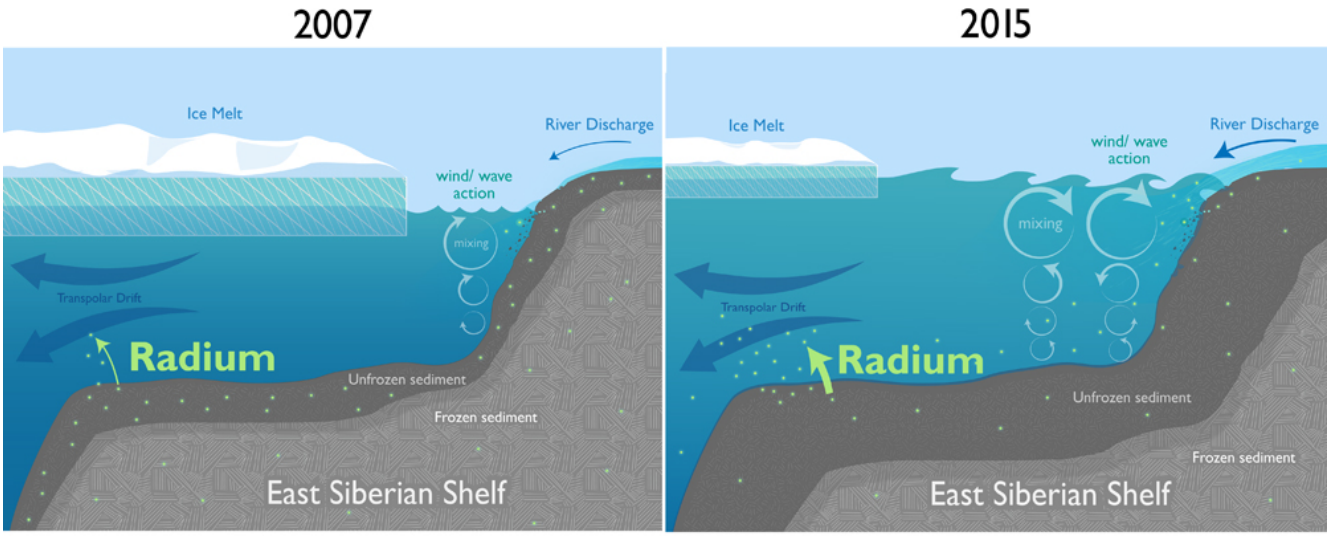


Figure 4. *Diminishing sea ice near the Arctic coast leaves more open water near the coast for winds to create waves. The increased wave action reaches down and stirs up sediments on shallow continental shelves, releasing radium and other chemicals that are carried up to the surface and swept away into the open ocean by currents such as the Transpolar Drift. Artwork: Natalie Renier, Woods Hole Oceanographic Institution.*

Reference:

Kipp, L. E., Charette, M. A., Moore, W. S., Henderson, P. B., & Rigor, I. G. (2018). Increased fluxes of shelf-derived materials to the central Arctic Ocean. *Science Advances*, 4(1), eaao1302. DOI: http://doi.org/10.1126/sciadv.aao1302

Barium isotope measurements help constraining the oceanic barium cycle

Hsieh and Henderson (2017, see reference below) propose a compilation of the oceanic barium (Ba) concentrations together with its isotopic profiles measured so far. Their review covers the main oceanic basins, comparing data obtained in the North and South Atlantic, North Pacific and the Southern oceans.

Their main conclusions are that near-surface Ba isotope values are controlled by basin-scale balances rather than by regional or short-term processes; isotope Ba fractionation during its removal from the surface is significant: the global Ba isotope data can be fit by mixing and removal/addition of Ba with a single isotope fractionation of 1.00058 ±0.00010; the resulting Ba isotope composition of the upper ocean waters is correlated with the fraction of Ba utilization at the basin scale; and in the deep waters, it is suspected that external inputs of Ba (released by sediments or hydrothermal sources) can be traced by their specific isotopic signatures. See Figure 5 below.

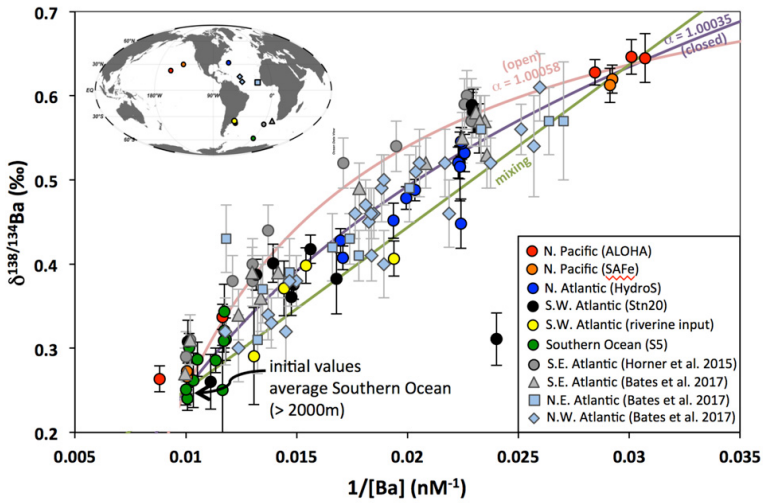


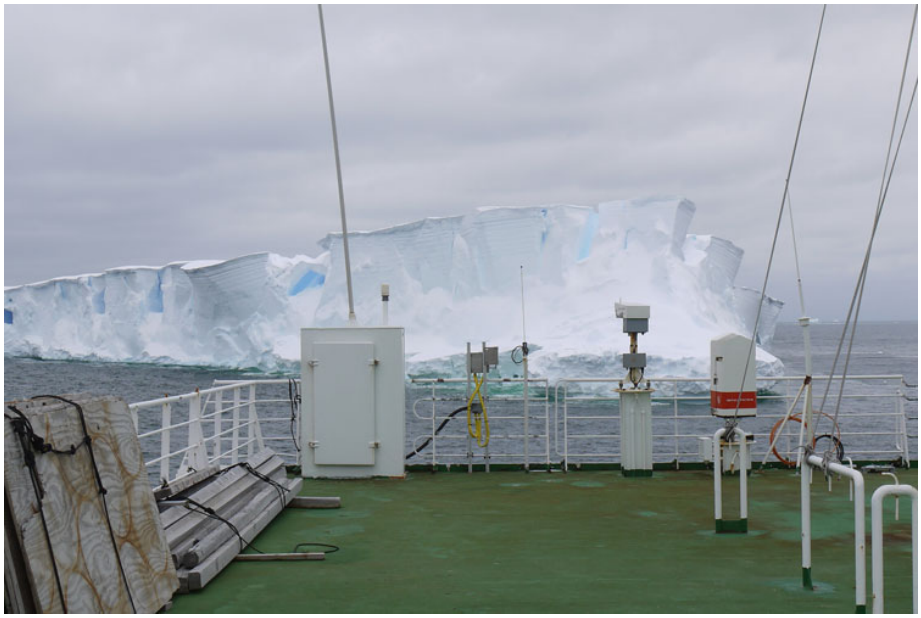
Figure 5. *Seawater Ba isotope compositions versus 1/[Ba] in the global ocean. The data are fitted with three curves generated by a steady-state (open) model, a Rayleigh fractionation (closed) model and a mixing model, each constrained using an initial composition equal to the average value in the deep Southern Ocean and a final value equal to the surface values in the Pacific Ocean. The results show that seawater Ba isotope compositions are controlled by basin-scale Ba utilization, remineralisation, and ocean mixing during the internal oceanic Ba cycle. External Ba inputs also play important roles in the oceanic Ba isotope budget. For example, riverine input introduces light Ba isotopic signatures to the surface ocean; and sediment or hydrothermal inputs may introduce heavy Ba isotopic compositions to the deep water, which have been identified with the non-conservative behaviour of Ba isotopes during the N-S Atlantic deep water mixing. Such distinct Ba isotope signatures from these sources can become useful tracers for constraining Ba inputs in the present and past ocean.*

Reference:

Hsieh, Y.-T., & Henderson, G. M. (2017). Barium stable isotopes in the global ocean: Tracer of Ba inputs and utilization. *Earth and Planetary Science Letters*, 473, 269–278. http://doi.org/10.1016/j.epsl.2017.06.024

Why did the concentration of atmospheric carbon dioxide rise so much and so quickly during the last deglaciation?

