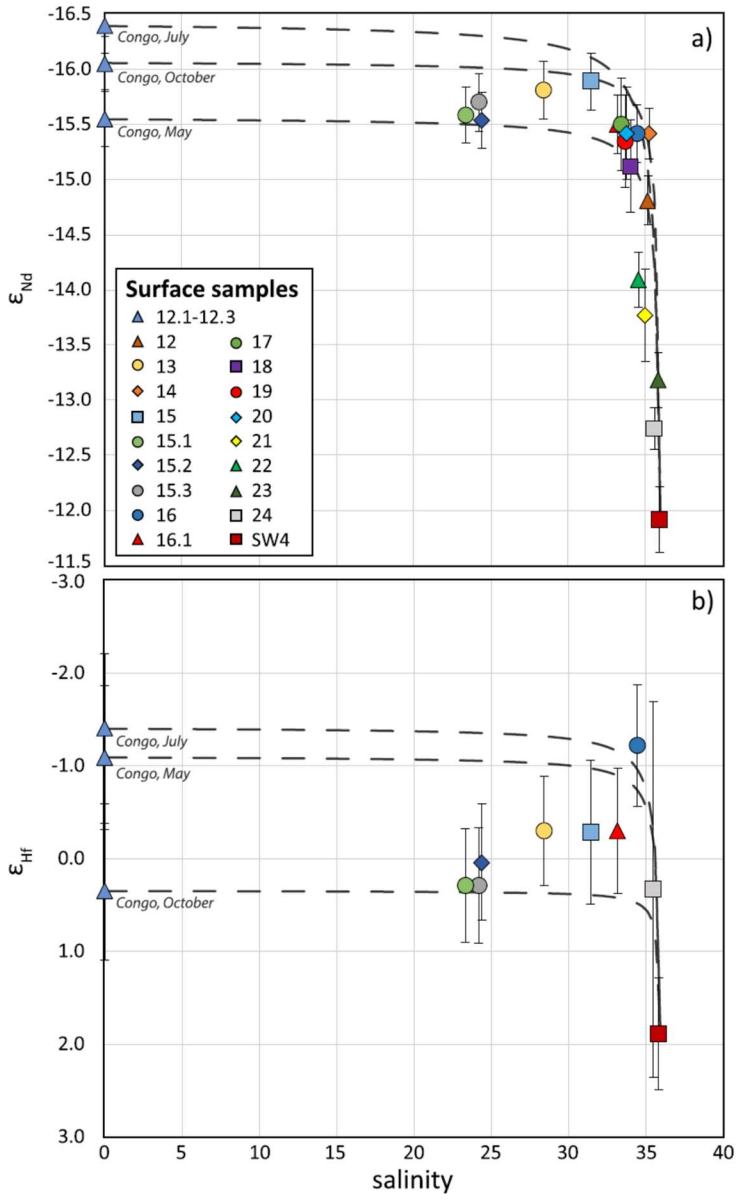
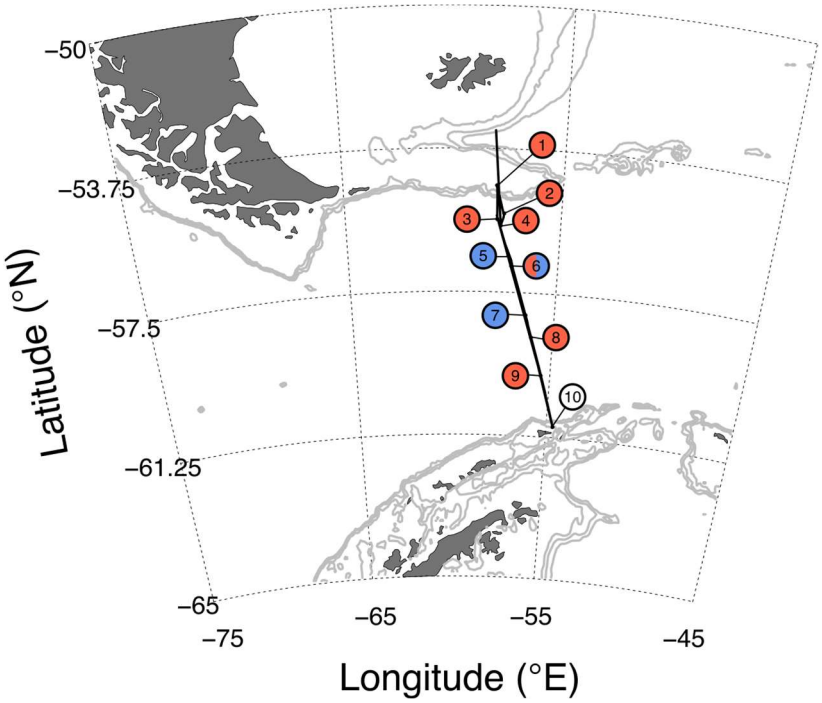
- Variability in the Arctic deep-sea due to increased particle flux at the margins (Valk et al.2020)
- Nd isotopes in the North Atlantic highlight the sensitive balance between vertical supply, horizontal supply and particulate removal (Stichel et al. 2020).