During the Last Glacial Maximum, the deep southern Pacific waters were stratified, efficiently accumulating old, CO_2-rich waters. Basak and co-authors (2018, see reference below) measured neodymium isotopes in sediment cores that clearly show that when these deep waters became less stratified as the climate warmed, they released their carbon, which could escape to the atmosphere...what a tempting prospect and beautiful teaser for the forthcoming PAGES-GEOTRACES workshop of December 2018!



View from RV Polarstern while collecting sediment samples used in the study by *Basak et al.*

Reference:

Basak, C., Fröllje, H., Lamy, F., Gersonde, R., Benz, V., Anderson, R. F., Molina-Kescher, M., Pahnke, K. (2018). Breakup of last glacial deep stratification in the South Pacific. *Science*, 359(6378), 900–904. DOI: http://doi.org/10.1126/science.aao2473

Shelf sediment dissolved iron source via non-reductive dissolution in the Gulf of Alaska

Crusius and co-workers (2017, see reference below), reveal temporal and spatial variability in the sources of iron (Fe) to the northern Gulf of Alaska, based on data from cruises from three different seasons from the Copper River (AK) mouth to beyond the shelf break. April data are the first to show late winter Fe behavior before surface-water nitrate depletion began. Sediment resuspension during winter and spring storms generated high "total dissolvable Fe" (TDFe) concentrations of ~1000 nmol kg^{-1} along the entire continental shelf, which decreased beyond the shelf break. In July, high TDFe concentrations were similar on the shelf, but more spatially variable, and driven by low-salinity glacial meltwater. Conversely, dissolved Fe (DFe) concentrations in surface waters were far lower and more seasonally consistent, ranging from ~4 nmol kg^{-1} in nearshore waters to ~0.6-1.5 nmol kg^{-1} seaward of the shelf break during April and July, despite dramatic depletion of nitrate over that period. The April DFe data can be simulated using a simple numerical model that assumes a DFe flux from shelf sediments, horizontal transport by eddy diffusion, and removal by scavenging. Calculations suggest dust is an important Fe source beyond the shelf break. See Figure 6 below.

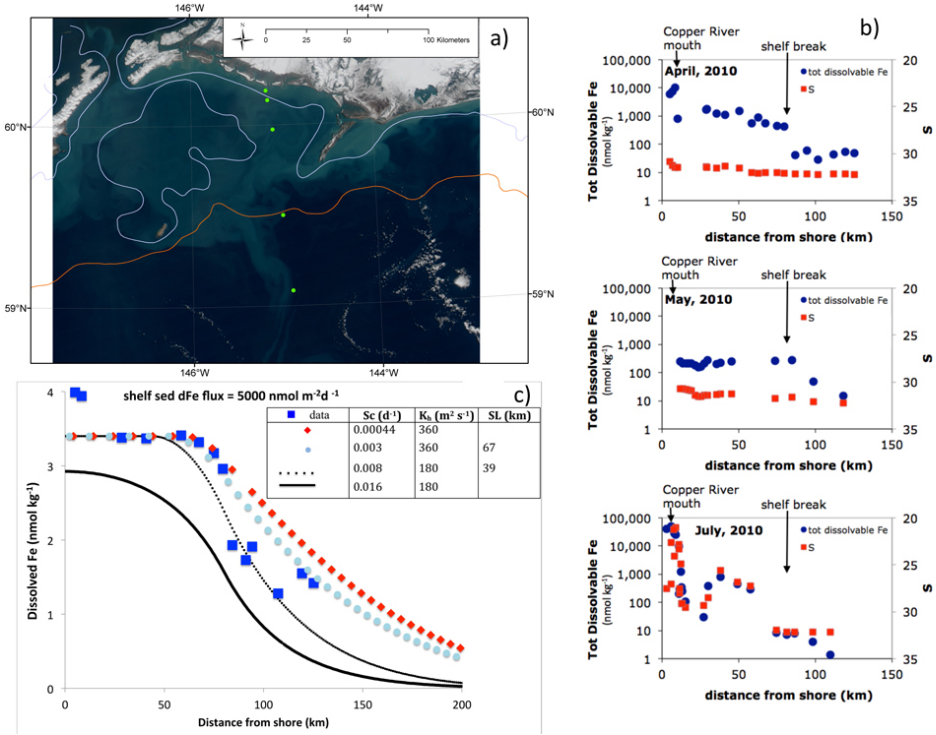


Figure 6. *Seasonal and spatial variability in Fe in the northern Gulf of Alaska: a) Sampling region in the northern Gulf of Alaska extending from the Copper River Mouth to ~50 km beyond the shelf break. The surface water transect was carried out along the line defined by the green dots (which define sampling stations). This is superimposed upon a MODIS image from 9 April, 2010 that shows resuspended sediments (light blue) landward of the 500-m depth contour (orange line). b) Surface water total dissolvable Fe (TDFe) concentrations and salinity plotted versus distance from shore during April, May and July. c) Dissolved Fe (DFe) data (blue squares) from April, along with several time-dependent model simulations that bracket the data, with varying flux of DFe from the shelf sediments, horizontal eddy diffusion, and removal by chemical scavenging.*

Reference:

Crusius, J., A. W. Schroth, J. A. Resing, J. Cullen, and R. W. Campbell (2017), Seasonal and spatial variabilities in northern Gulf of Alaska surface-water iron concentrations driven by shelf sediment resuspension, glacial meltwater, a Yakutat eddy, and dust, *Global Biogeochem. Cycles*, 31, doi:10.1002/2016GB005493.

Widespread nutrient co-limitation discovered on GEOTRACES cruise

Browning and co-workers (2017, see reference below) find that multiple nutrients must be supplied to stimulate phytoplankton growth on the southeast Atlantic GEOTRACES GA08 cruise. The paper has been published in *Nature*.

Experiments to date have suggested that across most of the ocean surface marine phytoplankton are limited by either nitrogen or iron. But simultaneously low concentrations of these and other nutrients have been measured over large extents of the open ocean, raising the question: are phytoplankton in these waters only limited by one nutrient?

Browning and co-workers tested this by conducting experiments throughout the SE Atlantic GEOTRACES GA08 cruise, where seawater samples were amended with nitrogen, iron, and cobalt—alone and in all possible combinations. They found that adding both nitrogen and iron in combination was needed to stimulate any significant phytoplankton growth over 1000s of kilometres of ocean. Furthermore, addition of cobalt in combination with nitrogen and iron further enhanced phytoplankton growth in a number of experiments. See Figure 7 below.

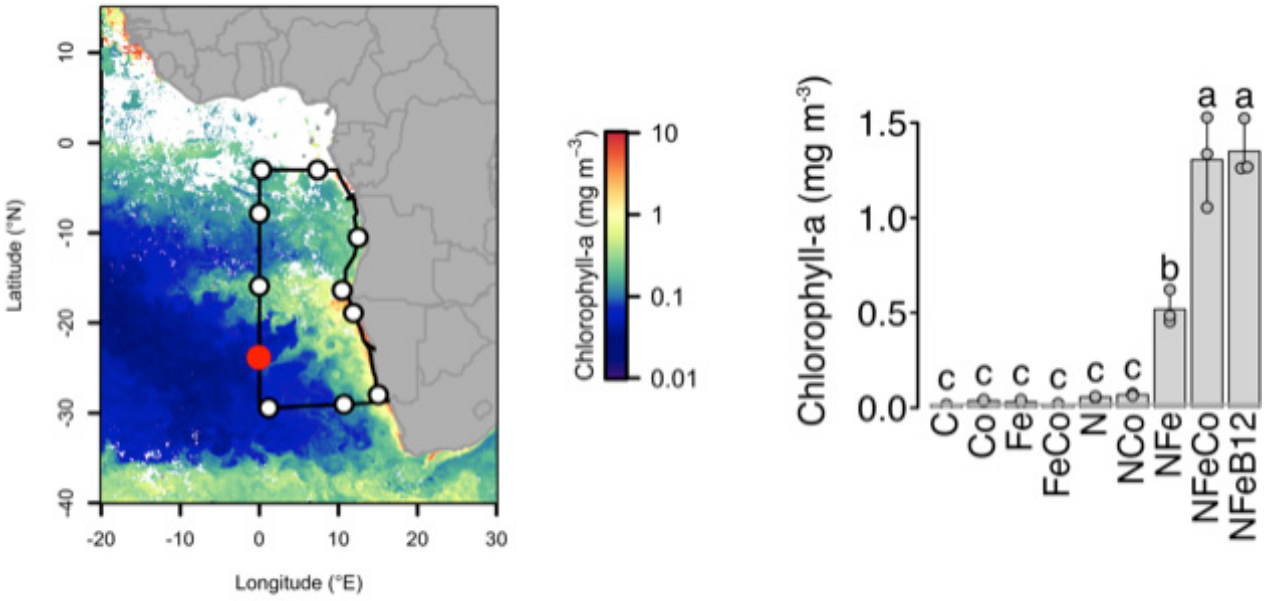


Figure 7. *Experiments were conducted throughout the SE Atlantic GEOTRACES cruise transect (lines and dots on the map) and demonstrated that nitrogen and iron had to be added to significantly stimulate phytoplankton growth. Supplementary addition of cobalt (or cobalt-containing vitamin B12) stimulated significant additional growth. Experimental responses illustrated in the right panel are from the site indicated by the red point on the map.*

Reference:

Browning, T.J., Achterberg, E.P., Rapp, I., Engel, A., Bertrand, E.M., Tagliabue, A. and Moore, C.M., 2017. Nutrient co-limitation at the boundary of an oceanic gyre. *Nature*. 551, 242–246 doi:10.1038/nature24063.

3. Activities

3.1 GEOTRACES intercalibration activities

The S&I Committee said goodbye to Greg Cutter and Peter Croot and we thank them for all their hard work over many years. We welcomed four new members, Ana Aguilar-Islas from the University of Alaska Fairbanks, Yoshiko Kondo from Technology Nagasaki University, Peter Sedwick from Old Dominion University, and Alyson Santoro from University of Santa Barbara.

The S&I Committee is currently composed of Ana Aguilar-Islas, Karen Casciotti, Tina van de Flierdt, Walter Geibert, Lars-Eric Heimbürger, Yoshiko Kondo, Maeve Lohan, Hélène Planquette, Peter Sedwick and Alyson Santoro. Maeve Lohan and Walter Geibert serve as co-chairs.

The S&I had no in-person meetings during this time period but had virtual meetings:

Virtual meetings (GoToMeeting):
22 May 2017

Virtual S&I-DMC co-chair meetings:
20 May 2017

In addition, the committee is in constant communication via email and through a shared online platforms, and the co-chairs are in regular personal exchange with members of the DMC and BODC at their respective locations.

Intercalibration for IDP2017:

For IDP 2017, all new data was intercalibrated prior to the release. Overall, the S&I committee approved 111 intercalibration reports and intercalibrated 458 different parameters. During the meetings of the S&I Committee, all datasets were introduced by the assigned committee members, and discussed by the full committee. In nearly all cases, questions of the committee about data quality could be easily resolved and only a limited number of parameters did not pass intercalibration, mostly due to issues with sampling methods.

New intercalibration procedures were constructed for the many new parameters released in IDP2017:

- Aerosols and rain
- HPLC pigments
- Single cell trace metals
- Targeted Metaproteomics
- Leachable particulate trace metals
- Artificial radionuclides

In addition, more than 85% of data from IDP2014 that were not previously intercalibrated were intercalibrated for IDP2017.

The S&I Committee handled the records for the inventories of all data submitted for intercalibration, which benefited a lot from the well-defined parameter names when preparing IDP2017. Just prior to the

release of IDP2017, the S&I Committee was involved in communications about the status of various datasets based on these records. The Committee was involved in identifying issues with IDP2017 and helping Reiner Schlitzer with intercalibrated data for IDP2017 v2.

The Cruise and Methods manual (Cookbook) was updated (new methods and sampling handling procedures) by the S&I Committee in time for the release of IDP2017. This is third version and is now available on the GEOTRACES website (http://www.geotraces.org/images/Cookbook.pdf).

New Intercalibration activities:

Lars-Eric Heimburger led a large ship-based intercalibration effort in the Mediterranean Sea in June 2017 for mercury speciation, in particular for gaseous dimethyl mercury. This involved collecting samples onboard and running analyses in a laboratory back on land. Ana Aguilar-Islas and Peter Sedwick are leading a sea-ice intercalibration effort and collected ice cores from the Ross Sea in April-June 2017. They will be distributing samples for analyses soon.

S&I on www.geotraces.org and other support by the International Project Office (IPO)
With the help of the IPO in Toulouse, the web resources for standards and intercalibration on www.geotraces.org were carefully reorganised and updated with the latest information on intercalibration procedures throughout the year. In general, support of the IPO in setting up the meetings, communicating with the GEOTRACES community and co-ordinating interaction of the S&I Committee with the other GEOTRACES committees proved to be extremely useful.

3.2 Data management for GEOTRACES

The GEOTRACES Data Assembly Centre (GDAC) is hosted by the British Oceanographic Data Centre (BODC), with the head office located in Liverpool; the GEOTRACES Data Manager (Helen Snaith) is based at the BODC office in Southampton, UK. Regular communication is maintained between the two sites so that support and assistance can be offered to the GEOTRACES Data Manager when required.

GDAC is responsible for the entirety of the GEOTRACES data activities from inception to completion. This takes into account the following components:

- interaction between PIs and national data centres in order to encourage regular and timely data and metadata submissions
- liaising with the Data Management Committee and S&I Committee to ensure issues and questions relating to GEOTRACES and its progress can be discussed, and deadlines can be met.
- input of metadata and data into the BODC database and compilation of documentation to include analysis methodologies
- Collation of data and metadata for the IDP2017 and IDP2017v2
- maintaining and modifying GDAC web pages to include updated ocean basin maps (http://www.bodc.ac.uk/geotraces/cruises/section_maps/) and upcoming cruises on the programme page (http://www.bodc.ac.uk/geotraces/cruises/programme/).

Helen Snaith took over as the GEOTRACES Data Manager in May 2017 when the previous data manager, Chris Daniels, had to take extended sick leave. Helen has carried out the overall project management for the position. In addition, Donna Cockwell, also based at BODC in Southampton, has

acted as the lead for data ingestion and data and metadata collation, with additional ingestion time provided by Emma Slater, based in BODC in Liverpool. Since April 2017, Donna has been working almost full time on data ingestion and preparation for the IDP2017 release in August 1027, and then on the corrections and addition of data for the release of IDP2017v2.