Mixing relationships between Nd and Hf isotopes and salinity of the Congo River and open ocean surface waters.

The paper presents the first combined dissolved neodymium (Nd) and hafnium (Hf) isotope and rare earth element (REE) concentration distributions following the Congo River plume along its flow path off the West African coast and along a connected offshore latitudinal section at 3°S.

Rahlf, P., Laukert, G., Hathorne, E.C., Vieira, L.H., and Frank, M. (2021) Dissolved neodymium and hafnium isotopes and rare earth elements in the Congo River Plume: Tracing and quantifying continental inputs into the southeast Atlantic. *Geochimica et Cosmochimica Acta* 294, 192-214.



Ten experiments were conducted through Drake Passage in the Southern Ocean to test for phytoplankton growth limitation by iron and/or manganese. Sites with a red label were found to be iron limited, whilst those with a blue label were found to be manganese limited; split red-blue label indicates iron-manganese co-limitation, whilst the white label indicates no nutrient was limiting.
Iron limited sites were generally found nearer to continental shelves (grey contours), where the supply of both iron and manganese is elevated but removal of iron compared to manganese is faster. In contrast, in the central part of Drake Passage, deep waters upwell to the surface that have been isolated from micronutrients inputs for long periods and are highly depleted in manganese.

Browning, T. J., Achterberg, E. P., Engel, A., & Mawji, E. (2021). Manganese co-limitation of phytoplankton growth and major nutrient drawdown in the Southern Ocean. Nature Communications, 12(1), 884. https://doi.org/10.1038/s41467-021-21122-6

GEOTRACES or GEOTRACES relevant cruises

- Research cruise Amazon-GEOTRACES 2 to the Amazon estuarine region approved (supposed to take place in 2022, will be applied for as GEOTRACES process study) as a follow-up research cruise to M147 (Amazon-GEOTRACES, GApr11 in Apr.-May 2018)
- Approval of Polarstern GEOTRACES cruise (section status planned) to the Central Arctic Ocean for 2024 (“ArcWatch-2”)
- Award of cruise RainbowPlume as part of German Corona Cruise Proposal Round. Cruise will be sailed in period September 2 to October 5, 2021 (RV Meteor) and will investigate

plume geochemistry at Rainbow vent field (mid Atlantic Ridge). PIs Achterberg, Koschinsky, Browning, Frank. We will apply for GEOTRACES Process Study status.
- GP21 section cruise on FS Sonne in the South Pacific Ocean has been re-scheduled for February-April 2022 (Achterberg, Frank, Koschinsky).

New projects and/or funding

- The successor cruise of M147 (GApr11, AMAZON-GEOTRACES) that took place in spring 2018 in the high-discharge period in the Amazon estuary and plume to study trace-metal DOM processes and fluxes was approved and is planned for the end of 2022 in the dry, low-discharge period, but is not yet scheduled. Cruise applicants are Andrea Koschinsky, Thorsten Dittmar, Martin Frank and Martha Gledhill. This second cruise will also be applied for as a GEOTRACES process study.
- Continued work on development of an improved submersible pump system for all ocean depths ("Seafeather 10k") of AWI with company Fielax GmbH (Project funding contribution of the German Ministry for economy).
- Funding from AWI Innovation fund for the development of a clean laser cutting device for filters and other sample aliquots ("Cleancut")
- Funding contribution from EGU for Geotraces summer school 2021 (had to be postponed and funding was returned)
- GEOTRACES-relevant sampling opportunities on an earlier Polarstern cruise (ArcWatch-1)
- DFG Funding for Jan Scholten (Kiel Uni), Eric Achterberg & Aaron Beck (GEOMAR) and Walter Geibert (AWI) for two postdocs to conduct Ra, Th and He isotope work on upcoming GEOTRACES cruise(s).

GEOTRACES workshops and meetings organised

- M147 Amazon-GEOTRACES (process study GApr11) online workshop on the 27th November 2020 organized by Andrea Koschinsky, Jacobs University Bremen; with participants from several Brazilian universities, GEOMAR, University of Kiel, and University of Oldenburg. (13 early career researchers involved)
- Distribution and impacts of ocean nutrient limitation', ASLO Summer Meeting 2021 (T. Browning, E. Bertrand, A. Tagliabue, M. Moore)
- GEOTRACES S&I committee meetings were moved to an online format, happening twice a week since September 2020 in the virtual space.
- GEOTRACES summer School planned for summer 2021 had to be postponed to 2022 due to pandemic situation.
- Euromarine funded Foresight Workshop: BioGeoscapes in Europe.
  Date: 17th -19th Nov 2021.