Data overview

The data management of the GEOTRACES Project is a large undertaking with a total of 105 cruises (including all cruise legs) associated with the project (this takes into account all section cruises, process studies and compliant data). More than 800 scientists have taken part in the GEOTRACES cruises, with 15 different nations having run a major GEOTRACES IPY/section/process study cruises.

Summary of completed GEOTRACES cruises to date:

Section cruises	**IPY cruises**	**Process studies**	**Compliant data**
38	11	47	9

In addition, 2 intercalibration cruises have been completed.

Delivery of IDP2017

The data and metadata for the first release of IDP2017 were delivered to AWI over a very tight timeframe. The loss of the principle data manager in late April 2017 resulted in a compressed delivery that overran on the original planned delivery. Additional issues in integrating some specific data types resulted in a few datasets not being included in the August 2017 release.

Working with the S&I Committee, GDAC was able to prioritise data expected to be approved in March 2017, meaning that all data delivered were included as in scope – not just those delivered by the April 2016 'guaranteed inclusion' deadline. The following table provides the number of datasets approved by S&I (IDP2014 and IDP2017), received by BODC, ingested into the BODC system and delivered for inclusion in IDP2017 by August 2017. A number of datasets were included into the IDP without full ingestion into the GDAC system first. These were primarily CTD data that were still awaiting sufficient metadata to allow full ingestion, but had sufficient documentation to be incorporated into the IDP release.

Summary of data delivered for IDP2017

	Approved by S&I	**Received by BODC**		**Ingested**		**Delivered**	
	Number	Number	% Approved	Number	% of Received	Number	% of Approved
Atlantic	781	774	99%	671	87%	756	98%
Pacific	242	229	95%	229	100%	229	100%
IPY	29	29	100%	29	100%	29	100%
Process Cruises	37	36	97%	28	78%	30	83%
Compliant Data	50	34	68%	34	100%	34	100%
Total	**1139**	**1102**	**97%**	**991**	**90%**	**1078**	**98%**

Delivery of IDP2017v2

After the first release of IDP2017, there were several issues identified in the datasets and it was decided to create a second release, IDP2017v2. During the period from September 2017 to January 2018, GDAC worked closely with the S&I Committee to identify any data that had been approved and submitted, but not correctly ingested into BODC.

Some errors in parameter naming were identified, as well as one identified mis-labelling of units, and an issue where errors reported as 2sigma had been reduced to the required 1sigma values, but the same scaling had inadvertently been applied to the values as well as the errors.

Inconsistency in flag definitions between data submission, storage at BODC and usage in the IDP were identified and consensus reached as to how to provide consistent flag values across datasets.

During this period, a solution was reached to enable the single cell trace metal data, not ingested or included in the original release, to be delivered to GEOTRACES and included in the second release. A Summary of data delivered for IDP2017v2 by February 2018 is given below, with the changed figures highlighted.

Summary of data delivered for IDP2017v2

	Approved by the S&I	**Received by BODC**		**Ingested**		**Delivered**	
	No	No	%age of App.	No	%age of Rec.	No	%age of Rec.
Atlantic	780	774	99%	**774**	100%	**774**	100%
Pacific	242	229	95%	229	100%	229	100%
IPY	29	29	100%	29	100%	29	100%
Process Cruises	37	**37**	100%	**31**	84%	**31**	84%
Compliant Data	50	**49**	98%	**49**	100%	**49**	100%
Total	**1138**	**1118 (+16)**	**98%**	**1112 (+121)**	**99%**	**1112 (+34)**	**99%**

3.3 GEOTRACES International Project Office

The GEOTRACES International Project Office (IPO) is based at the Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS) in Toulouse, France. The IPO is staffed by a single person, the IPO Executive Officer, Elena Masferrer Dodas. She works under the scientific supervision of Catherine Jeandel (CNRS, LEGOS, France).

The IPO is responsible for:

- assisting the Scientific Steering Committee (SSC) in implementing the GEOTRACES Science Plan and implementation plans of the programme;
- organising and staffing meetings of the SSC, working groups and task teams;
- liaising with the sponsors and other relevant organisations;
- seeking and managing programme finances;
- representing the project at international meetings;
- maintaining the project website and Facebook and Twitter pages;
- maintaining the project mailing lists;
- preparing GEOTRACES science highlights and the bimonthly GEOTRACES eNewsletter;
- maintaining the GEOTRACES publications database and the GEOTRACES Scientists Analytical Expertise Database;
- assisting the GDAC in securing information about upcoming cruises; and
- interacting with GEOTRACES national committees and groups, as well as other international projects.

This year, we want to highlight the following new products:

- GEOTRACES eNewsletter Special Issue – Outreach #2 – Questions and Answers

  A second issue of the GEOTRACES eNewsletter devoted to Outreach was published in December 2017. This special issue featured a video introducing the International GEOTRACES Programme. Following a suggestion from Ed Urban,, short video interviews to selected SSC members were conducted during the 2016 Scientific Steering Committee held in Toulouse. Questions related to the GEOTRACES programme were asked to these members as for example: how was the programme developed, why was it important for the programme to commit to developing a merged global database with rigorous data quality control, what is the international coverage of the programme, and others... The interviews were conducted in both English and French (with subtitles). Later, the IPO worked with Jean-Hugues Babary from Centre for the Development of the Pedagogy at the Université Paul Sabatier and the journalist Jean François Hait in editing the videos which are presented in this eNewsletter.

  This issue is available here: http://www.geotraces.org/outreach/geotraces-enewsletter/listid-12/mailid-861-geotraces-outreach2.

Figure 8. *GEOTRACES eNewsletter Special Issue devoted to Outreach.*

- New query capability for the GEOTRACES Publications database

  The GEOTRACES publication database existing in Mendeley has been made into a searchable on-line database available on the following GEOTRACES web page: http://www.geotraces.org/library-88/scientific-publications/peer-reviewed-papers. This database includes publications that are relevant for GEOTRACES research, along with Master and PhD dissertations.

  Three types of search functionalities are available:

  (1) Simple search: users can search publications by "author", "title" or "journal" entering the desired term into a search box,
  (2) Advanced search: by means of dropdown menus, users can select publications by "author", "title", "GEOTRACES cruise", "year" or "type of document", and
  (3) Parameter search: allows users to access a list of publications by specific TEI. In addition, users can retrieve publications by group of parameters (e.g., Aerosols, Dissolved TEIs, etc.) or by pre-defined subgroups (e.g., dissolved trace elements, etc.).

  In each case, search queries for "parameter" or "GEOTRACES cruise" will only list those publications linked to data included in the IDP2017.

  This facility has been accomplished thanks to a grant from the Observatory Midi-Pyrenees (OMP; Toulouse, France). To develop this database we benefited greatly from the help of Guillaume Brissebrat from the OMP's Data Centre (SEDOO).

- Intermediate Data Product 2017 Reference List

  Based on the above-described GEOTRACES Publication Database, and thanks to the help of Guillaume Brissebrat, we have been able to create a URL system that allows linking each IDP2017 data point to an up-to-date list of relevant publications for these data (see Figure 9 showing a list of publications for Fe_D_CONC_BOTTLE from the GP16 cruise track). This reference database is dynamic and updated whenever new papers are published, so future requests of the publication list related to Fe_D_CONC_BOTTLE along GP16 will, in addition to what is shown in Figure 9, also include new papers published since then. This dynamic inclusion of papers published after the release of the data product was a required feature for the IDP2017, because many datasets included in it were unpublished at the time of data submission.

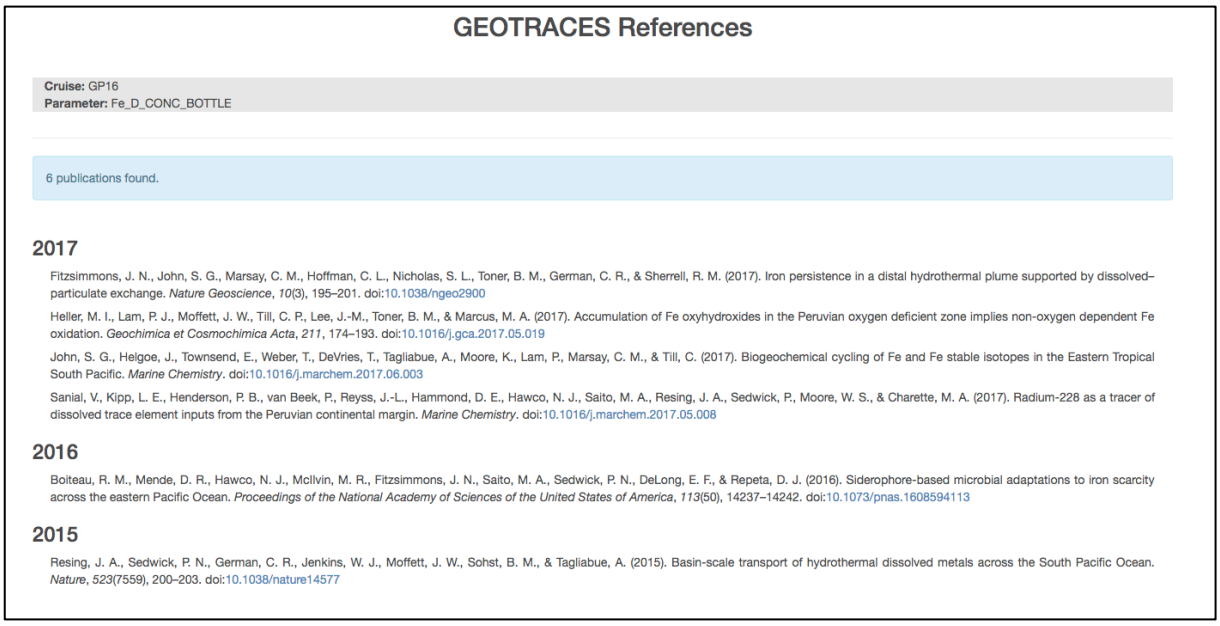


Figure 9. *List of publications related to Fe_D_CONC_BOTTLE along GP16 cruise track.*

- Release of the Intermediate Data Product 2017

  In order to ensure the successful release of the IDP2017, we have

  1. Proposed solutions to the different committees to facilitate their task. For example, we developed an on-line Google form that allowed collection of user's permissions to publish their data along with the list of publications for these data.
  2. Developed the GEOTRACES Publication database and IDP2017 reference list mentioned above.
  3. Organised the communication (advertising) of the new data product internationally by: (1) publishing special online newsletters and announcements that were distributed via the GEOTRACES mailing list, via other international programme's mailing lists, and sent directly to all identified GEOTRACES stakeholders; and (2) coordinating the organisation of two Town Hall meetings (in Goldschmidt 2017 and Ocean Sciences 2018).
  4. Developed the IDP2017 promotional materials (one brochure and one roll-up banner).
  5. Helped in organising the SCOR booth at Ocean Sciences.

6. Coordinated the production of the USB cards that contained the *eGEOTRACES Atlas* and were distributed at the Town Halls that were organised at the Goldschmidt 2017 and Ocean Sciences 2018 International Conferences.

All these tasks were completed under significant time pressures.

- GEOTRACES website (<http://www.geotraces.org>)

  As a special feature to be highlighted, we would like to announce that a new web page devoted to GEOTRACES Synthesis of Results Initiative and products has been added on the GEOTRACES site: http://www.geotraces.org/science/synthesis-of-results

  We want to thank Olivier Boebion (IT system administrator at Observatoire Océanologique de Villefranche sur Mer, France) for all his technical assistance with the GEOTRACES web site.

- Some statistics

  20 new highlights published (155 in total)
  6 eNewsletter published, including one special issue (bimonthly 32 in total)
  117 new peer-reviewed papers included in the GEOTRACES Publication Database (935 in total)
  116 new articles published on the GEOTRACES website
  105 new announcements sent through the GEOTRACES mailing list
  110 new posts on Facebook and 440 likes (top post reached 1.6K)
  532 tweets and 700 followers (top tweet reached 3.1K)
  117 new subscribers on the GEOTRACES website

3.4 GEOTRACES Workshops

A list of completed or planned GEOTRACES Workshops is available below:

Explore GEOTRACES IDP 2017 data with Ocean Data View, 2-3 May, Qingdao, China.

A hands-on workshop to teach standard and advanced Ocean Data View (ODV) methods for the exploration and scientific analysis of environmental data was held on May 2-3, 2018, in Qingdao, China. A total of 82 participants attended the workshop, including graduate and undergraduate students as well as young scientists, from Ocean University of China. During the workshop, the GEOTRACES Intermediate Data Product 2017 (IDP2017) was used as an example dataset. For Day 1, participants learned how to use ODV software, creating maps, property-property plots, sections and surface plots. In addition, participants learned how to create ODV data files with their own datasets. For Day 2, part of the participants (14 students) gave presentations based upon the topics in which they have interest, which cover global physical water circulation, GEOTRACES IDP2017 data, time-series data (Station Aloha), their own datasets, etc. Lastly, participants learned some tips for using advanced levels of ODV to work on their own datasets. Thanks to Mariko Hatta for delivering the lectures.

Further information is available at the following GEOTRACES web page:
http://www.geotraces.org/images/stories/documents/workshops/2018_ODV/ODV%20workshop%20report_OUC_final.pdf

Training Workshop on Metal Speciation and Isotopes, 12-17 May 2018, Xiamen, China.

A training workshop on metal speciation and isotopes in the ocean for GEOTRACES and beyond was organised by the State Key Laboratory of Marine Environmental Science (MEL) in Xiamen, China. The purpose of this workshop was to train graduate students and professionals who are interested in or will study trace metal and isotope biogeochemistry.

It is hoped that the workshop will also serve to enhance capacity of GEOTRACES-related studies. The training included classroom lectures and hands-on experiments in the laboratory equipped with a variety of measurement tools. Subjects covered included electrochemistry, metal speciation, trace metals and their isotopes.

Further information is available at the workshop web page: http://mel.xmu.edu.cn/conference/geotraces/

Forthcoming:

Introduction to the Awesome OCIM, 12 August 2018, Boston, USA.
A workshop to introduce Awesome OCIM (OA), a new modeling toolbox designed to bring cutting-edge transport matrix models to a wide community of users, will be held in August in Boston in the vicinity of the Goldschmidt 2018 meeting. The AO uses Ocean Circulation Inverse Model (OCIM) transport for realistic global 3D circulation. Within this circulation, broad features of the distribution of many marine TEIs can be achieved by combining just a few processes. For example, iron might be modeled as a combination of atmospheric and sedimentary sources, biological uptake, and remineralization. Thorium might be modeled with radioactive production and decay, plus scavenging. A clickable interface allows the user to include processes such as these, and tune their magnitude to match observed GEOTRACES data. Further adjustments to biogeochemical cycling can be achieved with changes to the underlying Matlab code.