  Location: Institut Ruđer Bošković, Zagreb, Croatia and on-line

  Aims: To capitalise on advances in trace element biogeochemistry, -omics disciplines and modelling approaches in marine science, the foundations of BioGeoSCAPES (a large-scale coordinated global microbial biogeochemistry program) are currently being laid at the international level.

The focus of this workshop will be to develop a community within Europe with an interest in the BioGeoSCAPES program and to develop ideas about how this program might be implemented across Europe:

The workshop will aim to combine assessment of the "State of the Art" with breakouts and discussions on the three following themes

-Trace element limitation, distribution, impact, significance

-Role of trace elements in microbial metabolisms

-Making complex interactions tractable

Spaces will be limited, but we do have some funding to support participants from ITC countries.

Please register your interest in attending the workshop by emailing: c.scape@geomar.de

Outreach activities conducted

- Press release for Southern Ocean Mn limitation paper. https://www.geomar.de/en/news/article/neuer-faktor-im-kohlenstoffkreislauf-des-suedozeans-nachgewiesen

Other GEOTRACES activities

- Intercalibration on dissolved V, Mo, U, Rb, Sr in seawater samples between Jacobs University Bremen and GEOMAR – in progress
- Sebastian Mieruch-Schnülle and Reiner Schlitzer from the Alfred Wegener Institute in Bremerhaven expanded the webODV online service for GEOTRACES and added the new "Data Exploration" tool that allows "ODV-like" interactive analysis and visualization of the GEOTRACES IDP data inside the users web browser. No data download or software installation are necessary. GEOTRACES webODV is available at https://geotraces.webodv.awi.de/.

New GEOTRACES or GEOTRACES-relevant publications (published or in press)

- Hollister, A., Whitby, H., Seidel, M. Lodeiro, P. Gledhill, M. and Koschinsky, A. (in final revision): Dissolved concentrations and organic speciation of copper in the Amazon River estuary and mixing plume. Marine Chemistry
- Andrade, R.L.B., Hatje, V., Pedreira, R.M.A., Böning, P., Pahnke, K., 2020. REE fractionation and human Gd footprint along the continuum between Paraguaçu River to coastal South Atlantic Waters. Chem. Geol. 532, 1-11. doi: 10.1016/j.chemgeo.2019.119303.
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Completed GEOTRACES PhD or Master theses (please include the URL link to the pdf file of the thesis, if available)

- Paffrath, R. (2020). Terrestrial Input of Rare Earth Elements and Neodymium Isotopes to the Ocean and their Transport and Cycling - Case Studies from the Arctic Ocean and the Southern North Sea. University of Oldenburg.
- Rahlf, P. (2020) Tracing water masses and terrestrial inputs with radiogenic neodymium and hafnium isotopes and rare earth elements in the southeastern Atlantic Ocean. PhD thesis, University of Kiel, https://macau.uni-kiel.de/receive/macau_mods_00001033?lang=de

GEOTRACES presentations in international conferences

- Hollister A., De Carvalho LM, Gledhill M & Koschinsky A (2020): Distribution and Size Fractionation of Dissolved Cobalt and Nickel along the Amazon Estuary and Mixing Plume. Goldschmidt Conference 2020, https://doi.org/10.46427/gold2020.1051
- Ehlert, C., Liguori, B.T.P., Pahnke, K. The Influence of Water Mass Mixing and Particle Dissolution on the Silicon Cycle in the Central Arctic Ocean. Ocean Sciences, 2020.
- Behrens, M.K., Pahnke, K., Cravatte, S., Marin, F., Jeandel, C. Trace element sources and fluxes in the zonal current system of the tropical West Pacific: evidence from combined rare earth element, Nd isotope distributions and physical oceanographic observations. Ocean Science, 2020.
- Yu, Y., Siebert, C,. Fietzke, J., Goepfert, T., Hathorne, E., Cao, Z., Frank, M (2020) The impact of MC-ICP-MS plasma conditions on the accuracy and precision of stable isotope measurements evaluated for barium isotopes. Online Goldschmidt Conference, June 21-26, 2020.
- Francois, R., Patton, G., Weis, D., Hathorne, E., Gutjahr, M., Frank, M (2020) An Experimental Investigation of the Acquisition of Nd by Authigenic Phases in Marine Sediment, Online Goldschmidt Conference, June 21-26, 2020.
- Xu, A., Hathorne, E., Frank, M. (2020): Geochemical Behavior of Hafnium in the Amazon River Estuary and its Flux to the Atlantic. Online Goldschmidt Conference, June 21-26, 2020.
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Submitted by Eric Achterberg (eachterberg@geomar.de).