For further information please visit the GEOTRACES web page: http://www.geotraces.org/meetings/meetings-by-year/eventdetail/331/-/introduction-to-the-awesome-ocim

GEOTRACES-PAGES Synthesis workshop: Trace Element and Isotope Proxies in Paleoceanography, 3 - 5 December 2018, Aix-Marseille, France.

In 2015, GEOTRACES launched a three-pronged initiative to synthesise and exploit GEOTRACES results following the three main scientific themes of the programme. Three workshops were planned. The first one focused on sources and sinks of TEIs at ocean boundaries, synthesising results obtained in the Atlantic Ocean basin (December 2015, Royal Society, synthesis paper published in October 2016 at *Philosophical Transactions of the Royal Society A*, DOI: 10.1098/rsta.2016.0228). The second one focused on the internal cycling of TEIs within the ocean and was jointly organised with the U.S. Ocean Carbon and Biogeochemistry Programme (OCB) in August 2016. This workshop stimulated dialog and common research projects between a community working on carbon fluxes and another one more focused on trace element cycles. Following this workshop, several products are currently in preparation (see a complete list of the anticipated products on the workshop web page: https://web.whoi.edu/geotraces-synthesis/).

The synthesis effort will continue in 2018 with a third workshop, jointly organised with the Past Global Changes (PAGES programme), on the synthesis of geochemical proxies used in paleoceanography (3-5 December 2018, Aix-en-Provence, France). By establishing an optimal understanding of the present-day cycles of tracers that are exploited as paleo-proxies, GEOTRACES is providing fundamental information to paleoceanographers who are applying these tools to their reconstructions. The workshop aims at fruitful exchanges within the paleoceanographic community, the GEOTRACES community and the broader oceanographic community of observationalists and modellers to exploit new data to provide a more rigorous calibration of proxies and interpretation of their records.

Further information is available at the workshop web page: https://geotracespages.sciencesconf.org/

BioGEOTRACES Workshop, November 2018, Woods Hole Oceanographic Institution.

A small, 3-day workshop meeting (<20 people) will take place in November 2018 at the Woods Hole Oceanographic Institution. This workshop will focus on the next steps in designing a new international programme—tentatively called GEOBIOMICS—to further the efforts of BioGEOTRACESs beyond those within the GEOTRACES programme. The focus of this initial workshop will be discussing capacity building, intercalibration and challenges of implementing such a programme, as well as identifying its overarching research goals and questions. The vision is for a fully integrated programme that delivers mechanistic insights into how environmental variability shapes biological activity in the ocean. This workshop will finalise a perspective paper (white paper) to submit to a high-profile journal showcasing studies that have linked 'omics' data with trace metal distributions in the ocean. This article would highlight the benefits of combining geochemical, physiological and molecular approaches and serve as the basis for future modeling efforts. Many of these insights have been facilitated by BioGEOTRACES efforts within the existing GEOTRACES programme.

3.5 GEOTRACES Summer School

The first GEOTRACES Summer School was held from 20 to 26 August 2017 in Brest, France. The summer school aimed at teaching the skills and knowledge necessary for a good understanding of the biogeochemical cycles of trace metals. It brought together 60 students and 26 world-leading international scientists (Figure 10).

***Figure 10**. 2017 GEOTRACES Summer School Participants.*

Throughout the week, a combination of lectures, practical sessions in the laboratory, poster presentations and drop-in sessions were held (Figure 11). The practical sessions included mass spectrometry (MC-ICPMS, MC TI-MS and HR-ICP-MC), modeling, Ocean Data View, voltametry, flow injection analysis, and sampling and sample handling. The programme is available to download from the Summer School web page: https://geotracesschool.sciencesconf.org/

Figure 11. *Images from the first GEOTRACES Summer School.*

The summer school was an absolute success, allowing PhD students and early-career researchers to see how their work fits within the international community of GEOTRACES, as well as permitting them to build a network of collaborations that will help them in their careers.

GEOTRACES is grateful to the organising committee: Hélène Planquette, Thomas Gorgues, Geraldine Sarthou, Aurélie Pinna and Nadine Reniers, the Scientific Committee, the sponsors (LabexMER and SCOR), and all the lecturers who made this summer school possible.

GEOTRACES plans to organise a second summer school in 2019 in Cadiz, Spain. For further information: https://geotracesschool.sciencesconf.org/

3.6 Special sessions at international conferences featuring GEOTRACES findings

The major event this year was the release of the GEOTRACES Intermediate Data Product 2017 at the 2017 Goldschmidt Meeting (August 2017, Paris, France) during a Town Hall session. A second Town Hall session to introduce the Intermediate Data Product 2017 was also held at 2018 Ocean Sciences Meeting (February 14, Portland, Oregon, USA). Also during this conference a joint U.S. GEOTRACES-OCB Town Hall session was organised aiming at assessing community interest in developing a framework for trace element, isotope, and other biogeochemical research in the Gulf of Mexico and Caribbean Sea (see U.S. national report for further details).

In addition, several GEOTRACES special sessions were held in major international conferences, including the following:

IUPAC 2017 - World Chemistry Congress, 9-14 July 2017, Sao Paulo, Brazil.
For further information: http://www.iupac2017.org/

GEOTRACES-session:

*5.8 Trace elements cycling, processes and fluxes across interfaces
Energy, Water and Environmental Sciences (EE)
Symposium Organisers: Roberto M. Torresi and Daniel Belanger.
Co-organiser: Vanessa Hatje

Goldschmidt 2017, 13- 18 August 2017, Paris, France.
For further information: http://goldschmidt.info/2017/

GEOTRACES or GEOTRACES-related sessions:

*10i: Cycles of Trace Elements and Isotopes in the Ocean: GEOTRACES and Beyond
Convenors: Tim Conway, Geraldine Sarthou, Tianyu Chen, Gregory de Souza, Aridane G. González, Kristen Buck, Tina van de Flierdt, Walter Geibert, Zhimian Cao, Catherine Jeandel

*10g: Submarine Groundwater Discharge: Forms, Delivery, Timing, Processes, Pathways and Scaling of Biogeochemical Fluxes
Convenors: Hans Dürr, Nils Moosdorf, Michael Böttcher, Hannelore Waska, Jing Zhang, Walter Geibert

*10h: Non-Conventional Stable Isotopes in the Ocean: Novel Applications, Technological Advances and Future Applications
Convenors: Horner Tristan, Pearce Christopher, Philip Pogge von Strandmann, Kathleen Scheiderich, Juan Carlos Silva-Tamayo

*10m: Insights into Ocean Processes Through the Application of Radioactive Tracers
Convenors: Paul Morris, Guizhi Wang, Virginie Sanial

*10n: Nutrient Biogeochemistry in the Ocean: Past, Present and Future
Convenors: Scott Wankel, Sinhué Torres-Valdés, Kimberly Popendorf, William Haskell, Christian März, Damien Cardinal, Wiebke Mohr, C. Mark Moore, Francois Fripiat, Xingchen Wang, Jia-Zhong Zhang

*17g: Paleoceanographic and Paleoclimate proxies: Their standing on Elderfield's proxy development Curve
Convenors: Marie-Laure Bagard, Marie Boye, Oscar Branson, Sambuddha Misra, Guillaume Paris, Kauzyo Tachikawa

Ocean Sciences 2018, 11- 16 February, Portland, Oregon, USA.
For further information: http://osm.agu.org/2018/#

GEOTRACES or GEOTRACES-related sessions:

*The Behavior of Trace Elements and Isotopes in Different Ocean Basins: New Insights from Comparisons and Contrasts
Primary Chair: Gregory A Cutter, Old Dominion University, Ocean, Earth and Atmospheric Sciences, Norfolk, VA, United States
Co-chairs: Adrian Burd, University of Georgia, Athens, GA, United States, Jay Thomas Cullen, University of Victoria, Victoria, BC, Canada and Tung-Yuan Ho, Research Center for Environmental Changes Academia Sinica, Taipei, Taiwan

*Abiotic and Biotic Retention, Recycling, and Remineralization of Metals in the Ocean
Primary Chair: Philip W Boyd, University of Tasmania, Institute for Marine and Antarctic Studies, Hobart, Australia
Co-chairs: Kristen N Buck, University of South Florida Tampa, College of Marine Science, Tampa, FL, United States; University of South Florida, College of Marine Science, St. Petersburg, FL, United States, Jessica N Fitzsimmons, Texas A&M University, Department of Oceanography, United States and Alessandro Tagliabue, University of Liverpool, Liverpool, United Kingdom

*The Dawn of BioGEOTRACES: Metal-Microbe Interactions in the Ocean
Primary Chair: Adrian Marchetti, University of North Carolina, at Chapel Hill, Department of Marine Sciences, Chapel Hill, NC, United States
Co-chairs: Maria Teresa Maldonado, University of British Columbia, Vancouver, BC, Canada, Alessandro Tagliabue, University of Liverpool, Liverpool, United Kingdom and Yeala Shaked, Hebrew University, Interuniversity Institute for Marine Sciences, Eilat, Israel

*Biogeochemical Processes Across Oxic-Anoxic Transitions
Primary Chair: Jeffry V Sorensen, University of Victoria, School of Earth and Ocean Sciences, Victoria, BC, Canada
Co-chairs: Roberta Claire Hamme, University of Victoria, School of Earth and Ocean Sciences, Victoria, BC, Canada and Tim M Conway, University of South Carolina, Columbia, SC, United States

*Ocean Biogeochemistry and Air-Sea Interactions
Primary Chair: Francesc Peters, Institute of Marine Sciences (ICM, CSIC), Barcelona, Spain
Co-chairs: William M Landing, Florida State University, Department of Earth, Ocean, and Atmospheric Science, Tallahassee, FL, United States, Oliver Wurl, Carl von Ossietzky Universität Oldenburg, Institute for Chemistry and Biology of the Marine Environment, Wilhelmshaven, Germany and Brian Ward, National University of Ireland, Galway (NUIG), School of Physics, Galway, Ireland

*Bridging Microbial, Stable Isotope, and Micronutrient Approaches to Marine Carbon and Nitrogen Recycling
Primary Chair: Patrick A Rafter, University of California Irvine, Irvine, CA, United States
Co-Chair: Robert T Letscher, University of New Hampshire, Earth Sciences, Durham, NH,

United States and Alexis Pasulka, California Polytechnic State University

Forthcoming:

Association for the Sciences of Limnology and Oceanography (ASLO) 2018 Summer Meeting, 10 -15 June 2018, Victoria, BC, Canada
For further information: https://aslo.org/victoria2018/main

GEOTRACES-related session:

*SS82: Emerging Models of Trace Metal Bioavailability to Aquatic Organisms

Conveners: David Semeniuk, Randelle Bundy and Anne Cremazy.

Goldschmidt 2018, 12- 17 August 2018, Boston, USA.
For further information: https://goldschmidt.info/2018/index

GEOTRACES session:

*Session 07i: New Insights in Marine Trace Element Biogeochemistry
Conveners: Christian Schlosser, Florian Scholz, Rene Boiteau, Tim Conway, Daniel Ohnemus, Jennifer McKay, William Homoky and Jessica Fitzsimmons.

3.7 Capacity building

Activities In an effort to help build GEOTRACES capacity in East Asia, Bob Anderson (director of the U.S. GEOTRACES project office) participated in two meetings in the Republic of (South) Korea in late 2017. Korea has recently acquired the NIOZ-TITAN clean sampling system for use aboard their new global-class research vessel ISABU. Following a successful test of their system in the summer of 2017, Korean scientists are keen to begin developing an ambitious GEOTRACES programme, with a focus on the Indian Ocean, where they plan to use the ISABU during each of the next several years. During these meetings, Anderson offered advice about the design and scientific goals of Korean GEOTRACES research. For further information please read the U.S. GEOTRACES national report available in the Annex.

Thanks to the sponsorship of the SCOR Visiting Scholars Programme, Catherine Jeandel, director of the GEOTRACES IPO, was enabled to travel to Brazil in June 2017 to give a 3-week course on "Tracers in the Oceans: applications of isotopes to unveil processes controlling trace element distributions" and provide training on isotope dilution techniques for the determination of rare earth elements at the laboratories of CIEnAm at Universidade Federal da Bahia. Sixteen graduate students from various universities of Brazil attended the course and had the opportunity to discuss their work with Jeandel. As a continuation of this activity one student will visit Jeandel for a few weeks to deepen her knowledge and practical skills in Nd chemistry. For further information, please read the Brazilian national report available on the Annex.

Travel Grants GEOTRACES gratefully acknowledges support from SCOR to enable scientists from developing countries and countries with economies in transition to participate in the GEOTRACES Summer School.

Sampling Systems It is a goal of GEOTRACES that every nation carrying out oceanographic research should have access to a trace metal-clean sampling system. GEOTRACES offers guidance based on past experience in the design and construction of sampling systems, as well as advice in operating these systems as shared facilities.

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

Nation	Status	System/ Carousel	Bottles	Depth
Australia	Complete	Powder coated aluminium, autonomous 1018 intelligent rosette system	12 x 10-L Teflon-lined Niskin-1010X	6000 m; 6 mm Dynex rope
Australia	2nd system (complete)	Polyurethane powder-coated aluminium autonomous Seabird rosette with CTD and other sensors, auto-fire module, and all titanium housings and fittings	12 x 12-L Teflon-lined OTE external-spring Niskin-style bottles	1750 m 9mm Dyneema rope or 200 m 6 mm Dyneema rope wth coupling to 6000 m CTD wire
Brazil	Complete	GEOTRACES WATER SAMPLER - 24-bottle sampler for use with modem equipped 911plus CTD	24 X 12-L GO-Flo	3000 m; Kevlar cable
Canada	Complete	Powder coated aluminium with titanium CTD housing, Seabird Rosette	24 X 12-L GO-Flo	5000 m conducting Vectran
China - Beijing	Complete	Seabird Rosette. Powder coated aluminium with titanium pressure housings and fittings	24 x 12-L OTE GO-Flo; 24 X 12-L Teflon-lined Niskin-X	8000 m; conducting Kevlar

China - Taipei	Complete	Teflon coated rosette	Multi- size GO-Flo	3000 m; Kevlar line
France	Complete	Powder coated aluminium with titanium pressure housing for CTD	24 X 12-L GO-Flo	8000 m; conducting Kevlar
Germany	Complete	Powder coated aluminium with titanium pressure housings and fittings	27 x 12-L OTE GO-Flo	8000 m; conducting Kevlar
India	Complete	Powder coated aluminum with titanium pressure housings and fittings	24 X 12-L Niskin-X	8000 m; conducting Kevlar
Israel	Complete	Powder coated aluminium, SeaBird Rosette	12 X 12-L Niskin; 8 X 12-L GO-Flo (Teflon coated)	2000 m, steel conducting cable
Italy	Complete	Go-Flo bottles on Kevlar line	5 x 20-L Go-Flos	Kevlar
Japan	Complete	Powder coated aluminium	12-L Niskin-X	7000 m; Vectran conducting Cable
Netherlands	Complete	Titanium frame	24 X 24-liter ultraclean polypropylene	10000 m; conducting Kevlar* **There is only one cable for the two systems*
Netherlands	Complete	Titanium frame	24 X 24-liter ultraclean PVDF	10000 m; conducting Kevlar* **There is only one cable for the two systems*
New Zealand	Complete	Powder coated aluminium	13 X 5-L Teflon-lined Niskin-X; 13 X 5GO-Flo	4000 m; 8 mm Kevlar line
Norway	In development	Standard 12 positions CTD Rosette GO	5-L Niskin-X	
Poland	Complete* (although the steel cable)	Powder coated aluminum, SeaBird Rosette	8x 10L GoFlo	3000m, steel conducting cable
Poland	Complete	Single bottle	10l G-FLO X Teflon coated	300m Kevlar

Poland	Complete	Teflon pump on-line	Surface water pump	1.5m fixed
Poland	In development	Pump CTD	Teflon hose 10mm	Up to 200m
South Africa	Complete	Powder coated aluminium, titanium housing/fittings	24 X 12-liter GO-Flo	6500 m; Kevlar cable
South Korea	Complete	Pristine Titanium frame	24 X 12-liter PVDF	10,000 m; conducting Kevlar
UK	Complete	2 x Titanium frame, Ti pressure housings	24 10-L OTE 24 10-L OTE	2 x 8000m conducting Kevlar
USA - CLIVAR	Complete	Powder coated aluminium	12 X 12-L GO-Flo	1500 m; conducting Kevlar
USA - GEOTRACES	Complete	Powder coated aluminium with titanium pressure housings and fittings	24 X 12-L GO-Flo	8000 m; conducting Kevlar
USA- University of Alaska Fairbanks	Complete	Seabird Rosette. Powder coated aluminium with Ti parts and pressure housing. Fires at pre-programmable depths	12 X 5-L Teflon-lined Niskin-X	No Kevlar line available yet.
USA- Old Dominion University	Complete	Seabird Rosette. SBE-19plusV2 CTD unit. Powder coated aluminium with Ti parts and pressure housing. Fires at pre-programmable depths	12 X 5-L Teflon-lined Niskin-X	2000 m 0.5-inch Kevlar wire
USA – Polar Programs	Complete	Powder coated aluminium with titanium pressure housings and fittings	12 X12-L Niskin-X	3000 m; conducting Kevlar

4. Plans for the coming year

Intermediate Data Product 2021

GEOTRACES aims for the next Intermediate Data Product (IDP) to be released in 2021. This is an interval of 4 years following the release of the second IDP, one year more than between the 1st and 2nd IDPs, to allow maximization of new data submissions and to give additional time to the different committees and scientists involved in building the IDP to work on the development of a new on-line metadata portal (see below).

New on-line GEOTRACES metadata portal

Since the GEOTRACES IDPs have been extremely successful, the amount of data to be reviewed, managed and processed has increased considerably. To facilitate the tasks of the core group of persons working on the construction of the product, GEOTRACES aims to create an on-line GEOTRACES data portal that allows (1) major participation of data contributors in directly filling in the information necessary for the evaluation and management of their data into the portal, (2) quick and easy access to this information for all people involved in the construction of the product, and (3) more automatic management of these data to allow easier updating and evaluation.

The development of this portal will be an important activity in 2018-2019 and the release of this portal will represent a significant achievement of the GEOTRACES programme. It is anticipated that this portal will be of interest of other scientific communities and international programmes.

Capacity building through GEOTRACES Summer Schools

Following the successful GEOTRACES Summer School organised in August 2017 in Brest, France, GEOTRACES plans to organise a summer school in Spain in 2019, and another one in 2020-2021 in Germany.

Scientific workshops

The following scientific meetings will be organised:

Regional and Basin Workshops:

A fourth East Asia GEOTRACES Workshop will be organised in Xiamen in early 2019. This workshop will continue collaboration advanced by the third East Asia Workshop (16-18 January 2017, Sapporo, Hokkaido, Japan) where a first picture of the current status of the studies in the Northwestern Pacific Ocean (NWPO) was completed and important scientific questions and directions for regional collaborative studies defined.

Future synthesis of results and other workshops:

GEOTRACES plans to design a new strategy to continue its synthesis efforts initiated by the suite of three synthesis workshops described earlier. This strategy could include, for example, a multi basin-scale synthesis workshop that seeks to connect GEOTRACES datasets with the broader datasets and understanding that exist for these regions (e.g., ocean physics, carbon cycle, biological productivity). This will have the potential to place GEOTRACES data within a broader framework of ocean science

questions. In any case, the synthesis will continue to respond to the expectation that GEOTRACES results benefit other oceanographic disciplines.

In this context, GEOTRACES will continue its efforts in bringing together the observational and modelling communities fostered by the three Data-Model Synergy Workshops that GEOTRACES organised in 2007, 2009 and 2011. Indeed, the use of GEOTRACES data by joint observational-modelling studies has led to important insights into TEI cycling via the development of new TEI models (for instance, on manganese, cobalt, aluminium, zinc, radium and Th/Pa) and it is for example, facilitating a critical assessment of how the models used for climate projections represent iron cycling (FeMIP, 2016, Tagliabue, A.[1]). In addition, following the release of the IDPs, modellers have started developing new complementary modelling toolboxes/software linked to GEOTRACES data (one example is the AWESOME OCIM, 2018, John, S. mentioned earlier). GEOTRACES will encourage and explore synergies within these modelling communities, and develop tools that can lead to the organisation of new data-model workshops.

BioGEOTRACES effort

As mentioned before, a new international programme may emerge to further the efforts of BioGEOTRACES efforts beyond those within the GEOTRACES programme. GEOTRACES investigators and the IPO will provide advice and recommendations, as appropriate, to help launch this new initiative.

Education and Outreach

Promotion of the use of the IDP data by the broad oceanographic community will be a priority in the next years leading to the release of the next data product. To date, GEOTRACES has developed several promotional and outreach materials, including printed materials (brochures, posters, banners, postcards, etc.) and other media products (e.g., promotional videos, http://www.geotraces.org/outreach/other-outreach-materials/videos/1468-21-questions-and-answers) and it uses social networks such as Twitter, Facebook, YouTube, etc. to promote its science and products. Several GEOTRACES PIs have collaborated with schools and teachers and have developed educational materials, including educational books for children. In addition, GEOTRACES is very active in organising sessions at international conferences, with about 50 sessions organised in the last 3 years including Ocean Sciences, ASLO, and Goldschmidt international conferences.

All these actions have given GEOTRACES visibility within the broad international oceanographic community. While GEOTRACES will continue this effort, GEOTRACES effort will also be placed in developing specific new products focused on stimulating the use of IDP data within the broader ocean science community. These products may include, for example, hands-on workshops to work with Ocean Data View (ODV) (similar to the Workshop Exploring GEOTRACES data with ODV held on August 2016 in Yokohama, Japan, during the Goldschmidt Conference and in May 2018 in Qingdao, China) or development of videos to show examples of successful data access and use (e.g., video informing investigators about the use and maintenance of GO-Flo bottles: http://www.geotraces.org/sic/historical-resources/1083-learn-how-to-disassemble-and-clean-go-flo-bottles-2).

[1] [1] Tagliabue, A., Aumont, O., DeAth, R., Dunne, J. P., Dutkiewicz, S., Galbraith, E., Misumi, K., Moore, J. K., Ridgwell, A., Sherman, E., Stock, C., Vichi, M., Völker, C.,Yool, A. (2016). How well do global ocean biogeochemistry models simulate dissolved iron distributions? Global Biogeochemical Cycles, 30(2), 149–174. doi:10.1002/2015GB005289
See also the FeMIP SCOR Working Group web page: http://www.scor-int.org/SCOR_WGs_WG151.htm

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